Drinking Water Source Assessment and Protection (DWSAP) Program

JANUARY 1999

Revision 1: Pages 13 and 15, April 1999
Revision 2: Pages 114, 155, and 193, January 2000

Division of Drinking Water and Environmental Management

California Department of Health Services

page intentionally blank

Table of Contents

Part Four: Voluntary Drinking Water Source Protection Programs

APPENDICES TO BE USED FOR A GROUND WATER SOURCE

List of Tables

List of Figures

Glossary of Terms

Abandoned Well: A well (1) the use of which has been permanently discontinued, or (2) that is in such a state of disrepair that no water can be produced. Because abandonment is a state that also involves intent on the part of the well owner, a definition that prescribes a set of conditions and a time limit for use in applying standards appears in California Well Standards, California Department of Water Resources (DWR) Bulletin 74-90, Section and DWR Bulletin 74-81, Section 21.

Assessment: An evaluation of a drinking water source that includes delineation of the boundaries of the source area and protection zones, as applicable, identification of possible contaminating activities (PCAs) within the delineated areas, a determination of the PCAs to which the source is most vulnerable, and a summary of the vulnerability of the source to contamination.

Assessment Map: A map that shows the location of the drinking water source, the source area and protection zones (if applicable), and an indication of the types of possible contaminating activities (PCAs) that exist within the source area and zones. The assessment map is part of a complete source water assessment. The recommended base map for the DWSAP program is a USGS quadrangle map (7.5 minute series).

Buffer Zone: A zone delineated to provide added protection to drinking water sources. The buffer zone is generally upgradient from the protection zones for a ground water source and may include the entire zone of contribution for the well, indirect recharge areas, or locations where the aquifer may be exposed at the surface.

Community Water System: A public water system which serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents.

Contaminants of concern: Microorganisms of drinking water importance, including fecal coliform bacteria, *Escherichia coli*, viruses, *Giardia lambia*, and *Cryptospordium*; chemicals for which maximum contaminant levels (MCLs) or California drinking water action levels have been established, and unregulated chemicals in drinking water for which monitoring is required (Table 7-1); turbidity and total organic carbon (TOC).

Detection: Detection of a contaminant at or above the "Detection limit for purposes of reporting" (DLR), pursuant to California Code of Regulations, Chapter 15, Title 22, Section 64400.45. DLRs have been established in regulation for inorganic chemicals and organic chemicals with MCLs. In addition, DHS has established DLRs for unregulated chemicals for which monitoring is required.

Drinking Water System: See Public Water System.

Improperly Destroyed Well: An abandoned well that has not been destroyed in accordance with California Well Standards, DWR Bulletin 74-90, Section 23 and DWR Bulletin 74-81, Section 23.

Local Primacy Agency: A county health authority which has received primacy delegation for the administration and enforcement of public water system requirements for community water systems serving less than 200 service connections, and noncommunity water systems.

Noncommunity Water System: A public water system that is not a community water system.

Nontransient-noncommunity water system: a public water system that is not a community water system and that regularly serves at least the same 25 persons over 6 months per year. Typically, a noncommunity water system serves a predominantly stable population (e.g., a school or factory).

Physical Barrier Effectiveness: A determination of the effectiveness of the physical barriers in preventing contaminants from reaching the drinking water source.

Physical Barrier Effectiveness Evaluation: A review of a drinking water source and its site characteristics to determine physical barrier effectiveness. As a minimum, the review considers the natural geologic materials and/or hydraulic conditions and the construction features of the well or intake. These characteristics are generally independent of land use, PCAs, or contaminant characteristics.

Possible Contaminating Activity (PCA): Human activities that are actual or potential origins of contamination for a drinking water source. PCAs include sources of both microbiological and chemical contaminants that could have adverse effects upon human health.

Protection: The process of managing the activities within a delineated source area or protection zone to prevent drinking water source contamination.

Protection Zone: A delineated area within the source area of a drinking water source. Zones differentiate areas of varying significance in terms of threat to the water source from contamination.

Public Water System (also Drinking Water System): A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following: (1) Any collection,

treatment, storage, and distributions facilities under control of the operator of the system which are used primarily in connection with the system, (2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system, (3) Any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

Service Connection: The point of connection between the customer's piping or constructed conveyance, and the water system's meter, service pipe, or constructed conveyance.

Source Area: The capture area for a drinking water source. For a surface water source, the source area is the watershed. For a groundwater source, the source area is the recharge area and the area within delineated protection zones.

Source Water: Water drawn to supply drinking water from an aquifer by a well or from a surface water body (e.g., reservoir, lake, river) by an intake. Such water may or may not be treated before being distributed by a drinking water system for consumption.

Susceptibility: see Vulnerability.

Transient-noncommunity water system: a public water system that is not a community water system or a nontransient-noncommunity water system. Typically, a noncommunity water system that serves a predominantly changing population (e.g., a restaurant or campground).

Vulnerability: A determination of the most significant threats to the quality of the water supply that takes into account the physical barrier effectiveness of the drinking water source. The vulnerability evaluation also considers the type and proximity to the water supply of activities that could release contaminants. Vulnerability, as defined in the DWSAP Program, is consistent with existing California regulations (see Section 8.4). Vulnerability is equivalent to "susceptibility," as the latter is used in US EPA source water assessment and protection guidance.

Acronyms

ARB	Air Resources Board
AWWA	American Water Works Association
BMP	Best Management Practice
Cal/EPA	California Environmental Protection Agency
CDF	California Department of Forestry and Fire Protection
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Calculated Fixed Radius
CSFM	California State Fire Marshal
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization Amendment
DDWEM	Division of Drinking Water and Environmental Management
DFA	Department of Food and Agriculture
DHS	Department of Health Services
DOC	Department of Conservation
DOGGR	Division of Oil, Gas, and Geothermal Resources
DPR	Department of Pesticide Regulation
DTSC	Department of Toxic Substances Control
DWFOB	Drinking Water Field Operations Branch
DWR	Department of Water Resources
DWTPB	Drinking Water Technical Program Branch
DWSAP	Drinking Water Source Assessment and Protection
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GIS	Geographical Information System
GPS	Global Positioning System
GWR	Ground Water Rule
IWMB	Integrated Waste Management Board
LPA	Local Primacy Agency
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	National Resources Conservation Service
OEHHA	Office of Environmental Health Hazard Assessment
PCA	Possible Contaminating Activity
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SWAP	Source Water Assessment Program
SWP	Source Water Protection

SWRCB	State Water Resource Control Board
USDA	US Department of Agriculture
USGS	US Geological Survey
US EPA	U.S. Environmental Protection Agency
WHPP	Well Head Protection Program
ZOC	Zone of Contribution

page intentionally blank

PART ONE

Introduction

An introduction to the California Drinking Water Source Assessment and Protection Program document, and a summary of the minimum components for an assessment

Section 1—California's process of developing the DWSAP Program and information on State contacts

Section 2—The DWSAP Program's background, goals and schedule

Section 3—The minimum components of a drinking water source assessment under the DWSAP Program

page intentionally blank

1.0 Introduction

This document presents California's Drinking Water Source Assessment and Protection (DWSAP) Program. The Department of Health Services' (DHS') Division of Drinking Water and Environmental Management is the lead agency for development of the DWSAP Program and its implementation.

The DWSAP Program has been prepared in response to the 1996 reauthorization of the federal Safe Drinking Water Act (SDWA), which included an amendment requiring states to develop a program to assess sources of drinking water and encouraging states to establish protection programs. A drinking water source protection program envisions a partnership between local, state, and federal agencies to ensure that the quality of drinking water sources is maintained and protected.

The drinking water source assessment is the first step in the development of a complete drinking water source protection program. The assessment includes a delineation of the area around a drinking water source through which contaminants might move and reach that drinking water supply. In addition, it includes an inventory of activities that might lead to the release of microbiological or chemical contaminants within the delineated area. This enables a determination to be made as to whether the drinking water source might be vulnerable to contamination.

California's DWSAP Program will address both ground water and surface water sources, drawing upon US Environmental Protection Agency (EPA) guidance, DHS' experiences from other related programs, and advice from advisory committees and the public. The EPA has indicated in its drinking water source assessment guidance (US EPA, 1997) that delineation and contaminant inventory elements for ground water sources are to be consistent with wellhead protection program approaches. Since California has not developed a wellhead protection program, the ground water portion of the DWSAP will serve as the State's wellhead protection program. For surface water sources, DHS' experience with other activities, such as watershed sanitary surveys, will be helpful in developing the surface water components of the DWSAP.

The California DWSAP Program will be submitted to EPA by early 1999. DHS anticipates that the submitted document will clearly convey to the public and to drinking water systems the goals and objectives that DHS and EPA seek to accomplish with the DWSAP program, along with methods that are technically appropriate and easily understood.

This document describes California's DWSAP Program and presents the DHS procedures for conducting drinking water source assessments. Although DHS is responsible for performing these assessments, the Department recognizes that some public water systems may wish to perform their own assessments. In such cases, the systems will need to conduct assessments in conformance with the DHS procedures.

Public water systems may also choose to perform more complex drinking water source assessments. The water purveyor should contact DHS prior to conducting an assessment in order to receive the latest program documentation.

When a public water system has completed an evaluation through another program that is the functional equivalent of a portion or all of the drinking water source assessment, that information may be submitted for purposes of the drinking water source assessment.

For example, drinking water systems that utilize surface water sources are required under California law to perform watershed sanitary surveys on a 5-year cycle. Many of the watershed sanitary surveys done prior to the DWSAP Program will most likely adequately satisfy most of the components of the assessment process, other than the vulnerability ranking. Where watershed sanitary surveys may not be adequate for the DWSAP assessment, the cyclic nature of these surveys offers opportunities to incorporate the components of the DWSAP Program.

Groundwater evaluations done for purposes of an Assembly Bill 3030 Groundwater Management Plan (Water Code §10750 et.seq.) may contain information pertinent to DWSAP Program components.

This document also contains DHS' recommendations for voluntary protection activities for public water systems and communities.

1.1 Description of the DWSAP Program Document

The development of the DWSAP Program is summarized below and discussed in greater detail in Parts One and Two of this document. The "Source Water Assessment" portion of the program, for which DHS is responsible, is presented in Part Three. The "Source Water Protection" aspects of the program, which are optional and may be enacted voluntarily by drinking water systems or communities, are presented in Part Four.

Fundamental to the assessment and protection elements are issues related to technical data, which will be addressed in appropriate sections of this document.

The DWSAP Program document describes the following:

- The background of the State's DWSAP Program and its goals.
- The minimum acceptable components of a drinking water source assessment under the DWSAP Program.
- The State's efforts to ensure public participation, including meeting with other state agencies, the formation of both Technical and Policy Advisory Committees, and public workshops.

- The roles and duties of government agencies with respect to drinking water source assessment and protection.

- Procedures for performing assessments.

- Guidance for protection programs.

1.1.1 Assessments

The DWSAP Program describes DHS' procedures for conducting drinking water source assessments, including:

- Location of the drinking water source

- Delineation of source area and protection zones for both surface water and ground water sources. The surface water source areas are defined by the boundaries of the watershed; zones, if delineated, are closer to the drinking water supply. The ground water source areas and protection zones are delineated based on readily available hydrogeologic information on ground water flow, recharge and discharge, and other information deemed appropriate by the State.

- Identification of possible contaminating activities (PCAs) that are considered potential origins of contamination within each drinking water source area and its protection zones. PCAs include activities associated with both microbiological and chemical contaminants that could have adverse effects upon human health.

- Determination of the PCAs to which the drinking water source is most vulnerable. The vulnerability determination considers the characteristics of the source and site, the risk ranking of PCAs identified in the inventory, and the proximity of the PCAs to the source.

- Assessments for new drinking water sources by public water systems.

1.1.2 Protection

The DWSAP Program includes California's recommendations to encourage voluntary drinking water source protection:

- Descriptions of state actions to support local entities in developing local protection programs. These include technical assistance, financial assistance, training and demonstration projects.

- Identification of management approaches that can be used to protect the water supply from contaminants associated with PCAs. These approaches may include, as appropriate, implementation of regulatory and non-regulatory control measures and public education.

- Criteria for developing contingency plans indicating the location and provision of alternate drinking water supplies for each public water system in the event of loss of one or more of the normal sources of supply.

1.1.3 Implementation of Assessment and Protection Programs

The DWSAP Program includes California's approach for implementing assessment and protection activities, including

- Description of the methods DHS will use for assessing California's nearly 16,000 active drinking water sources. These methods comprise the minimum components of drinking water assessments.

- Guidance for larger public water systems and others that may choose to perform their own assessments. This guidance states that watershed sanitary surveys already completed satisfactorily for compliance with DHS regulations fulfill most of the assessment components for surface water supplies.

- Guidance for implementing successful drinking water source protection programs at the local level.

1.2 State Contacts

To find out more information about the California DWSAP Program, please contact:

Alexis Milea
Department of Health Services
Drinking Water Program Technical Unit
2151 Berkeley Way, Room 461
Berkeley, CA 94704
(510) 540-2177

Leah Walker
Department of Health Services
Drinking Water Program Technical Unit
50 D Street, Suite 200
Santa Rosa, CA 95404
(707) 576-2295

The Division of Drinking Water and Environmental Management's Web site, accessible via "Prevention Services" on the DHS Web site at http://www.dhs.ca.gov, also contains information on the DWSAP. The site includes a schedule of DWSAP-related events, advisory committee meeting notes, and updates of draft documents related to the program, as well as other material pertinent to California's drinking water.

2.0 DWSAP Program Background, Goals, and Schedule

2.1 Background

2.1.1 Requirement and Authority for DWSAP Program Development

The 1986 Amendments to the SDWA established a new Wellhead Protection Program to protect ground waters that supply drinking water wells of public water systems. Under SDWA Section 1428, each State was required to prepare a Wellhead Protection Program and submit it to EPA by June 19, 1989.

The 1996 Amendments to the SDWA established a related program for states, called the Source Water Assessment Program (SWAP). The key elements of this program—protection area and zone delineation, inventory of possible contaminating activities (PCAs), and vulnerability analysis—are also elements of a Wellhead Protection Program.

EPA's guidance indicates that the intent of the 1996 SDWA amendments was to promote source water protection, with assessments being the initial step.

Section 116762.60 of the California Health and Safety Code requires DHS to develop and implement a program to protect sources of drinking water. The program is to include a source water assessment program and a wellhead protection program.

2.1.2 Coordination of the State Source Water Assessment Program

In California, the source water assessment program is being called the Drinking Water Source Assessment and Protection (DWSAP) Program, and it will satisfy the mandates of both the 1986 and 1996 SDWA amendments. The DWSAP Program is intended to address assessments, and also to facilitate the development of protection programs for both ground and surface waters.

The DHS Drinking Water Program is coordinating the effort with technical support from the State Water Resources Control Board (SWRCB). Members of the DHS DWSAP Program Task Force are:

Bob Hultquist (Chair)	DHS Drinking Water, Technical Programs
Alexis Milea	DHS Drinking Water, Technical Programs
Leah Walker	DHS Drinking Water, Technical Programs
Steve Book	DHS Drinking Water Program Headquarters
Jeff Stone	DHS Drinking Water, Technical Programs
Rich Haberman	DHS Drinking Water, Field Operations Visalia District
Cliff Bowen	DHS Drinking Water, Field Operations San Francisco District
Toby Roy	DHS Drinking Water, Field Operations San Diego District
Gunther Sturm	DHS Drinking Water, Field Operations Lassen District
Burt Ellsworth	DHS Drinking Water, Field Operations Northern California Region
Ken Harris	State Water Resources Control Board, Water Quality Division

Judy Bloom USEPA Region IX, Ground Water Office

2.1.3 Existing Drinking Water Source Protection Programs

Since Congress passed the Wellhead Protection Program requirement in 1986, wellhead protection has been an active program on the national level. As of 1996, 44 states had wellhead protection programs approved by EPA. The remaining states (California, Alaska, Pennsylvania, Iowa, Florida and Virginia) have some elements of wellhead protection or source water protection in place. The groundwater elements of this DWSAP Program constitute California's Wellhead Protection Program.

In California, a number of communities and counties have wellhead protection or watershed protection programs under development or already implemented.

2.1.4 Drinking Water-Related Efforts in California

Under California's surface water treatment regulations, water systems that use surface water for a drinking water supply were required to complete a watershed sanitary survey. This survey included the determination of watershed boundaries and identification of PCAs. January 1, 1996, was the deadline for survey completion and updates are required every five years. As of June 1997, almost all the larger water systems (greater than 1,000 service connections) had completed their surveys. Some small systems have not completed the required surveys, but they will be completed as part of this program.

A number of government agencies, ground water management districts and others have already mapped ground water basins and water supplies within those basins. Some water suppliers, Regional Water Quality Control Boards, and the DHS Drinking Water Program have done a preliminary identification of activities of concern to drinking water sources.
The Groundwater Management Act (Assembly Bill 3030) took effect in January 1993. Under this act, local water agencies or groups of agencies can create their own ground water management plans according to their own requirements and may raise money to run them. A Wellhead Protection Program is an allowable element of an Assembly Bill 3030 (AB 3030) Groundwater Management Plan. As of June 1997, 88 AB 3030 Groundwater Management Plans had been adopted throughout the state. In addition, there are 42 resolutions of intention to adopt plans, and another 55 agencies considering plan adoption.

2.2 Goals of the DWSAP Program

The goals of the DWSAP Program are listed below (not in order of priority):

- **Protection and benefit of public water systems of the State.**

  The focus of the program is information gathering and attention to activities that may affect drinking water quality to enable communities and public water systems to better protect and manage the surface water and ground water resources of the state

- **Improve drinking water quality and support effective management of water resources.**

  The assessments can be used to develop protection strategies that are more economical and desirable than monitoring and treatment of drinking water supplies.

- **Inform communities and drinking water systems of contaminants and possible contaminating activities that may affect drinking water quality or the ability to permit new drinking water sources.**

  As communities and public water systems gather information about activities that have contaminated or may contaminate drinking water sources, they will be able to make better decisions about how to protect and manage existing and future drinking water sources.

- **Encourage a proactive approach to protecting drinking water sources and enable protection activities by communities and drinking water systems.**

  Water suppliers, communities, planners and the public at large are encouraged to actively manage and plan activities around drinking water sources and within their delineated protection areas and zones to reduce or eliminate the threat of contamination.

- **Refine and target the monitoring requirements for drinking water sources.**

  State and federal regulations require water suppliers to monitor for a long list of inorganic and organic chemicals. With proper identification of PCAs, monitoring requirements can be targeted to the needs of the drinking water source. The result is enhanced public health protection with a potential saving in monitoring costs.

  Similarly, regulations require monitoring for microbiological contaminants, some of which may be targeted to specific PCAs. Regulatory limits on other parameters such as turbidity must also be met by drinking water systems. To the extent that these "non-chemical" constituents can be controlled by effective assessment and protection programs, they may bring about monitoring and/or treatment relief. Reductions in organic matter in a drinking water source may also result in lower concentrations of disinfection byproducts.

- **Focus cleanup and pollution prevention efforts on serious threats to surface and ground water sources of drinking water.**

By identifying activities that may pose greater health risks than others to drinking water sources, communities and agencies may be able to prioritize their environmental activities. For example, hazardous waste cleanup, pollution prevention efforts, and other activities of environmental and public health significance that directly improve or protect drinking water supplies may be addressed earlier or allocated more resources than others that are not related to drinking water supplies.

- **Meet federal requirements for establishing wellhead protection and drinking water source assessment programs.**

  Compliance with requirements ensures that the California program meets the minimum national standard for source water protection, and is necessary in order to receive future federal source water protection funds.

- **Assist in meeting other regulatory requirements.**

  Information that is obtained in the DSWAP Program will be of assistance to state and local agencies, communities and public water systems in meeting various regulatory requirements. Examples include the requirements of the California Environmental Quality Act (CEQA), and upcoming federal regulatory requirements, such as the Ground Water Rule and the Enhanced Surface Water Treatment Rule.

2.3 Statutory Schedule and Timeline

States are required to submit a program to EPA within 18 months of EPA's publication of guidance, which occurred on August 6, 1997. Therefore, California must submit its Program to EPA no later than February 1999. California's submittal to EPA for approval will be for both its DWSAP Program and for its Wellhead Protection Program, which is incorporated into the DWSAP.

EPA has nine months to approve California's program. This would occur no later than November 1999.

Thereafter, the State will have two years to complete the assessment for all drinking water sources (November 2001), though an 18-month extension may be obtained (May 2003). US EPA has indicated that it will grant the 18-month extension to states, if requested.

California's time line for completion of assessments for its 16,000 active drinking water sources includes the 18-month extension, so that assessments will be completed by May 2003.

3.0. Minimum Components of Drinking Water Source Assessments

This section includes a brief listing of the minimum components of a drinking water source assessment, with references to pertinent sections and appendices of the document.

An overall review of the implementation of a drinking water source assessment is presented in Section 9.0, and comprehensive checklists for the submission of the assessment are presented in Appendix G for surface water sources and in Appendix N for ground water sources.

DHS recommends using information that is the functional equivalent of all or some components of the source water assessment to fulfill the DWSAP when such information exists. In other words, if a watershed sanitary survey for a surface water source has been prepared, that information should be used for the DWSAP Program. Similarly, when an evaluation of a ground water basin, as done for example for a Groundwater Management Plan, provides information applicable to a ground water source, that information should also be used.

A public water system that is conducting its own drinking water source assessment and intends to use information that it believes is the functional equivalent of a component of the DWSAP Program, should work with DHS to assure that the intended approach satisfies components of the DWSAP Program.

3.1 Surface Water Source of Drinking Water

✓**Location of the Drinking Water Source.** Section 9.1 and Appendix A.

The location (latitude, longitude) of the intake or well shall be determined by a global positioning system (GPS) with accuracy of 25 meters, or by another method with equivalent accuracy. An interim location may be obtained through use of a USGS quad map (7.5 minute series)., or another method with similar accuracy.

✓**Delineation of Source Area and Protection Zones.** Section 6.1, and Appendix B.

Identify watershed boundaries.

Zones are not required, but if they are established, the distances listed below may be used. For large water bodies, the zones may be limited to the area within an appropriate travel time distance from the intake.

400 feet from banks of reservoir, or primary stream
200 feet from tributaries
2,500 feet from intakes

✓**Drinking Water Physical Barrier Effectiveness Checklist.** Section 8.2.1 and Appendix C.

Evaluate the drinking water source and its site characteristics in terms of the effectiveness of the physical barriers in preventing contaminants from reaching the source:

> Complete form and make determination of the effectiveness of the source's physical barriers to contamination, based on geology and hydrogeologic considerations: Low, Moderate, or High.

✓**Inventory of Possible Contaminating Activities (PCAs).** Section 7.0 and Appendix D.

Use checklists to identify the types of PCAs that occur in the source area (watershed) and in zones, if zones are established.

> Attach a list to the assessment map of the types of PCAs identified in the inventory and the area or zone(s) in which they occur (see Vulnerability Ranking).

✓**Vulnerability Ranking.** Sections 8.0 and Appendix F.

Evaluate each PCA in terms of its risk ranking, location (on watershed or in zones), and the Physical Barrier Effectiveness of the source. Prioritize PCAs to identify those to which the source is most vulnerable. Prepare prioritized listing of PCAs and attach to the assessment map.

✓**Assessment Map.** Section 9.0 and Appendix G.

Prepare an assessment map (based on a USGS quadrangle map, 7.5 minutes series) that shows:

1. Location of the drinking water source (surface water intake)

2. Source area (watershed for surface water source)

3. Zones (optional for surface water sources)

4. Attached prioritized listing of PCAs with the area or zone(s) in which they occur, and indicating to which the source is most vulnerable.

✓**Completion of Assessment and Summary.** Section 9.5 and Appendix G.

Complete the assessment and prepare a summary. Submit to the DHS Drinking Water Program district office.

The completed assessment should include the assessment map, delineation calculations, physical barrier effectiveness checklists, PCA inventory forms, vulnerability ranking, and other information presented on the checklist in Appendix G.

✓**Public Notification.** Section 9.6 and Appendix G.

The following information on the assessment must be included in the water system's annual consumer confidence report:

- A statement that a drinking water source assessment has been conducted.
- The date of the assessment.
- Location where assessment is available for review (local DHS district office and, when feasible, at the public water system's office).
- A statement that a summary of the assessment can be mailed upon request.
- A vulnerability summary of the assessment identifying the PCAs to which the system is most vulnerable.
- A contact phone number.

3.2 Ground Water Source of Drinking Water

✓**Location of the Drinking Water Source.** Section 9.1 and Appendix H.

The location (latitude, longitude) of the intake or well shall be determined by a global positioning system (GPS) with accuracy of 25 meters, or by another method with equivalent accuracy. An interim location may be obtained through use of a USGS quad map (7.5 minute series) or another method with similar accuracy.

✓**Delineation of Source Area and Protection Zones.** Section 6.2 and Appendix I.

Identify recharge area boundaries (if known) and indicate on the assessment map.

Zones are required.

Minimum acceptable method for determining zones

Calculated fixed radius (CFR) method.

Modified CFR, if direction of groundwater flow is known.

[DHS and LPAs may use arbitrary fixed radius, at minimum distances specified in Table 6-2, for non-community systems.]

Minimum distances of zones

The minimum radii of zones, determined from CFR equation, except for wells in fractured rock aquifers, are:

600 feet for Zone A (microbiological)
1,000 feet for Zone B5 (chemical)
1,500 feet for Zone B10 (chemical)

For fractured rock aquifers, the minimum radii are:

900 feet for Zone A (microbiological)
1,500 feet for Zone B5 (chemical)
2,250 feet for Zone B10 (chemical)

Delineation methods more sophisticated than CFR or modified CFR are not subject to minimum distances.

Maximum distances of zones

Zones for a drinking water source need not extend beyond a known hydrogeologic boundary.

✓**Drinking Water Physical Barrier Effectiveness Checklist.** Section 8.2.1 and Appendix J.

Evaluate the drinking water source and its site characteristics in terms of the effectiveness of the physical barriers in preventing contaminants from reaching the source:

Complete form and make determination of the effectiveness of the source's physical barriers to contamination, based on geology and hydrogeologic considerations: Low, Moderate, or High.

✓**Inventory of Possible Contaminating Activities (PCAs).** Section 7.0 and Appendix K.

Use checklists to identify the types of PCAs in the protection zones (and in the source area, if information is readily available).

Attach a list to the assessment map of the types of PCAs identified in the inventory and the area or zone(s) in which they occur (see Vulnerability Ranking).

✓**Vulnerability Ranking.** Sections 8.2.1 and Appendix M.

Evaluate each PCA in terms of its risk ranking, location (zone), and the Physical Barrier Effectiveness of the source. Prioritize PCAs to identify those to which the source is most vulnerable. Prepare prioritized listing of PCAs and attach to the assessment map.

✓**Assessment Map.** Section 9.0 and Appendix N.

Prepare an assessment map (based on USGS quadrangle map, 7.5 minute series) that shows:

1. Location of the drinking water source (well).

2. Source area (zones plus recharge area, if known, for groundwater source)

3. Zones (required for ground water sources)

4. Attached prioritized listing of PCAs with the area or zone(s) in which they occur, and indicating to which the source is most vulnerable.

✓**Completion of Assessment and Summary.** Section 9.5 and Appendix N.

Complete the assessment and prepare a summary. Submit to the DHS Drinking Water Program district office.

The completed assessment should include the assessment map, delineation calculations, physical barrier effectiveness checklists, PCA inventory forms, vulnerability ranking, and other information presented on the checklist in Appendix N.

✓**Public Notification.** Section 9.6 and Appendix N.

The following information on the assessment must be included in the water system's annual consumer confidence report:

- A statement that a drinking water source assessment has been conducted.
- The date of the assessment.
- Location where assessment is available for review (local DHS district office and, when feasible, at the public water system's office).
- A statement that a summary of the assessment can be mailed upon request.
- A vulnerability summary of the assessment identifying the PCAs to which the system is most vulnerable.
- A contact phone number.

page intentionally blank

PART TWO

Roles of the Public and Government Agencies in the Development of California's DWSAP Program

A description of the public participation in the development of the DWSAP, and the activities of government agencies that are related to drinking water assessment and protection

Section 4—Public participation in the DWSAP Program

Section 5—Roles and responsibilities of government agencies

page intentionally blank

4.0 Public Participation in the DWSAP Program

Public participation in developing the DWSAP Program is crucial to the success of the program, because it:

(1) ensures that interested parties understand the proposed program
(2) provides technical review of the program elements
(3) helps forge consensus among parties affected by the program
(4) ensures that concerns of the public are fully addressed, and
(5) fosters a closer working relationship between government agencies and the public.

Public involvement in the program itself is required at three different levels. The first level is during the development of the statewide DWSAP Program. The second level is the availability or distribution of drinking water source assessments for public review after they are completed (Part Three of this document). The third level is during development of voluntary local drinking water source protection programs (Part Four).

Listed below are the public involvement steps in the development of the California DWSAP Program.

4.1 Stakeholders in the Process

Agency stakeholders. In April 1997 the Department of Health Services convened an interagency group of federal, state and local agencies including: the US Environmental Protection Agency, the US Geologic Survey, the US Bureau of Land Management, the US Bureau of Reclamation, the US Forest Service, the CalFed Program (which deals with issues of San Francisco Bay and the Sacramento River/San Joaquin River Delta), the Department of Water Resources, the State Water Resources Control Board, Regional Water Quality Control Boards (North Coast, Colorado River Basin, Lahontan, Central Valley), the Department of Pesticide Regulation, the Department of Food and Agriculture, the Department of Forestry and Fire Protection, the California Council of Directors of Environmental Health, and local environmental health departments (Riverside County and Contra Costa County).

The purpose of the meeting was to explain the DWSAP Program, identify key players in related programs, and discuss program implementation. The principal issues discussed were standardized mapping to facilitate integration of information, protection areas and zones for delineation purposes, PCA inventories, drinking water source and site characteristics, vulnerability analyses, and public participation.

Other stakeholders. A list of approximately 120 individuals or representatives from various organizations interested in or potentially affected by the DWSAP program has been developed for California. This list, which represents a broad spectrum of the general public, was used to develop the Public Policy Advisory Committee, described below. Additional people or organizations were added during development of the program.

Stakeholder groups are presented in Table 4-1.

4.2 Technical and Policy Advisory Committees

A Technical Advisory Committee was developed to review and comment on the technical elements of the program. This committee was comprised of technical experts in ground water and surface water and protection (Table 4-2). The Technical Advisory Committee met in August and November 1997 and February, April, June, August and November 1998 to review and comment on proposed program elements. A subcommittee of the Technical Advisory Committee met six times by telephone during February to June 1998.

The Public Policy Advisory Committee included stakeholders who wanted to be actively involved in the program development. DHS sent invitations for the first meeting of the advisory committee to over 120 individuals representing stakeholder business, industry, agriculture, environmental groups, medical and public health advocacy organizations, and others. The committee also met in August and November 1997 and February, April, May, August and October 1998 to review and comment on drafts of the DWSAP program, and on the schedule, format, and agenda for the public workshops.

Members of both committees were invited to comment on any aspect of the program, and to attend each other's meetings. Meetings were also open to any interested parties.

4.3 Mailing List of Interested Parties

A DWSAP Program mailing list of approximately 300 was developed, comprised of interested parties, including members of the various advisory committees and the interagency group. Notifications of meetings of the technical and public policy advisory committees and public workshops, along with drafts of the DWSAP Program, were sent to those on the mailing list.

4.4 Development and Availability of Draft DWSAP Program Documents for Comment

Drafts of the DWSAP Program were submitted to the advisory committees for review and comment. Additionally, drafts were sent to local, state and federal agencies, the American

Waterworks Association, Association of California Water Agencies, and other organizations. These groups were requested to submit comments. As mentioned above, drafts were also provided to those on the DWSAP Program mailing list.

DHS also made drafts of the DWSAP Program available by posting them on the Internet (accessible via "Prevention Services" and "Division of Drinking Water and Environmental Management" at the DHS Web site, http://www.dhs.cahwnet.gov), with a request for comments. DHS is responding to comments submitted by the public during development of the DWSAP program, and intends to indicate its response in its submittal to US EPA. Comments received by e-mail are read and incorporated into revised documents as appropriate, but only those comments received as hard copy are addressed in the more formal response mechanism.

4.5 Public Outreach

Materials on the Internet

Since October 1997, DHS has used its Web site to present information related to the DWSAP Program. The information includes the schedule of advisory committee meetings, workshops, and other activities, notes from those meetings, and other information that provides updates on the program and invites public participation. Copies of this information have been provided to the DWSAP mailing list, and on request to those without Internet access.

Staff presentations

Presentations on the DWSAP Program were made in 1997 and 1998 by DHS staff from headquarters and field offices staff. Information on the programs was presented to professional organizations, water supplier organizations, watershed management groups, and other interest groups and organizations. A list of presentations will accompany the program submittal to US EPA.

Public workshops

Nine informational workshops were held at five locations around the state (Chino, Fresno, Redding, San Francisco Bay Area, Thousand Oaks) in April and May 1998. These workshops explained the DWSAP Program and invited comments from the general public.

4.6 Revisions of the DWSAP Program Document

Comments and suggestions for improvements from members of the advisory committees, and other comments that DHS staff received from the public (for example, during presentations or workshops) have been incorporated into the DWSAP Program document. The first draft

DWSAP was released in October 1997. Revised drafts were made available to the public in January, April, and August 1998.

4.7 Final Public Comment Period

A public comment period on the final review draft occurred in August-September 1998. Written comments were received from eighteen agencies, organizations and individuals. DHS has prepared a response to the comments and has addressed many of the concerns in the final draft of the DWSAP program.

Table 4.1 Potential Stakeholders

Public Agencies
Counties
Cities
Regional Water Quality Control Boards
Water Districts
Sewage Districts
Sanitation Districts
Flood Control Districts
Ground Water Management Districts
Resource Conservation Districts
Department of Fish and Game
Department of Toxic Substances Control
Department of Pesticide Regulation
Integrated Waste Management Board
Office of Environmental Health Hazard Assessment
Department of Water Resources
Department of Food and Agriculture
State Water Resources Control Board
Teale Data Center
National Resources Conservation Service
US Bureau of Reclamation
US Environmental Protection Agency
US Fish and Wildlife Service
US Forest Service
US Geological Survey

Private Companies
Agriculture
Mining
Gravel Production
Private Water Companies
Well Drillers
Manufacturing, Petroleum, and other Industries
Landfill Operators

Private Organizations
Farm Bureau
Chambers of Commerce
Construction/Real Estate Organizations
Well Drillers' Groups
Mutual Water Companies
Agricultural Groups
Environmental Groups
Recreational Groups
Watershed Conservancies
Consumer Groups
Rate-payer Groups
Water-Oriented Associations
Planning Associations

Individuals
Pumpers
Farmers
Rate-payers
Consumers
Educators

Others
UC Agricultural Extension
Public Health Groups
Vulnerable Population Groups
Business Groups representing Chemical Manufacturing
Tribes

Table 4.2 Technical Advisory Committee

Elaine Archibald	Water Industry Consultant
Norm Brown	Integrated Water Technologies
Neil Dubrovsky	US Geological Survey
Pat Dunn	California Department of Pesticide Regulation
Terry Fleming	US Environmental Protection Agency
Carl Hauge	California Department of Water Resources
John Letey	University of California Center for Water & Wildland Resources
Bruce Macler	US Environmental Protection Agency
Mary Ann Mann	Metropolitan Water District of Southern California
Jon Marshack	Central Valley Regional Water Quality Control Board
Sue Murphy	California Rural Water Association
Richard Nagel	San Fernando Valley Water Master
Harrison Phipps	Groundwater Resources Association of California
Anthony Saracino	Groundwater Resources Association of California
Paul Veisze	California Department of Fish and Game
Nira Yamachika	Orange County Water District

5.0 Roles and Responsibilities of Government Agencies

A variety of state, local and federal agencies have responsibilities and authority for protection of ground water and surface water supplies. Drinking water source protection does not transfer authority for potential pollution control away from existing agencies. Information developed during source water assessments (delineation, PCA inventory and vulnerability analysis) may be used by agencies with existing authority in setting priorities for technical assistance, outreach, field inspections, enforcement actions and other activities.

Private water purveyors also administer some water-related activities, especially in regard to water importation, recharge, reclamation, pumping, and reuse.

This section will describe the roles and responsibilities of various governmental agencies with respect to the drinking water source assessment and protection program. Information generated and maintained by a number of these agencies is accessible through DHS' directory of source water protection-related activities.

A number of government agencies were contacted to determine their existing activities that may have application in carrying out a drinking water source assessment or in providing information for a voluntary source water protection program. A survey form was sent out and responses were received from the agencies listed below. A compilation of the information received is shown in Table 5-1.

Local Agencies

City of Benicia

Contra Costa County, Environmental Health Division
Sonoma County, Permit and Resource Management Department
Placer County Environmental Health Department
Riverside County, Department of Environmental Health

State Agencies

Air Resources Board, Stationary Source Division
Department of Water Resources
Department of Forestry and Fire Protection (CDF)
State Fire Marshall/ Pipeline Safety and Enforcement Division (Part of CDF)
Integrated Waste Management Board

Department of Toxic Substances Control
Department of Pesticide Regulation
Department of Health Services, Division of Drinking Water and Environmental Management
State Water Resources Control Board, Clean Water Programs
State Water Resources Control Board, Division of Water Quality
State Water Resources Control Board, Division of Water Rights
Regional Water Quality Control Board, North Coast Region 1
Regional Water Quality Control Board, Central Coast Region 3
Regional Water Quality Control Board, Los Angeles Region 4
Regional Water Quality Control Board, Central Valley Region 5
Regional Water Quality Control Board, Lahontan Region 6
Regional Water Quality Control Board, San Diego Region 9

Federal Agencies

U.S. Department of Agriculture, Forest Service
U.S. Department of Agriculture, Natural Resources Conservation Service
Department of the Interior, Bureau of Land Management
U.S. Environmental Protection Agency, Region 9

State/Federal Agency

CalFed Bay Delta Program

5.1 Local Agencies

5.1.1 Counties and Cities

California has fifty-eight (58) counties. Various county departments, such as planning, building, permitting, public works and environmental health, have jurisdiction over many activities that are related to the protection of water supplies. Thirty-four (34) of the counties have been designated Local Primacy Agencies (LPAs) to carry out the regulation of small public water systems.

Besides its counties, California also has more than 450 incorporated cities and many other municipalities. These local governments are often concerned with ensuring the availability of high-quality water supplies to residents. State enabling legislation gives local governments variable powers and duties, depending on how they were formed, to protect water supplies.

A variety of water-related activities are undertaken by county and city governments. These include:

Ground Water Recharge
Hazardous Materials Spills Emergency Response
Hazardous Waste Management Planning
Land Use Planning and Zoning
Large and Small Water Supply Systems Monitoring
Pesticide Regulation by County Agricultural Commissioners
Regulation of Individual Waste Disposal (Septic) Systems
Regulation of Underground Storage Tanks
Sanitary Landfill Ground Water Monitoring
Solid Waste Management Planning
Water Well Permitting
Watermaster for an Adjudicated Basin

5.1.2 Special Districts

California has thousands of special districts that undertake or have authority for activities related to drinking water source assessment and protection. The types of districts include:

Flood Control and Water Conservation Districts
Public Utility Districts
Community Services Districts
Sewer and Sewer Maintenance Districts
Storm Water Drainage and Maintenance Districts
Water Replenishment Districts
Reclamation Districts
Irrigation Districts
Levee Districts
Local Drainage Districts
Resource Conservation Districts and Water Conservation Districts

The drinking water protection related activities that these districts undertake may overlap those of cities and counties. The activities include:

Ground Water Management
Control/Correction of Saline Water Intrusion
Ground Water Recharge
Land Reclamation
Watershed Protection
Water Conservation

Irrigation Water Supply
Sewer Construction and Maintenance
Drinking Water Supply
Sewage Collection, Treatment and Disposal
Power Supply
Refuse Disposal
Soil Conservation
Wet, Swamp and Overflowed Land Drainage

Local governments sometimes expand and coordinate activities through "Joint Powers Authorities" pursuant to §6500 et seq. of the California Government Code, which includes the formation of separate agencies or entities.

5.2 State Agencies

A number of State agencies, boards, departments, and offices share responsibility with federal and local agencies for ground and surface water protection in California (see Table 5-1). They are identified and their roles briefly described below:

The **Health and Welfare Agency** houses the **Department of Health Services (DHS)**:

Division of Drinking Water and Environmental Management (DDWEM)

The DDWEM, within DHS, promotes public health through the regulation and monitoring of public water systems, wastewater reclamation projects, disposal of low level radioactive waste, shellfish production and harvesting operations, and medical waste generators.

DDWEM is responsible for carrying out the federal Safe Drinking Water Act (SDWA) in California. Activities of DDWEM related to drinking water source assessment and protection are primarily conducted by the Drinking Water Field Operations Branch (DWFOB) and the Drinking Water Technical Programs Branch (DWTPB).

The DWFOB is responsible for the inspection and regulatory oversight of approximately 8500 public water systems to assure delivery of safe drinking water to all California consumers. There are 15 district offices distributed widely throughout the state. Activities involved in the oversight of public water systems include issuing permits, performing inspections of existing facilities, reviewing plans for new facilities, issuing administrative orders and citations to public water systems for violations of laws and regulations, and ensuring that public water systems comply with water quality standards and monitoring requirements.

The DWTPB is responsible for providing technical support for the drinking water program and carrying out its administrative functions. The branch is composed of the Technical Operations Section and the Technical Programs Section. The Technical Operations Section administers its programs through several units: Certification Unit (certification of water treatment operators and water treatment devices), the Standards and Technology Unit (development of monitoring and water quality regulations and conduct special studies and programs), and the Recycled Water Unit (development of recycled water criteria and regulations, proposal evaluation and recommendations). The Technical Programs Section includes the Data Management Unit, which collects, compiles, evaluates and reports drinking water quality data from large and small drinking water systems in the State.

The **California Environmental Protection Agency (Cal/EPA)** serves as the point of accountability for the management of the State's environmental protection programs, bringing together functions that cut across various programs designed to address environmental pollution. Organizations in Cal/EPA are:

State Water Resources Control Board (SWRCB)

The SWRCB formulates and adopts the State's policy for water quality control, assisting and overseeing the Regional Water Boards, and in conjunction with the courts, administers California's system of water rights.

Regional Water Quality Control Boards (Regional Water Boards)

The nine Regional Water Boards formulate, adopt, and implement (with State Water Board approval) water quality control policies and plans within their jurisdiction. Collectively, the nine Regions cover all of California. Each Regional Water Board designates beneficial uses of surface and ground water resources, and establishes water quality objectives to reasonably protect existing and potential beneficial uses of water resources in its region, as well as implements programs to achieve compliance with the water quality objectives. Beneficial uses, water quality objectives, and the implementation program are specified in each region's Water Quality Control Plan, as called for in the California Water Code, §13240.

Regional Board activities related to drinking water source assessment and protection include:

Basin Planning

Each Regional Water Board has adopted one or more Water Quality Control Plans (Basin Plans) for their jurisdiction, which is based upon surface water hydrologic basin boundaries. The Basin Plans identify existing and potential beneficial uses of marine, ground, and surface waters; establish water quality objectives to protect the beneficial uses; specify implementation programs to achieve these objectives; and describe surveillance and monitoring activities to evaluate the effectiveness of the water quality program.

Basin Plans contain standards for surface water and ground water quality that are independently established by each Regional Water Board as water quality objectives necessary to protect the identified beneficial uses. Thus, there are differences both among and within Regions, depending upon the particular ground water basin and the assigned beneficial uses.

National Pollutant Discharge Elimination System (NPDES) and Waste Discharge Requirements

Under the authority of the federal Clean Water Act, the NPDES program regulates point source discharges to surface waters such as wetlands, lakes, rivers, estuaries, bays and oceans. In California, the Porter-Cologne Water Quality Control Act regulates any discharge of waste that may affect water quality in California. Waste discharges are declared to be a privilege, not a right, and require permission from the applicable Regional Water Board.

Waste Discharges to Land

The State Water Board has adopted regulations (California Code of Regulations, Title 23, Chapter 15, and Title 27) which implement provisions in the Porter-Cologne Act. These regulations apply to all hazardous and non-hazardous wastes discharged to land, including surface impoundments. The Chapter 15 regulations prescribe siting standards, construction standards, ground water and vadose zone monitoring requirements, and closure and post-closure procedures and requirements.

Protecting ground and surface water from the migration of contaminants from solid waste disposal facilities is the responsibility of the State and Regional Water Boards. This responsibility is executed by requiring all solid waste disposal facilities to conform to waste discharge requirements adopted by a Regional Water Board.

Hazardous Waste Facility Monitoring

Under a Memorandum of Agreement with DTSC, the State and Regional Water Boards carry out a ground water monitoring and surveillance program, perform water quality-related review work, and develop regulations, standards, and

guidelines pursuant to the federal Resource Conservation and Recovery Act (RCRA).

Underground Storage Tanks

In 1983, the California Legislature enacted underground tank legislation requiring an inventory of underground storage tanks along with a program to permit their continued use. The State Water Board, the nine Regional Water Boards, and local agencies share responsibility for enforcement and cleanup. The State Water Board compiled the inventory of underground containers in California and provided this information to the appropriate Regional Water Boards, cities, and counties. The container inventory, as directed by the legislation, also included pits, ponds, sumps, and lagoons, each storing a wide variety of substances.

The State Water Board established standards for the monitoring of existing tanks and the construction of new ones. These, along with requirements for repair and closure, are described in the California Code of Regulations, §2610 et seq.

Non-Point Source Pollution

The federal Clean Water Act was amended in 1987 to include Section 319, which required the states to develop and implement non-point source management programs. The State Water Board subsequently adopted a "Non-point Source Management Plan" in 1988, and by early 1990, had organized a multi-faceted, surface and ground water, non-point source program which focused on agriculture, mining, urban runoff, construction, and pesticides. The non-point source program seeks to reduce or eliminate surface and ground water pollution through the implementation of management measures to control non-point source pollution at its source.

Remediation

The Regional Water Boards, in responding to a surface or ground water pollution problem or nuisance, may issue a "cleanup and abatement" order to any responsible party to require corrective action. Their authority covers all discharges of waste, hazardous or otherwise, which enter or threaten to enter surface or ground water.

Coastal Zone Act Reauthorization Amendment (CZARA) of 1990

The two primary federal statutes that establish a framework for address nonpoint source (NPS) pollution are Section 319 of the Clean Water Act (1987) and Section 6217 of the CZARA. Together, they encourage states to assess water quality problems associated with NPS and to develop programs to control NPS sources of pollution. CWA §319 requires that states develop an assessment report and a management program specifying NPS controls. CZARA §6217(a) requires states to establish coastal NPS programs to develop and implement management

measures for NPS pollution to restore and protect coastal waters. California received $5.4 million of federal funding under the CWA in 1997 to carry out its NPS program.

In 1988, the SWRCB adopted the California NPS Management Plan that outline a three-tiered approach for address polluted runoff: (1) voluntary implementation of Best Management Practices (BMPs), (2) regulatory-based encouragement of BMPs, and (3) effluent limitations. In response to CZARA §6217, the SWRCB, the RWQCBs, and the California Coastal Commission initiated a joint effort to improve the state-wide NPS program and comply with CZARA requirements. As a result, California is working to enhance its state-wide NPS program by better utilizing existing state authorities and programs, pursuing watershed approaches, and encouraging voluntary cooperation.

Other Activities Conducted by the State and Regional Boards

Other activities related to source water protection include: Water quality assessments (Clean Water Act Section 303d updates), routine aerial surveillance, AB2021 report to legislature (Pesticide Contamination Prevention), and the Above Ground Storage Tank program.

Department of Toxic Substances Control (DTSC)

The DTSC protects public health and the environment from the improper handling storage, transport, and disposal of hazardous substances.

DTSC's primary activities related to drinking water source assessment and protection are included in two programs mandated by federal law:

Resource Conservation and Recovery Act (RCRA)

Under the federal Toxic Substances Control Act, the USEPA regulates the treatment, disposal (including incineration, landfill, alternative technology), and storage of hazardous chemical substances. The federal RCRA Program has been delegated to DTSC. This program regulates the treatment, transportation, storage and disposal of hazardous waste.

DTSC, under Health and Safety Code §25100, issues permits that govern the general operation of hazardous waste management facilities. They specify conditions on the way hazardous materials may be transported, handled, treated, stored, or disposed. The permits also impose conditions for waste analysis, record keeping, site monitoring, containment procedures, site improvements, closure procedures, and financial responsibility.

California Superfund Program

DTSC is authorized by California's Hazardous Waste Control Law and Hazardous Substance Account Act (California Superfund) with enforcement powers for the cleanup of hazardous substances. Their program complements the federal "Superfund" program and provides for: (1) cleanup or impact reduction at hazardous waste sites, (2) response capability to State and local agencies in hazardous substance emergencies, and (3) compensation to persons who suffer loss or injury caused by the release of a hazardous substance.

DTSC specifies their approach in their *Preliminary Endangerment Assessment Guidance Manual*. The DTSC cleanup strategy is based on a health risk assessment approach.

Department of Pesticide Regulation (DPR)

DPR regulates the use and management of pesticides to prevent pollution of surface water bodies and ground water aquifers that may be used for drinking water supplies, as mandated in the State Pesticide Contamination Prevention Act (1986).

DPR is responsible for regulating the sale and use of pesticides, evaluating and mitigating environmental and human health impacts of pesticide use, and promoting alternative pest control strategies. The DPR program relies on authorities in the California Food and Agriculture Code (§13141 et seq.).

Additional authorities in the California Pesticide Contamination Prevention Act require the DPR to carry out specific activities to prevent ground water from being contaminated. Prevention is the preferred goal, because once ground water has become contaminated, cleanup activities are very difficult, expensive, and time consuming. This Act requires: (1) Pesticide registrants to submit specific information to the DPR regarding the impacts of their products on ground water; (2) DPR to identify pesticides that have the potential to pollute ground water to be put on a Ground Water Protection List; and (3) DPR to conduct a monitoring program for pesticides in soil and ground water.

As specified in a Memorandum of Understanding between DPR and the State Water Board, DPR is the first agency to respond to any detection of a pesticide in surface water or ground water with voluntary measures and/or regulatory action.

DPR is currently developing a program to identify areas in the state where ground water is potentially vulnerable to pesticide contamination.

Integrated Waste Management Board (IWMB)

The IWMB oversees the safe treatment, storage, recycling, disposal of solid waste by local agencies.

Air Resources Board (ARB)

The ARB regulates emissions of air pollutants than can effect the quality of surface and ground water.

Office of Environmental Health Hazard Assessment (OEHHA)

OEHHA provides information to environmental regulators and the public about adverse health effects that result from environmental exposures to noninfectious agents.

OEHHA's mission is to protect and enhance public health and the environment by objective scientific evaluation of risks posed by hazardous substances.

OEHHA's functions and responsibilities related to drinking water source assessment and protection include developing health-protective exposure standards for different media (air, water, land) to recommend to regulatory agencies, including drinking water chemical contaminant standards for DHS. OEHHA's Water Toxicology Unit performs major risk assessment and hazard evaluations relating to chemical contaminants in drinking water. These activities include developing health advisories, action levels, proposed maximum contaminant levels, and public health goals for chemical substances, additives, and pollutants in drinking water and on chemical monitoring activities for the drinking water supply. The program also provides education to the public and other governmental agencies on drinking water contamination and regulatory standards development.

OEHHA is responsible for implementing the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). This initiative statute prohibits businesses from discharging into drinking water sources chemicals identified by the State to cause cancer or reproductive toxicity. It also requires warnings to be provided whenever exposures to those chemicals are anticipated to occur.

The **Resources Agency** includes several pertinent departments:

Department of Water Resources (DWR)

The DWR develops, conserves, and manages the water resources of the State.

The mission of the Department of Water Resources is to manage the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.

Major responsibilities of the Department include preparing and updating the California Water Plan to guide development and management of the State's water resources. The State and Regional Water Boards must consider this Plan in their decisions. In addition, the Porter-Dolwig Ground Water Basin Protection Law (California Water Code §12920 et seq.) gives the DWR authority to initiate or participate in investigations, studies, plans and design criteria for projects to prevent degradation of ground water throughout the State.

The Department also administers increasingly complex programs involving flood control for the Central Valley, dam safety for more than 1,200 dams statewide, local assistance projects, water management strategies, water quality improvement, and water supply data collection and studies. DWR staff provides technical and financial assistance to local water communities; works with a number of governmental and wildlife agencies on environmental issues and projects; manages State Water Project and Reclamation Board lands; educates the public about California's water resources; and operates and maintains the State Water Project.

DWR provides support for the use of ground water though the distribution of hydrogeologic studies and other technical information. In addition, well drillers are required to file a report to DWR on each well drilled.

Department of Conservation (DOC)

Among other functions, the Division of Oil, Gas, and Geothermal Resources (DOGGR) within the DOC acts to prevent contamination of ground water due to the drilling, operation, maintenance, and abandonment of oil, gas, and geothermal wells. This includes both extraction and injection wells.

The State Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) issues permits for the approximately 21,000 Class II (oil/gas production) injection wells in California. These are accepted by the USEPA for the Underground Injection Control program under one Memorandum of Understanding with DOGGR and accepted by the Regional Water Boards under another Memorandum of Understanding.

California Department of Forestry and Fire Protection (CDF)

The Department of Forestry and Fire Protection protects the people of California from fires, responds to emergencies, and protects and enhances forest, range and watershed value providing social, economic and environmental benefits to the citizens of the State. Managing California's natural resources is an important part of the Department's mission. CDF oversees enforcement of California's forest practice regulations. This includes review of Timber Harvest Plans submitted by private landowners and logging companies who want to harvest trees on their property. CDF also operates six Demonstration State Forests where research and experiments in forest management are conducted.

State Fire Marshal, Pipeline Safety Division (CSFM)

Within CDF, the California State Fire Marshal has the exclusive responsibility of regulating and enforcing safety on all intrastate hazardous liquid pipelines within the state, including some of the pipelines coming from offshore platforms located within three miles of the California coast.

CSFM is also recognized as an interstate agent of the United States Department of Transportation's Office of Pipeline Safety (OPS). As such, CSFM is responsible for inspection, investigation and emergency response concerning interstate pipelines.

The **Department of Food and Agriculture (DFA)** is a cabinet level agency.

Among other functions, DFA inventories agricultural operations, dairies, and animal feedlots. DFA also investigates water quality issues involving the accumulation of nitrate in ground water.

5.3 Federal Agencies

Federal water programs are administered primarily by the U.S. Environmental Protection Agency. The U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, the U.S. Department of Agriculture (USDA) and other federal agencies play complementary roles. The U.S. Geological Survey (USGS) principally compiles information that assists others in their water protection efforts.

National Resources Conservation Service (NRCS)

NRCS (previously known as the Soil Conservation Service) has a long history of addressing non-point source pollutants by working with farmers and communities

through voluntary implementation programs. NRCS assistance has primarily focused on nutrients, pesticides, sediment, animal wastes, and salinity issues in surface and ground waters. Assistance encompasses planning and preventive measures to small scale monitoring and suggestions of conservation practices to help solve non-point source pollution problems. NRCS also offers point, field and watershed models to predict the transport and fate of these parameters in surface and subsurface waters.

US Geological Survey (USGS)

The role of the USGS is to serve as the primary earth sciences research agency in the United States. The Survey has no regulatory or management responsibilities, and is focused entirely on the need to provide sound scientific data, information, and assessments in support of those agencies that have regulatory and management responsibilities for geologic, hydrologic and, now, biologic resources.

U.S. Environmental Protection Agency (US EPA)

Several federal programs related to drinking water source assessment and protection are administered by the U.S. Environmental Protection Agency. The primary purpose of the Safe Drinking Water Act (SDWA) is to ensure the safety of drinking water served to the public. The SDWA includes the Wellhead Protection Program, the Sole Source Aquifer Program, and the Underground Injection Control Program.

Other federal environmental laws to protect water supplies include, but are not necessarily limited to, the Clean Water Act (CWA) which ensures protection of surface waters designated, in part, for use as drinking water; the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, otherwise known as “Superfund”), and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These laws provide authorities, financial support, and technical assistance to protect sources of drinking water, especially ground water.

page intentionally blank

Table 5-1. Matrix of Drinking Water Source Water Assessment and Protection Roles.

Oversized table — not available in this version

Pages 1 and 2 of Table 5-1
inserted in this version on
May 21, 2018

Page 2 of oversized table — not available in this version

TABLE 5-1 Matrix of Government Agency Roles for Drinking Water Source Assessment and Protection

Agencies		Activities	Geologic Data	Well Logs	Aquifer yield	Water level measurements	Water quality testing	Water quality monitoring	Water Quality planning	Groundwater withdrawals	Classification of water supplies	Groundwater recharge	Permit water withdrawals	Interbasin transfer review	Sole source aquifer designation	Water Rights	River basin planning	Flood control	Surface impoundments (recreation, mixed-use)	Water Conservation	Storm Drain facilities	Wetland protection	Saltwater intrusion	Wastewater reclamation	Wastewater discharges	Surface impoundments (wastewater)	Wastewater sludge disposal	Septic systems	Sewer collection systems	Control of non-point source pollution	Protection of Drinking Water	New drinking water source approvals	Surface impoundments (drinking water supplies)	Surface impoundments (irrigation, agriculture)	Well construction standards	Certification of well drillers	Underground injection control	Domestic water supply wells	Agricultural wells	Oil, gas, geothermal wells	Monitoring wells, other wells
STATE AGENCIES	Resources Agency	Department of Water Resources	D, R, T, O, E, A, M, S, P	D, R, T, O, E, A, M, S, P	D, R, T, O, E, A, M, S, P	D, R, T, O, E, A, M, S, P	D, T, A, S	D, R, T, O, A, M, S, P	D,R,T,F O, E, A, M, S, P	D, R, O, A	D, T, P	F		D, R, T, O, E, A, M, S, P			D, R, T, O, E, A, M, S, P	T, O, E, R, M, P, Po	F	D, T, E, A, S, P, F		O	D, R, T, O, E, A, M, S, P	D, R, T, E, A				D, R, T, O, E, A, M, S, P			D, R, T, O, E, A, M, S, P	D, R, T, O, E, A, M, S, P	All except Po, Rg	All except Po, Rg	D, R, T, O, E, A, M, S, P			D, R, O, E, A, F	All except Po, Rg	D, R, T, O, E, A, M, S, P	D, R, T, O, E, A, M, S, P
		Department of Forestry and Fire Protection (CDF)																												Rg, M	Rg, M										
		State Fire Marshal, Pipeline Safety Div. (Part of CDF)																																						
	CAL-EPA	Integrated Waste Management Board																									R, T, O, Rg, S, Po														
		Department of Pesticide Regulation						D, R, T, A, M																						Rg, Po, R, D, T, E, A, M	Rg, Po, D, R, T, E, A, M						D, M, A	D, M, A		D, M
		Air Resources Board, Stationary Source Division						R, E																																
		Office of Environmental Health Hazard Assessments																																						
		Department of Toxic Substances Control	D, R, T, O,E,Rg, A, M, G	D, R, T, O,E,Rg, A, M, G	D, R, T, O,E,Rg, A, M, G	D, R, T, O,E,Rg, A, M, G	D, R, T, O,E,Rg, A, M, G	D, R, T, O,E,Rg, A, M, G		D, R, T, O, M, Rg																									R, T, E, M,S,Rg (Mon.						D,R,T, O,E,Rg,A, M,S
	Water Resources Control Board (CAL-EPA)	Clean Water Programs	Po	Po		Po	Po	Po				F							E, P				F	F, Po	F, Po	Po	Po							Po							Po
		Division of Water Quality					D, R, T, A	all	all		Po, P	R								D, R, T, F, E, A, P, Po	all	R, P	D, T, M																		
		Division of Water Rights								Rg		Rg	Rg	Rg		Rg			Rg	Rg			Rg	Rg																	
		Regional Water Quality Control Boards [1]	R,O, Rg, M, P, Po, T	R, O, Rg, M, P, Po	R, O, Rg, M, P, Po, S	All except F, A, S	all	all	all	R, E, P, O	E, D, Rg, S, P, PO	D, R, T, O, Rg, E, M, P	R, E	R, E	P, Po, R, E	Po, R, E	all	R, O, E, Rg, M, P, Po,T	D,R,E,A Rg,M,S P,Po	P, Po, R, E	All	all	All except F, M	All except P	All	All	All	O, R, M, Rg, Po, T, S	R, Rg, M, D, Po, O	All	All except F		R	R, T, O, Rg, M, S, Po, A	Po, R		R, O, Rg, A, M			R, T, Rg, D, M, O, A
	Health & Welfare	Dept. of Health Services, Drinking Water Program		R, D, A	R, T, A	R, A, T	Rg,A,M S, Po, D, R, T	Rg,A,M S, Po, D, R, T	R, T, A	R, D	Rg, D, R, T, A, S, Po	Rg, D, R, T, A, S, Po	R	R	R	R, A		R	R, Rg, A, M, S, Po	R, T, Po				Rg, R, A, S, Po, T	R, T	R, T	R, T	R, T			All	All	All		R, Rg, Po			Rg,S, Po,D, T, E, A, M			R, T
State-Federal		Cal-Fed Bay Delta Program						D	Po			P				Po		P	P	P			Po	Po																	
FEDERAL AGENCIES		USDA Forest Service	Po, P, R, M, O	Po, O	Po, P, O	O, Po		Po, A, O, D, R, T, M	P, Po, R, T	Po, O, E, M		Po, O, M	Po, P	R, T, O, Po	R, M, O	R, T, O, E, Po	Po, P, R, T,M	Po, O, M	D, R, T, M, Po, Rg, A	Po		Po, P, S, M, T, R	Po, P	R, T, A, M, P, Po	R, T, A, M, P, Po	D, R, T, Rg, A, M, Po	R, T, A, M, P, Po	R, T, A, M, P, Po	R, T, A, M, P, Po	D, T, A, M, P, Po	D, R, T, A, M, P	D, R, T, A, M, P	D, R, T, Rg, A, M, Po	D, R, T, Rg, A, M, Po			E	D, M, T, A, P		D, R, T	O, Po
		USDA Natural Resources Conservation Service	R, T, E, A, P	A, P		R, T, E, A, P	R, T, A, P	R, T, E, A, P	R, T, F, E, A, P			R, A, P				E	R, T, F, E, A, P	All except Rg	All except D, Rg	D, R, T, F, E, A, M, S	R, T, E, A, P	all	R, T, A, P	R, T, E, A, P	R, E, A, P					All except O, Rg	R, T, F, E, A, M, S, P		P	P	R, T, E, S			T, E	T, E		
		Dept. of the Interior, Bureau of Land Management		D		D	D	D	P, Po		D					D, R, Po						D, P, Po, R, T							D, R, T, E, P, Po	D								D, R, T, P, Po	
		Dept. of the Interior, US Geological Survey	D, T, A	D, A	D, T, A, M, S	D, T, A, M, S	D, T, A, M, S	D, T, A, M, S		D, T, A, M, S	D	D, T, A, M						D, T			D, A, T	D, T, A, M	D, T, A, M	D, T, A, M	D, T, A, M	D, T, A, M	D, T, A, M												D, T, A, M
		US EPA Region 9	D, R, A, M, O, T	D, R, T, O, A, M, Po	D, R, T, O, A, M, Po	D, R, A, M, O, T	D, R, A, M, O, T	D, R, A, M, O, T	R, T, S, O			P, Po, T, O, D			Rg, O, P, Po, T, E		D, T, R				R, Rg, O, T	T, O, Rg, R	D, Rg, O	O, E, D, Rg, R	P, Po, T	Rg	P, Po, T, Rg	O, E, D, Rg, Po	Rg, O, A, M		D, R, A, M, O, P, Po				Rg, P, Po		All	D, R, A, M, O	D, R, A, M, O	Rg, D, T, F,O, A, M, E, Po	D, R,T, Rg,A,M S, P, Po,O
LOCAL		COUNTY GOVERNMENT [2]	D, R	D, R, Rg	Rg		D, R, Rg,T E,M	D,R,T,E, M	D,R,T,E, M		D, R,T,Rg								M, Po, T								D,R,T, Rg, M,S	All except F, P			D,R,T, E,M, Rg,O	D,R,T, E,M, Rg,O	Rg		D, R, T, E, Rg, S	D, R, E, Rg		All except F, P	All except F, P	Rg	All except F
		CITY GOVERNMENT[3]				D	D, R, T, Rg, P	D, R, T, Rg, P	D, R, T, Rg, P				R, P			R, P			D, Rg, A, P	R, E, P	R, Rg			D, R, A			D, R, A		R, P	R, E		R, P, Po	D, R, O, E, Rg, A, M						

M = Monitoring D = Data Collection
Po = Policy R = Review/Comment
A = Analysis T = Technical Assistance
P = Planning F = Financial Assistance
O = Oversight S = Standards development
E = Education/information
Rg = Regulatory (permit, inspection, enforcement)

Notes:

1. Regional Boards responding to survey: San Diego, Los Angeles, Lahontan, Central Valley, North Coast, Colorado River Basin, Central Coast.
2. Counties responding: Placer, Riverside, Sonoma, Contra Costa
3. Cities responding: Benicia

c:\swap\swapduty9\sheet1

TABLE 5-1 Matrix of Government Agency Roles for Drinking Water Source Assessment and Protection (continued)

Agencies		Activities	Landfill siting/regulation	Solid waste disposal	Small quantity generators	Source reduction	Hazardous waste disposal	Hazardous waste materials, handling & storage	Surface impoundments (hazardous waste)	Hazardous spills	Household hazardous waste collection	Under ground storage tanks	Above ground storage tanks	Contamination correction/cleanup	Contaminant Source Identification/Evaluation	Agricultural operations (crops)	Agricultural operations (animal facilities)	Fertilizer application	Pesticide application	Certification of pesticide appliers	Mapping/G.I.S.	Data Management	Research	Land use planning/regulation	Growth management/ strategic planning	Analyze development proposals	Land acquisition(ag, open space)	Municipal facilities planning	Infrastructure development	Contingency planning	Legislative recommendations	Delineate source protection Areas	Hazardous Liquid Pipelines	Abandoned Mines	Campground Water Systems	Soils Data	Watershed Planning	Watershed Restoration	Conservation Planning on Private Lands	Watershed Management via CRMP groups
STATE AGENCIES	Resources Agency	Department of Water Resources	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg	R, T, O, E, Rg					D, T, A, R, S	D, R, T, O, E, A, M, S, P	D, R, T, O, A, M, P	D, R, T, O, A, M, P				R, P, Po	F	F			D, R, T, O, A, M, P				D, R, T, O, A, M, P			
		Department of Forestry and Fire Protection (CDF)																					D, M	Rg, R															
		State Fire Marshal, Pipeline Safety Div. (Part of CDF)								Rg, T			Rg, T								D, T, A	D, T, A										Rg, T, D, E, S, Po								
	CAL-EPA	Integrated Waste Management Board	R, T, O, Rg, S, P, Po	All except F		D, R, T, E, A, S, P, Po					S, Po, E, D, R, A			O, R, T, A, M													R, Po													
		Department of Pesticide Regulation													M, A, R, D, T, P, Po	Rg, Po, M, A	Rg, Po		D, Rg, T, E, M, A, Po	Rg	D, R, T, Po	D	D, R, T, A, M, Po																
		Air Resources Board, Stationary Source Division																																					
		Office of Environmental Health Hazard Assessments													A, S																								
		Department of Toxic Substances Control	R,T,O, E,Rg,A,M, S		D,R,T,OE, Rg,A,M,S, Po	D,R,T,OE, Rg,A,M,S, Po	D,R,T,OE, Rg,A,M,S, Po	D,R,T,OE, Rg,A,M,S, Po	D,R,T,OE, Rg,A,M,S, Po	all except P	Rg, O, F			all except F																									
	Water Resources Control Board (CAL-EPA)	Clean Water Programs	Po	Po			Po	Po	Po			D, T, F, E, S, Po, Rg	Rg	D, T, F, E, S, Po	Po						Rg, Po, P, D	A						F			R								
		Division of Water Quality													D, R, T, E, S, Po																								
		Division of Water Rights																																					
		Regional Water Quality Control Boards [1]	All except F	All except F, P			Rg, M, A, R, O, P, Po		All except F	Rg, R, M, T, O, D, A		All	All	All	D, R, A, M,O,Rg S, Po		R, D, Rg, O, M, T, E	Rg, P, R	Rg, P, R		R, A	D, R, O, A, M	R, F, O	R, T	R, A, S	R, T, P		R, D	R		R, A	R,O,Rg, D, A, S, P, Po		All except F			All except F	All except F		All except O
	Health & Welfare	Dept. of Health Services, Drinking Water Program		R			R			R, T			R, S, Po, Rg (water)	R, T	D, R, T, E, S, Po		R				D, R	D, R, T	D, R, E	R	R	R		R	R	R, Po	R	R, Rg, T, E, S, Po			Rg,O,D, R, T, M, E, S, Po		R	R		
State-Federal		Cal-Fed Bay Delta Program																																					
FEDERAL AGENCIES		USDA Forest Service	D, R, T, O, M, P, Po	D, R, T, O, M, P, Po	D, R, T, O, M, P, Po	D, R, T, O, M, P, Po	D, R, T, O, M, P, Po	D, R, T, O, M, P, Po		P, Po, D, T		D, R, T, P, Po	D, R, T, P, Po	D, R, T, O, M, P, Po	D, R, T, A, M, P			D	D, R, T, A, M, P		D, R, T, S, P	T, M, S, P	D, R, T, A, M, S, Po	Po, P, S, M, A, T, R		R, T, Po	D, R, T, Rg, A, S, P		D, R, T, A, M, S, Po	P	R, T, O, E, P, Po	D, R, T, A, M, P	D, R, T, O, M, P, Po	D, R, T, A, M, P, Po	Po, P, M, D, T	D,R,T,O E, A, M, S, P, Po	R,T,F,O A, M, S, P, Po	R,T,F,O E,A,M P, Po	T, F, D	
		USDA Natural Resources Conservation Service	R, T			R, T, F, E, A, S, P										R, T, F, E, S, P	R, T, F, E, A, S, P	R, T, F, E, A, S, P	R, T, F, E, A, S, P		R, T, O, E, S, P	R, T, O, E, A, S, P, Po		R, T, E, A, P	R, T, E, P	R	R, T, E, F				D, R, T, E, A, P			All except F, Rg	D, R, T, E, A, M, P	D, R, T, F, E, A, M, P	D, T, E, P	
		Dept. of the Interior, Bureau of Land Management	D, R, P, Po																D, R, Po	Po, R	D, T, P	D, T, P		P, Po, T, R, D			R, P, Po				R, P, Po								
		Dept. of the Interior, US Geological Survey								D, T, A, M					D, T, A, M, S			D, A	D, A		D, T, A, S	D, T, A, S	D, T, A, M, S								D, T, A, S							
		US EPA Region 9	D, R, T, O, A,M, P, Po	All		T, E, P, Po	All except E	D, R, A, M, O, P	D, R, A, M, O, P	D, R, A, M, O, P		All	All	All	D, R, A, M, O, P		O, Rg, Po		R, F, T, M, S, P, Po		D, R, T, A, S, Po, P	D, R, T, A, S, Po, P									D, T, Po, R							
LOCAL		COUNTY GOVERNMENT [2]	All except F	All except F	All except F		D,R,T, E,Rg	D,R,T, E,Rg,A,M, Po		T, Rg, E, Po	E, T, F	R, T, O, E, Rg, Po	R, T, O, E, Rg	O, T, E, Rg							D, R			D,R,Rg, E, T, M, S, P, Po	D, R, Rg	D, Rg													R, T, E, P, Po, M
		CITY GOVERNMENT[3]																			D, R, S							R, S, P	R, S, P	R, S, P								

M = Monitoring
Po = Policy
A = Analysis
P = Planning
O = Oversight
E = Education/information
Rg = Regulatory (permit, inspection, enforcement)

D = Data Collection
R = Review/Comment
T = Technical Assistance
F = Financial Assistance
S = Standards development

Notes:

1. Regional Boards responding to survey: San Diego, Los Angeles, Lahontan, Central Valley, North Coast, Colorado River Basin, Central Coast.
2. Counties responding: Placer, Riverside, Sonoma, Contra Costa
3. Cities responding: Benicia

c:\swap\swapduty9\sheet1

PART THREE

Source Water Assessments

A description of the procedures DHS will use in conducting source water assessments for ~16,000 active drinking water sources in California

Section 6—Delineation of source areas and protection zones

Section 7—Inventory of activities within source areas and protection zones

Section 8—Vulnerability of drinking water sources to contamination

Section 9—Implementation of the Drinking Water Source Assessment Program

Section 10—New drinking water sources

page intentionally blank

6.0 Delineation of Source Areas and Protection Zones

The delineation step in the assessment defines the boundaries of the areas to be evaluated. Appendices A and B should be used for source location and delineation of surface water sources, and Appendices H and I, for ground water sources.

6.1 Delineation for Surface Water Sources

The source area for surface water sources in the DWSAP Program is the area within the boundaries of the watershed that is tributary to the surface water intake. This is consistent with California Code of Regulations, Title 22, Chapter 17, Section 64665, which requires each public water system with a surface water source to conduct a watershed sanitary survey. In December 1993, a Watershed Sanitary Survey Guidance Manual was prepared by the American Waterworks Association (AWWA), California/Nevada Section, Source Water Quality Committee, in conjunction with the DHS Division of Drinking Water and Environmental Management. The guidance specifies that the area to be surveyed should include the entire watershed boundary.

As an option, in addition to the source area, a public water system may desire to establish zones closer to the surface water intake. The purpose of these zones is to define portions of the watershed where activities have a higher risk of contaminating the water supply. Within the zones, there could be a more thorough evaluation of activities that occur. The zones would aid in establishing both the appropriate levels of surveillance, and management (or voluntary protection) approaches.

Zones can potentially reduce the effort involved in conducting source water assessments. California surface water treatment regulations require water purveyors to survey the entire watershed. If zones are established, DHS may allow a less detailed review on portions of the watershed outside the zones. In addition, in the vulnerability analysis (Section 8.0), surface water sources that have zones defined will be able to assign less risk to possible contaminating activities (PCAs) located on the watershed, but outside of the zones. If zones have not been defined, PCAs are considered to be of equal risk, regardless of their location on the watershed.

To establish zones for surface water sources of drinking water, a variety of methods may be used. These include:

1. **Fixed Distance:** In this method, an example of which is shown in Figure 6-1, setbacks from reservoir boundaries, tributaries and/or the intake may be established by using fixed distances. This method, while not technically sophisticated, is relatively simple to implement.

2. **Time-of-Travel:** In this method, the protection zone is actually a stream reach rather than an area. This method is typically used for determining response times for spill events. The time-of-

travel between an upstream monitoring point and the point of interest is calculated. Potential contaminants with a certain time-of-travel would be of primary concern.

3. **Modeling:** Surface runoff and ground water discharge models can be used to assess the impact of individual contaminants from possible contaminating activities (PCAs), and to identify areas within the watershed with the greatest potential impact on drinking water source quality.

Regardless of the method used, factors that may be considered in determining zones include topography (slopes), soils, geology, vegetation, precipitation, hydrology and land uses.

Establishment of zones, if done by public water systems or communities, should be done in consultation with DHS.

Interested water suppliers, communities or groups that require additional information may wish to refer to the EPA document, *State Methods for Delineating Source Water Protection Areas for Surface Water Supplied Sources of Drinking Water* (US EPA, 1997).

If zones within the watershed are established for a surface water source, DHS suggests distances of 400 feet from reservoir or primary stream boundaries, 200 feet from tributaries, and 2,500 feet from intakes. The zones may be limited to that portion of the watershed within a travel-time distance from the intake that allows adequate time to respond to spill events.

Ground water under the influence of surface water

For drinking water sources that have been classified as ground water under the direct influence of surface water (GWUDI), the source area should include the land area within the watershed boundaries. This is consistent with DHS regulations, because GWUDI wells are considered surface water sources and are subject to surface water treatment regulations. Zones for these sources may be established by ground water methods and/or surface water methods.

For drinking water sources that are indirectly under the influence of surface water (e.g. where the source of water is underflow of a surface water body, and the source has not been classified as GWUDI) it is appropriate to include the land area within the watershed boundaries in the source area. The recharge area, if different than the watershed area, may also be included in the source area. Zones are to be established using ground water methods as appropriate. The areas to be assessed should be determined in consultation with DHS.

6.2 Delineation for Ground Water Sources

The source area for a ground water source includes the recharge area; where the recharge area is separate from the well, the source area also includes the area within the protection zones established for the well. In addition, the source area may include a buffer zone, if one is established. These areas and zones are described in this section.

6.2.1 Types of Aquifers

The DWSAP Program assumes two primary types of aquifers for ground water sources: porous media and fractured rock. Although there are additional types of aquifers in California, this program uses a simplified approach by categorizing sources into one of these two types. A water system conducting its own assessment may use a different approach after consultation with DHS.

For **porous media aquifers**, open spaces within the aquifer are assumed to exist between individual particles that comprise the aquifer. In a typical porous material, such as sediment (e.g., sand and gravel), the openings are primary–that is, they represent the spaces between grains that were formed when the sediment was originally deposited. Consequently, they are numerous and regularly spaced, with a density and orientation of open spaces that tends to be isotropic (uniform in all directions) within the aquifer. Using water well data, ground water flow conditions of such aquifers are readily measured and quantified.

Fractured rock aquifers may also have primary porosity and permeability, such as cavities which form in new lava flows. Most “bedrock” aquifers, however, have open space along faults and fractures which formed long after the rock was formed ("secondary permeability and porosity”). Because fractures develop in response to geologic stresses, they are often grouped in specific directions, creating permeability and ground water flow paths which are anisotropic (not uniform in all directions). Such aquifers can have highly localized and complex ground water flow properties which may be difficult to characterize quantitatively.

6.2.2 Recharge Areas

The source area for a ground water source includes the recharge area. Recharge areas, which may be natural or artificial, are land areas that contribute water to an aquifer. Recharge occurs naturally from lakes, wetlands, direct precipitation, stream inflow, and subsurface inflow from upgradient sources of groundwater. Figure 6-2 is an illustration of a recharge area.

Artificial recharge can occur as a result of injection wells and man-made facilities such as spreading grounds, unlined canals, and activities such as irrigation practices. Wells and bore holes can act as conduits to aquifers.

Recharge Areas for Porous Media Aquifers

The **primary** recharge area consists of the area with permeable alluvial materials directly overlying an unconfined or semi-confined aquifer, where there is direct percolation of water into the unconfined or semi-confined aquifer. The primary recharge area for a confined aquifer also consists of the permeable materials, but the recharge area may be several or many miles away from the area of the confined aquifer from which extraction takes place.

Secondary or upland (i.e., watershed) recharge areas include the land at higher elevations usually consisting of a rock type that is much less permeable than the alluvial materials. Water recharges aquifers from these areas by overland flow of surface water and infiltration from stream flow into fractures in the rock. The groundwater in these fractures may then recharge groundwater in the alluvial aquifers.

Recharge Areas for Fractured Rock Aquifers

Recharge areas for fractured rock aquifers are similar to those for porous media, but because flow patterns are typically more complex, recharge area boundaries are more difficult to determine. Fractured rock aquifers can also exist in either confined or unconfined settings. In unconfined or poorly confined conditions, these aquifers can have very high flow (and contaminant transport) rates under rapid recharge conditions such as storm events. Transport times across fractured rock flow systems may be as short as hours to weeks, much more brief than in porous media aquifers.

Most types of fractured rock aquifers have proportionally less water storage capacity than porous media aquifers. Bedrock aquifers may still provide significant water supply where the aquifers are part of regional bedrock ground water systems, or whether the aquifers are associated with mountainous areas of high precipitation and recharge. Fractured rock aquifers are characterized by rapid and large rises in the water table during recharge/maximum flow events, and can be influenced by recharge from a large portion of the drainage basin. For this reason, in the DWSAP program the initial estimates of the boundaries of a recharge area for a well in a fractured rock aquifer are the general physical boundaries of the drainage basin.

The recharge area for each ground water source should be identified to the extent possible from a review of the topography, hydrogeology, and other information for the area. If possible, the approximate location of the recharge area should be shown on the drinking

water source assessment map. An assessment of the entire recharge area is not necessary for this program, but may be useful to a water purveyor.

Though the recharge area for a ground water well may be some distance away from the well, defining protection zones immediately around the ground water source provides a starting point for PCA inventories and protection efforts.

Even ground water sources that are in confined aquifers where the recharge area is located at a distance are susceptible to nearby activities that may cause contamination (e.g., improperly constructed wells, or abandoned, improperly destroyed wells).

6.2.3 Delineation Methods for Ground Water Zones

According to the 1986 Safe Drinking Water Act Amendments, the areas to be assessed and protected for ground water sources (wellhead protection areas) are defined as "the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field".

For purposes of the DWSAP, the areas to be assessed for ground water sources are a set of protection zones at the land surface adjacent to and surrounding the well. Zones identify and differentiate areas of varying significance in terms of threat to the water source from contamination.

In confined aquifers, the zones are adjacent to and surrounding the well, but the recharge area may be located at a distance from the area immediately associated with the well, as discussed above. Unconfined aquifers may also have primary recharge areas at some extended distance from the well. Table 6-1 presents information about the confinement of aquifers.

There are a number of methods for defining zones for ground water sources. The methods recommended for use in California are listed below with a brief description. The primary criterion to be used is time-of-travel (the time for ground water to travel from a point in an aquifer to a pumping well). Particular contaminants may travel faster or slower than ground water, though it is generally rare that contaminants move faster than water within an aquifer. In some cases, contaminants (e.g., free phase solvents) are not necessarily subject to the same limitations as water. The time-of-travel criterion is more accurate for estimating zones than an arbitrary distance approach. However, due to limited resources to conduct assessments, zones for non-community water systems may be initially delineated by the arbitrary fixed distance method.

Delineation methods range from simple to complex, requiring varying amounts of hydrogeologic data and technical expertise. Simpler methods may be done initially to approximate the zones and to determine where more detailed hydrogeologic data is

needed. If necessary, the delineations can be refined at a later date using a more complex method if the drinking water source is determined to be vulnerable to PCAs.

There are six primary delineation methods selected for use in California, in order of increasing technical sophistication.

1. Arbitrary fixed radius
2. Calculated fixed radius
3. Modified calculated fixed radius
4. Analytical methods
5. Hydrogeologic mapping
6. Numerical flow/transport models

These methods range from simple and inexpensive to highly complex and costly. It is important to note that more than one method can be used to determine protection areas and zones for a ground water source. When resources, site-specific information and technical expertise are available, the more sophisticated analytical, mapping or modeling methods can be used to provide a higher degree of accuracy. Listed below is a description of each method.

Arbitrary Fixed Radius

This method involves drawing a circle of a specified radius around a well being protected. The radius is a reasonably conservative minimum distance determined by DHS based upon general hydrogeological considerations and professional judgement. In the DWSAP program this method may only be used for non-community water systems.

Calculated Fixed Radius

The pumping of wells within an aquifer results in artificially induced changes (such as drawdown and cones of depression) to the natural ground water system. (See Figure 6-3). This delineation method attempts to define zones that encompass the land surface area impacted by the changes due to a pumping well.

The calculated fixed radius (CFR) method involves drawing a circle around a well to estimate the zone of contribution (ZOC) for a specified time-of-travel criterion. A radius is calculated using Equation 6-1 shown below that is based on the theoretical volume of water that will be drawn to a well in the specified time. The input data required by the equation includes the pumping capacity of the well, the screened interval of the well and the effective porosity of the aquifer. The time period to be used is described in Section 6.2.5.

The protection zone determined by the calculated fixed radius (CFR) (Equation 6-1) is a circle that extends the same distance in all directions from the well. In an area with a flat water table, this is a reasonable approximation of the zone of contribution. This method

provides a more accurate estimate of the appropriate size of zones than the arbitrary fixed radius method, but may still be inaccurate because it does not take into account the actual rate and direction of ground water flow, recharge and other factors that may influence contaminant transport.

The equation for the calculated fixed radius is

$$R_t = \sqrt{Q\,t / \pi\,\eta\,H} \qquad \textbf{Equation 6-1}$$

where

R_t = radius of zone (feet) for time period t
Q = pumping capacity of well (ft^3/year), where ft^3/year = gpm x 70,267
t = travel time (years) (2, 5, or 10 years, as described in Section 6.2.5)
π = 3.1416
η = effective porosity (decimal percent)
H = screened interval of well (feet)

The pumping capacity to be used is the maximum rate the well can be pumped, in gallons per minute converted to the equivalent in cubic feet per year. Pumping capacity of the well should be known by the water purveyor. If the capacity is unknown, the purveyor may conduct a pump test to determine the appropriate value. If that is not possible, an estimate can be made if justification is provided. If there are no references to use to estimate the pumping rate, DHS should be consulted for assistance in determining the appropriate value to use in the delineation.

For wells that are used intermittently, using the maximum pumping rate of the well may result in extremely large zones which do not correspond to the actual production of the well, particularly at the 5 and 10-year travel times. In this case, with the concurrence of DHS, a water supplier may use the total annual production of the well (in ft3/year) in the highest of the previous three to five years. Water suppliers are encouraged to consider future production levels if significant growth is expected to occur in the service area.

The length of screened interval to be used in the equation should be based on well construction information. If the actual value is unknown, an initial conservative estimate can be made equal to 10% of the pumping capacity of the well in gallons per minute (gpm), with a minimum of 10 feet. For example, the estimated screened interval for a well that pumps at 400 gpm is 40 feet.

Effective porosity should be estimated using available information for the aquifer. However, if a value is not known, a value of 0.2 can be used for an initial calculation. The estimated value of 0.2 for effective porosity is reasonably conservative for most aquifers in California based on available information.

Figure 6-4 is an illustration of the CFR method. Figure 6-5 is a conceptual illustration of the three zones using the CFR method.

Modified Calculated Fixed Radius Method

In an area with a sloping water table (the most common situation), the circle described by Equation 6-1 tends to overestimate the zone of contribution (ZOC) in the down-gradient direction and to underestimate the ZOC in the up-gradient direction. To address this situation, the DWSAP provides a modified calculated fixed radius approach for sites where the direction of ground water flow is known. This approach is appropriate for ground water sources located in porous media aquifers.

In the modified approach, the radius is calculated using Equation 6-1 and the associated input data. The upgradient extent of the zone is determined as **1.5 R** (e.g., one and one-half times the calculated radius). The down-gradient extent of the zone is **0.5 R** (e.g., one-half the calculated radius). The resulting shape is a circle with a radius of **R**, shifted upgradient by a distance of **0.5 R**. Figure 6-6 is a conceptual illustration of the three zones using the modified CFR method. The sizes of the zones in the modified CFR are the same as those determined by the CFR method (Figure 6-5).

If a water purveyor wishes to use the modified CFR method, the calculations used to determine the direction of ground water flow should be submitted with the assessment report (see below).

Estimation of direction of ground water flow. In order to accurately estimate the direction of ground water flow, the estimate must use at least three (3) wells in the vicinity of the drinking water well. The topographic elevation at each well, the distances between the wells, and the total head at each well must be known. Ground water "contours" or equipotential lines are determined from the information for the three wells, and the ground water flow direction is perpendicular to the contour lines. For more information in determining the direction of ground water flow, refer to the EPA document *Ground Water and Wellhead Protection*, pages 30 to 31 (US EPA, 1994).

The "total head" is the water level in a well, usually expressed as feet above sea level, which consists of the elevation head and the pressure head. In an unconfined aquifer, the pressure head equals zero at the water table surface.

Analytical Methods

These methods involve the use of equations to define ground water flow and contaminant transport. The uniform flow equations (Todd, 1980) shown in Figure 6-7 are often used to define the area of contribution to a pumping well in a sloping water table. These are the most widely used methods for accurately delineating ground water protection zones.

These methods require the input of various hydrogeologic parameters to calculate the distance to the downgradient divide, or stagnation point, and the width of the zone of contribution to the well. The upgradient extent of the protection area can then be calculated based on either a time-of-travel or flow boundaries criterion. Site specific hydrogeologic parameters are required as input data for each well at which the method is applied. These parameters can include the transmissivity, porosity, hydraulic gradient, hydraulic conductivity, and saturated thickness of the aquifer.

Figure 6-8 illustrates an example of a protection zone determined by using the analytical methods.

Detailed Hydrogeologic Mapping

In many hydrogeologic settings, flow boundary and time-of-travel criteria can be mapped by geological, geophysical, and ground water tracing methods. The flow boundaries are defined by lithologic variation or permeability contrasts within the aquifer. Geological observations may provide surface indications of lithology changes, which will correlate with ground water source area boundaries. Detailed hydrogeologic mapping may also include mapping of ground water levels in order to identify ground water drainage divides.

This method for delineating ground water protection zones within a source area may be particularly useful for shallow aquifers, and for fractured rock aquifers.

Figure 6-9 is a conceptual example of using hydrogeologic mapping to delineate ground water protection zones in fractured bedrock.

Numeric Flow/Transport Models

Ground water source areas and protection zones can be delineated using computer models that approximate ground water flow and/or solute transport equations numerically. A wide variety of numerical models are presently available both commercially and through various organizations.

Numeric flow/transport models are particularly useful for delineating protection areas where boundary and hydrogeologic conditions are complex. Input data may include such hydrogeologic parameters as permeability, porosity, specific yield, saturated thickness, recharge rates, aquifer geometry, and the locations of hydrologic boundaries. Solute transport parameters such as dispersivity may also be incorporated in these models.

To be accurate, these models require site-specific field verification and adjustment.

6.2.4 Selecting A Ground Water Delineation Method

Protection zones within a source area should be delineated using the times-of-travel specified in Section 6.2.5. The preferred delineation method is one that utilizes the most detailed information available, although a simpler approach may be appropriate for an initial delineation, with a more detailed evaluation later (e.g., in a voluntary protection program). A simpler approach may result in larger delineated protection zones than might be obtained from a more elaborate approach, given the conservative (i.e., health protective) nature of the simple models.

DHS staff will use simple approaches, due to the number of drinking water sources that need to be assessed. However, DHS believes that the more complex approaches are beneficial where appropriate data are available. Such approaches give the most site-specific information, and may preclude the initiation of protection activities beyond those that are needed for protection of a specific ground water source.

Table 6-2 provides guidance on the types of delineation methods that should be used.

Porous Media Aquifers

As a general approach, DHS will use the calculated fixed radius method for delineations for assessment purposes. For non-community water systems, DHS may choose to use the arbitrary fixed radius method. Where DHS has sufficiently detailed information on the direction of ground water flow, the modified calculated fixed radius method will be used.

Fractured Rock Aquifers

In fractured rock aquifers, the complexity of the flow system does not lend itself to a simple delineation method that accurately reflects the appropriate size, shape and direction of zones. Given the resources and time available to conduct the assessments, DHS recommends the minimum delineation method in fractured rock to be the calculated fixed radius method, increasing the calculated radius of each zone by 50%. The default effective porosity of 0.2 would be used in the equation. Increasing the size of the zones in fractured rock reflects the increased vulnerability of these sources compared to those in porous media aquifers.

Wells in Multiple Aquifers

When a well is located in multiple aquifers, the protection zones should be delineated using the methods and values that are more conservative (i.e., health protective). If the well is located in multiple porous media aquifers with varying effective porosity or other parameters, the delineation should use the values that produce the larger delineated area. If the well is located in porous media and fractured rock aquifers the delineation should use the fractured rock method.

Ground water under the influence of surface water

For wells that are ground water under the direct influence of surface water (GWUDI), the source area should include the land area within the watershed boundaries. This is consistent with DHS regulations, because GWUDI wells are considered surface water sources and are subject to surface water treatment regulations. Zones for these sources may be established by ground water methods and/or surface water methods.

For wells that are indirectly under the influence of surface water (e.g., where the source of water is underflow of a surface water body, and the source has not been classified as GWUDI) it is appropriate to include the land area within the watershed boundaries in the source area. The recharge area, if different than the watershed area, may also be included in the source area. A source that is indirectly under the influence of surface water may be indicated if the ground water zones encompass a surface water body. Zones are to be established using ground water methods as appropriate. The areas to be assessed should be determined in consultation with DHS.

6.2.5 Approach for Defining Ground Water Zones

All ground water sources should have zones defined. The suggested approach is to define four zones, and an optional fifth zone. See Figure 6-10 for a conceptual illustration of these zones.

If the delineated area for a ground water source encompasses a surface water body (lake, river, stream, creek, wetland, etc.), the source may be under the influence of surface water and the delineation should be reviewed in consultation with DHS (see Section 6.2.4).

Suggested protection activities for each of the zones are discussed in Part Four, Voluntary Drinking Water Source Protection Programs.

Well Site Control Zone

The well site control zone encompasses the area immediately surrounding the well, what most people think of as the "wellhead." The purpose of this zone is to provide protection from vandalism, tampering, or other threats at the well site.

This zone is determined by using a simple radius, (or equivalent area if a different shape, i.e., a square, is desired). DHS recommends a minimum radius of 50 feet for well site control zones for all public water systems in the state.

Zone A - Microbial/Direct Chemical Contamination Zone

The purpose of this zone is to protect the drinking water supply from viral, microbial and direct chemical contamination. The zone is defined by the surface area overlying the portion of the aquifer that contributes water to the well within a **two-year time-of-travel**.

The two-year time-of-travel criterion is used because this is the current recommendation of the proposed Ground Water Rule (GWR). Existing research indicates that bacteria and viruses survive less than two years in soil and ground water. Use of this criterion provides consistency with the proposed GWR.

This area provides only a limited time for responding to serious microbiological contamination or chemical spills.

As an illustration of what the size of Zone A might be, see the chart in Figure 6-11, for the calculated fixed radius method using the two-year time-of-travel, with porosity assumed as 0.2 and varying screened intervals. The DHS-recommended minimum radius is 600 feet for all ground water sources of drinking water in porous media aquifers, and 900 feet in fractured rock aquifers. These distances are believed to be sufficiently conservative (i.e., health protective) for protection from microbiological contaminants.

Zones B5 and B10 - Chemical Contamination Zones

The purpose of Zones B5 and B10 is to prevent chemical contamination of the water supply, and to protect the drinking water source for the long term. These zones are used to focus attention on possible chemical contamination that may exist near the well but at a greater distance than Zone A.

Zone B5 encompasses the area between the two- and **five-year time-of-travel**. This zone provides for more response time for chemical spills than Zone A.

Zone B10 encompasses the area between the five- and **ten-year time-of-travel**. The primary purpose of this zone (along with the recharge area) is to encourage decision-makers and planners to recognize long-term aspects of the drinking water source. The ten-year time-of-travel allows for some attenuation or remediation of contaminant sites, or if necessary, time to develop alternate sources of water supply.

Figures 6-12 and 6-13 are illustrations of the sizes of Zones B5 and B10, respectively, determined by the calculated fixed radius method, using five- and ten-year travel times, with porosity assumed as 0.2 and varying screened intervals.

The DHS-recommended minimum radius is 1,000 feet for Zone B5, and 1,500 feet for Zone B10 for porous media aquifers, and 1,500 and 2,250 feet, respectively, for fractured rock aquifers.

A more sophisticated delineation method (e.g., as done voluntarily by a public water system) may determine zones that encompass a smaller area than a circle with the DHS minimum radius.

This may be technically appropriate for the source and documentation should be provided to DHS.

Buffer Zone—Additional Zone, If Needed

The purpose of this zone is to provide added protection for drinking water sources. It can be used to delineate a larger setback away from activities that may be significant potential sources of contamination (e.g., landfills or hazardous material disposal sites), and to provide additional information that may be helpful for longer term planning. The buffer zone is generally upgradient from the protection zones and may include the entire zone of contribution for the well, indirect recharge areas, or locations where the aquifer may be exposed at the surface.

Drinking water systems that choose to establish a Buffer Zone may do so based on activities that occur outside of the protection zones, and the vulnerability of the drinking water source to possible contamination.

Detailed analytical methods may be necessary to determine the appropriate area for the Buffer Zone. Determination of Buffer Zones may be done in consultation with DHS. An assessment of the buffer zone may be useful to the water purveyor.

6.2.6 Modification of the Shape and Size of Zones

Local knowledge and professional judgement may be used to modify the shape and size of the zones to allow for site-specific characteristics, taking into account the DHS minimum distances. For example, where several wells have overlapping protection areas, it may be appropriate to combine the zones of the individual wells into a larger combined zone. The larger combined zone could then be evaluated as a single entity for purposes of subsequent steps in the assessment. Similarly, if narrow areas of land exist between delineated zones of neighboring wells, it may be appropriate to merge the zones of the two wells, incorporating the area in between, and evaluate the merged area as a single zone.

For wells located within the same wellfield, it may be appropriate to consider the wellfield as one larger well with the combined production capacity of all the wells. Zones could be established around the entire wellfield.

6.3 Assessment Map

After the delineation of the source area and protection zones has been completed, the locations should be shown on the assessment map. The map should be based on a USGS quadrangle 7.5 minute series topographic map, and should also show the location of the drinking water source.

6.4 Boundary Drinking Water Sources

Several drinking water sources originate beyond California's boundaries (e.g., Colorado River, Klamath River). DHS will work with Region 9 of the US EPA and other states, as appropriate, to obtain information pertinent to source water assessments for drinking water systems that utilize these water bodies. For ground water sources with source areas or protection zones that may cross California's boundaries, DHS will also work with US EPA Region 9 and other states to obtain pertinent information and coordinate assessments to the extent practical.

Where drinking water sources outside of California (e.g., Truckee River) may require information for their source water assessments, DHS will also work with US EPA Region 9 and other states, as appropriate, to provide information.

6.5 Tribal Drinking Water Sources

For drinking water sources on tribal lands, DHS will work with US EPA Region 9 and tribes to provide pertinent information that is needed to complete drinking water source assessments for tribal lands. Where tribal lands occupy protection areas or zones of non-tribal sources of drinking water, DHS will work with US EPA Region 9 and tribes to obtain information that is needed for those specific assessments.

6.6 Transmission Facilities from Drinking Water Intake to Treatment Plant

When a drinking water intake is located at a different site than the treatment plant (if there is one), the untreated water may be conveyed through an aqueduct, canal, pipeline or other transmission facility. There is the possibility that an activity may exist within the vicinity of the transmission facility that could contaminate the water supply. In California, the threat of contamination to the water supply through this means is reviewed in two ways:

1. Water systems using surface water sources that utilize open channel transmission facilities are required to include the drainage area that contributes to the channels in the watershed sanitary survey for the source. As part of the DWSAP program, the transmission facilities will be assessed using the information from the watershed sanitary surveys.

2. Closed transmission facilities (pipelines) are reviewed and evaluated by DHS (or LPAs) during water system inspections (sanitary surveys).

Table 6-1. Indicators of presence and degree of confinement of aquifers.

Information Source	Highly Confined	Semiconfined (Leaky)
Geologic		
Geologic maps and cross-sections	Presence of continuous, unfractured, confining strata (clays, glacial till, shale, siltstone).	Evidence of vertical permeability in confining strata (fracture traces, faults, mineralization or oxidation of fractures observed in cores).
Environmental geologic and hydrogeologic maps	See above.	Presence of artificial penetrations (abandoned or producing oil and gas wells, water wells, exploration boreholes).
Hydrologic		
Water level elevation (single well) of potentiometric surface	Above the top of the aquifer (not diagnostic for differentiation of highly and semi-confined aquifers).	Same
Hydraulic head differences between aquifers	Large head difference in water levels measured in wells cased in different aquifers (not diagnostic for differentiation of highly and semiconfined aquifers).	Same
Water level fluctuations (continuous measurement)	Short-lived and diurnal fluctuations in response to changes in barometric pressure, tidal effects, external loading, no response to recharge events.	Similar to highly confined aquifer, but may also exhibit relatively large and rapid response to recharge events because of leakage through discrete points.
Hydrologic measurements in confining strata	No changes in water levels in response to pumping; diurnal but not seasonal water level fluctuations (see above).	Changes in water levels in response to pumping; seasonal water-level fluctuations in response to seasonal variations in precipitation.
Pump test for storativity	Storativity less than 0.001.	Between 0.01 and 0.001 (not diagnostic).
Pump test for leakage	Pump drawdown vs time curve matches analytical solution(s) for highly confined aquifer. Estimated or calculated leakage less than 10^{-3} gal/day/ft2.	Pump drawdown vs time curve requires use of analytical solution for leaky aquifer. Estimated or calculated leakage 10^{-2} to 10^{2} gal/day/ft2 .
Numerical modeling	Simulation of potentiometric surface possible without estimates of leakage, or required estimates are low (see above).	Simulation of potentiometric surface requires use of large leakage values.
Hydrochemistry		
General water chemistry	Chemical characteristics indicative of long distance from recharge area(region-specific).	Qualifies as confined using other criteria, but chemical characteristics more similar to ground water in recharge zones.
Anthropogenic atmospheric tracers	No detectable tritium or fluorocarbons in ground water.	Detectable concentrations of tritium or fluorocarbons (less than 40 years old).
Isotope chemistry	Carbon-14 dating of water samples indicates age > 500 years.	See above.
Contaminants	No detectable concentrations of potential contaminants identified by inventory of possible contaminating activities.	Qualifies as confined using other criteria, and contaminants detected in aquifer.
Changes in water chemistry over time	Head declines from long-term pumping have not resulted in changes in water chemistry indicators of vertical leakage.	Head declines from long term pumping have resulted in changes in water chemistry indicators of vertical leakage (see above).
Time of travel through confining strata	Time of travel calculations based on measured or estimated values of difference in hydraulic head, porosity and hydraulic conductivity exceed 40 years.	Time of travel through confining strata < 40 years based on calculations or presence of tritium or fluorocarbons.

Source: Handbook Ground Water and Wellhead Protection, EPA, September 1994, Document EPA/625/R-94/001

Table 6-2. Delineation methods, types of system that may use particular methods, minimum data that are required, and the minimum radii of zones.

Delineation method	Type of system that may use method	Minimum data required	Minimum radius of zone
Arbitrary fixed radius	Non-community	Location of source	See below for Porous Media and Fractured Rock
Calculated fixed radius (CFR) (porous media)	All*	Location of source, Pumping capacity of well (gpm), Screened interval of well (indicate method used to estimate), Effective porosity (indicate method used to estimate)	A = 600 feet B5 = 1,000 feet B10 = 1,500 feet
CFR (fractured rock) Note that fractured rock uses CFR and increases size by 50 percent.	All*	Location, Pumping capacity, Screened interval, Effective porosity	A = 900 feet B5 = 1,500 feet B10 = 2,250 feet
Modified CFR	All*	Location, Pumping capacity, Screened interval, Effective porosity, Direction of ground water flow	A = 600 feet B5 = 1,000 feet B10 = 1,500 feet
Analytical methods	All	Location, Capacity, Screened interval, Effective porosity, Hydraulic conductivity, Hydraulic gradient, Direction of ground water flow	No minimums**
Hydrogeologic mapping	All	Hydrogeologic parameters, Lithology, Groundwater level	No minimums**
Numeric flow/transport models	All	Hydrogeologic parameters, Recharge rates, Aquifer geometry, Hydrologic boundaries	No minimums**

* Systems with detailed hydrogeologic data are encouraged to conduct more sophisticated analyses.

** Systems using more sophisticated methods are encouraged to compare the sizes of zones to minimum sizes derived by simpler methods to assist in the review of the delineation.

ZONE A = 400' from reservoir or primary stream boundaries
200' from tributaries

ZONE B = 2500' from intake

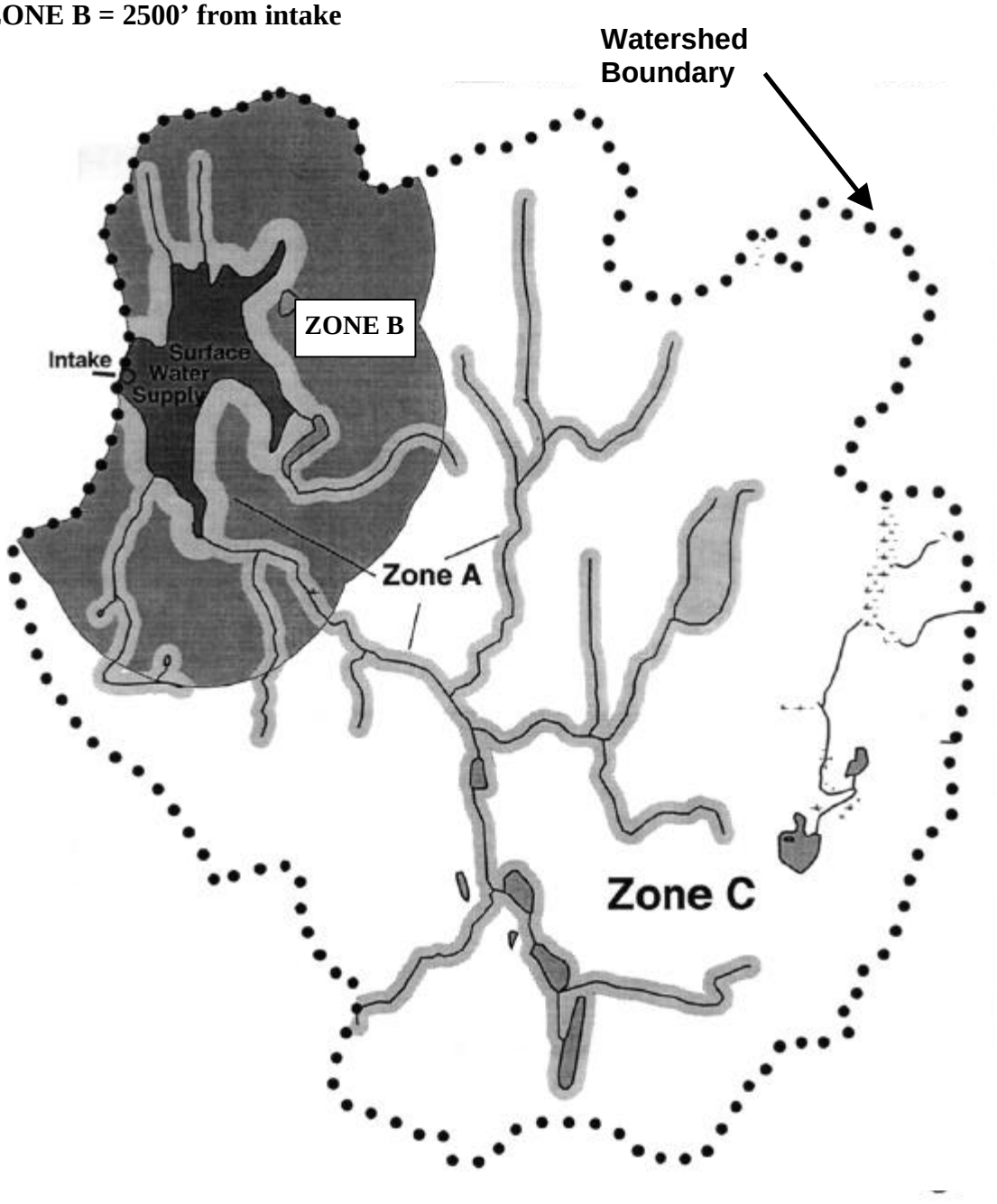


Figure 6-1. Surface water supply protection areas showing suggested zones (Adapted from Massachusetts DEP "Developing a Local Surface Water Supply Protection Plan," 1996)

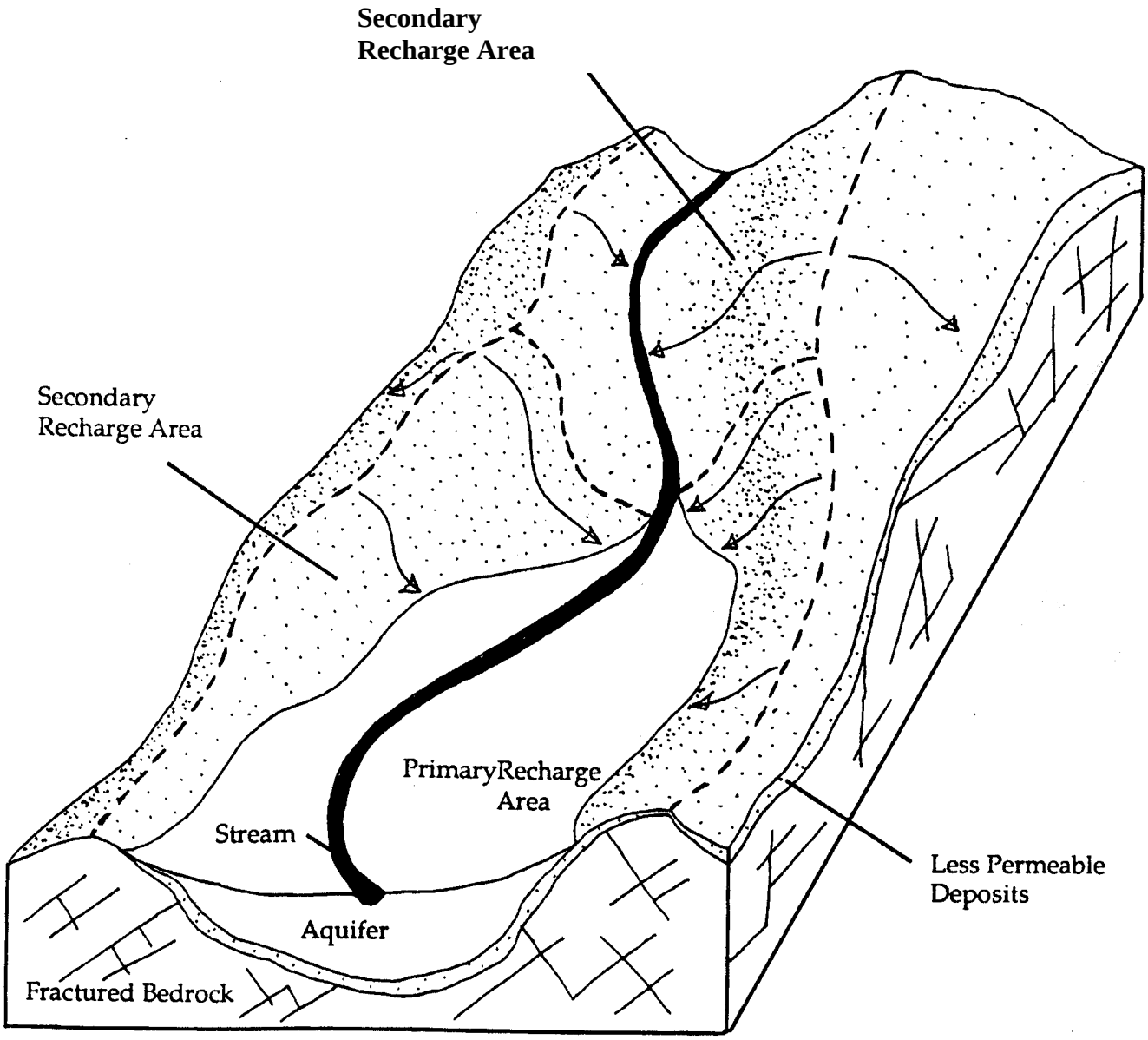


Figure 6-2. Illustration of recharge areas (Adapted from Witten and Horsley, 1995)

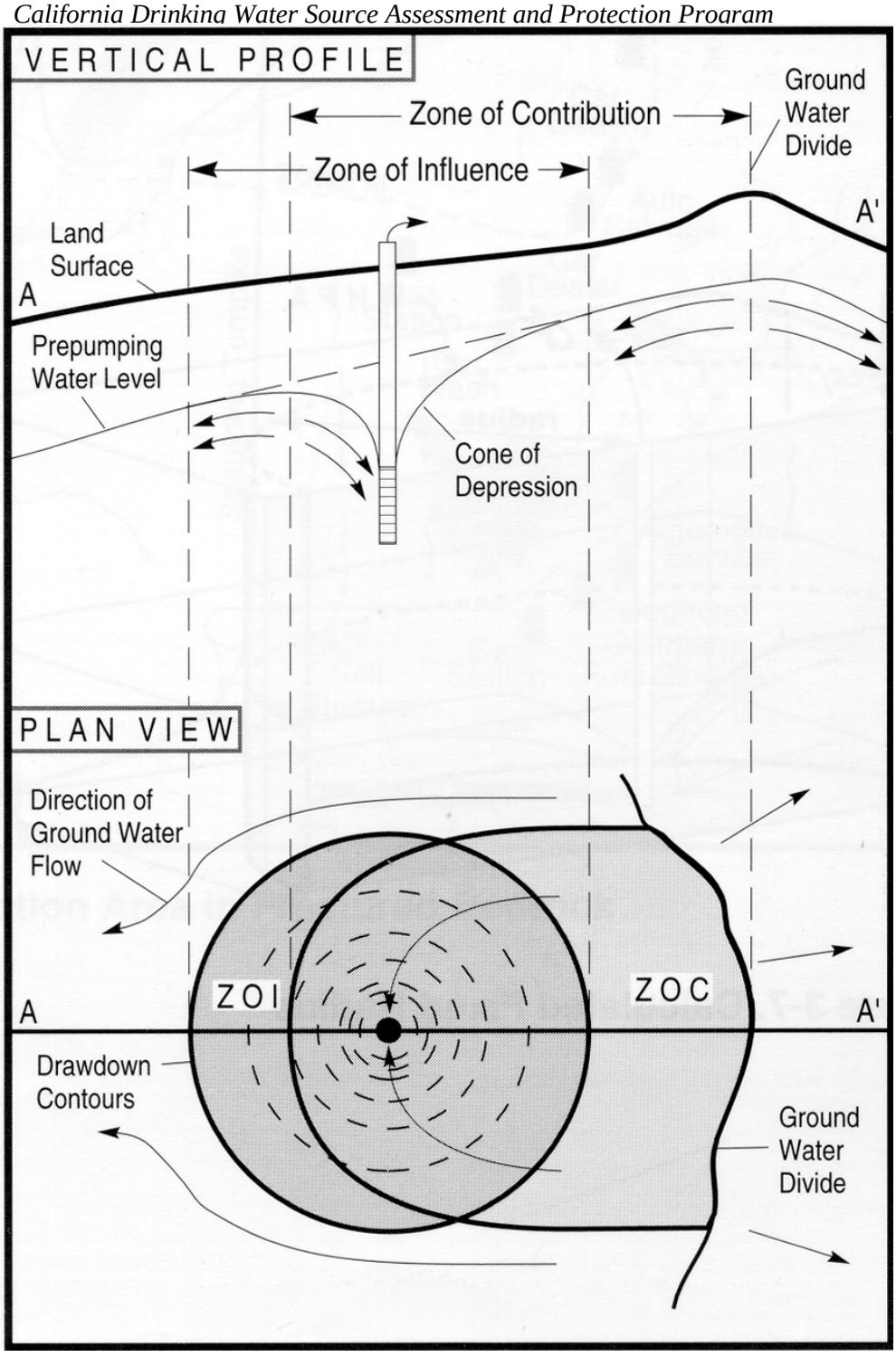


Fig. 6-3. Changes to the ground water system due to a pumping well (From Witten, Horsley, 1995)

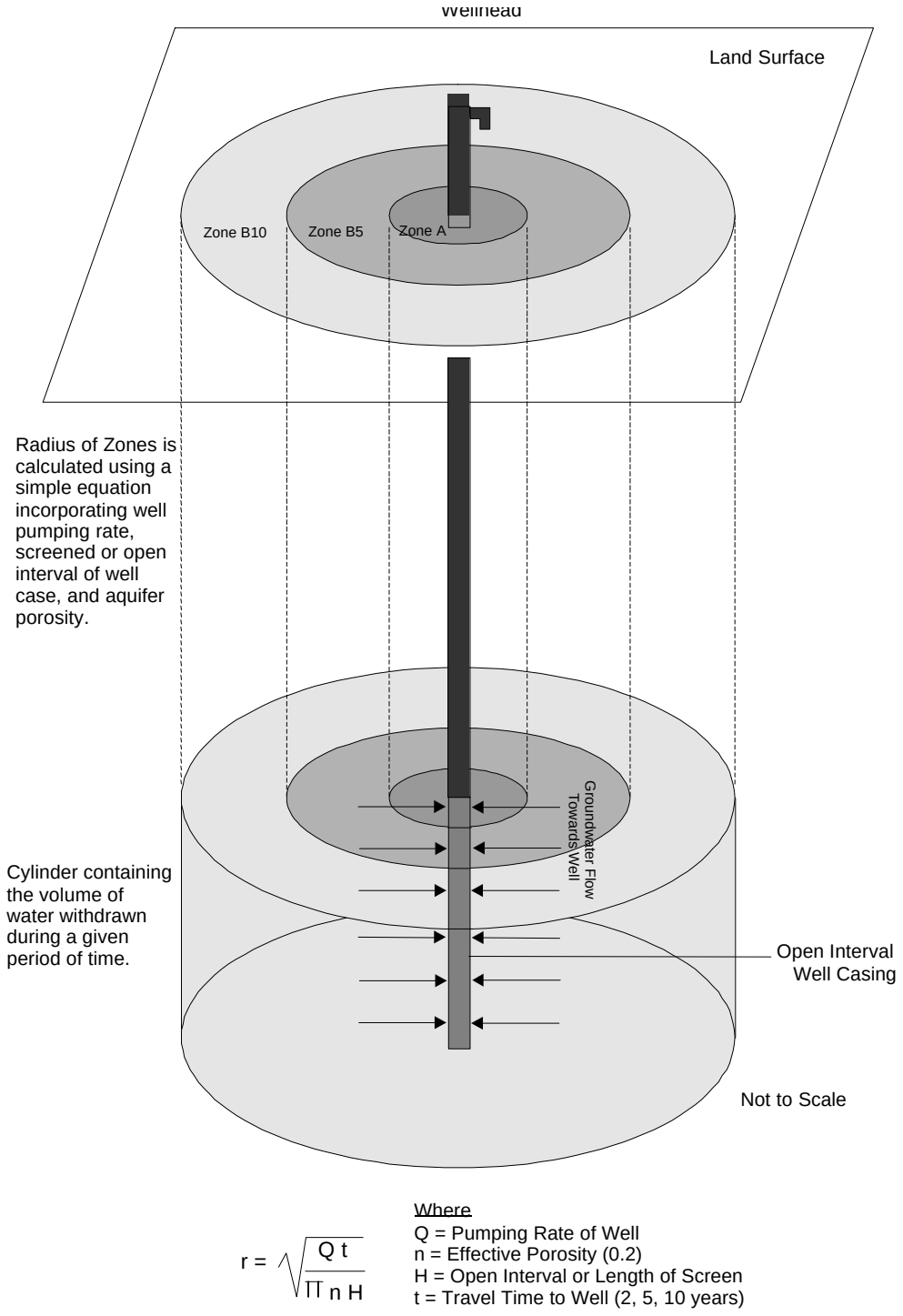


Figure 6-4. Calculated fixed radius delineation method (Adapted from Washington State, "Wellhead Protection Program Guidance Document," 1995)

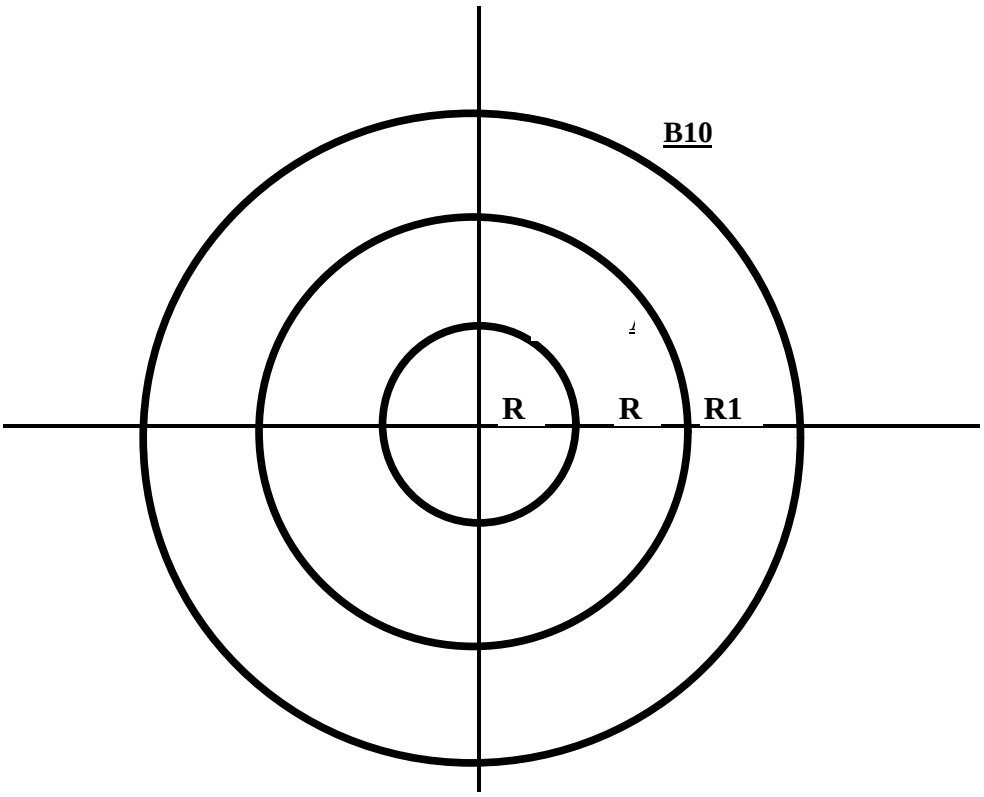


Figure 6-5. Conceptual illustration of the calculated fixed radius method.

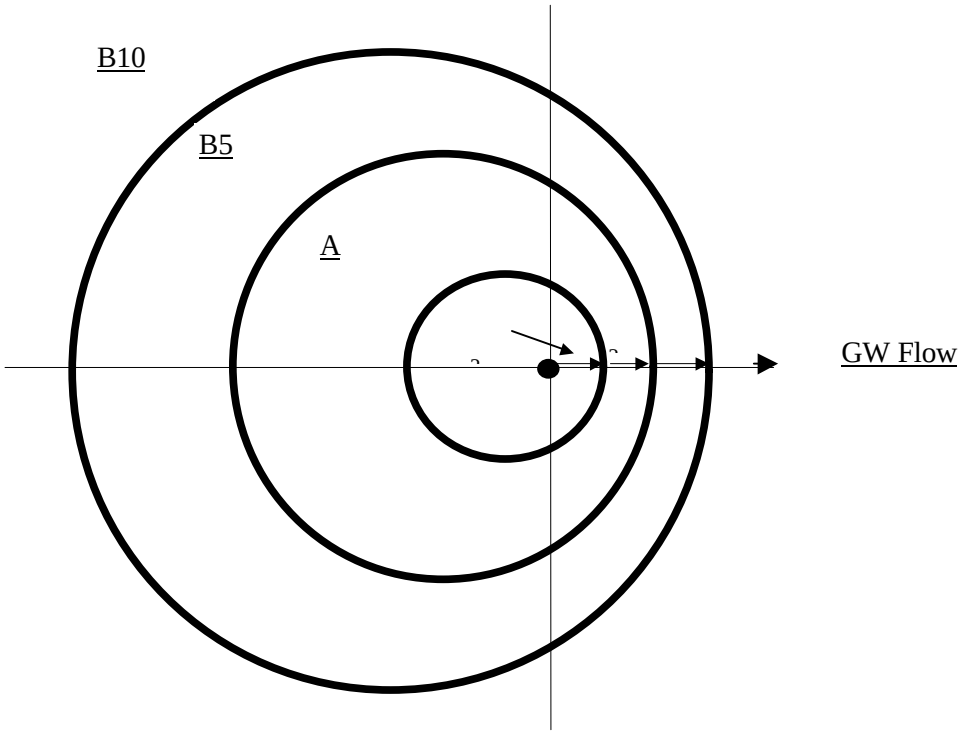
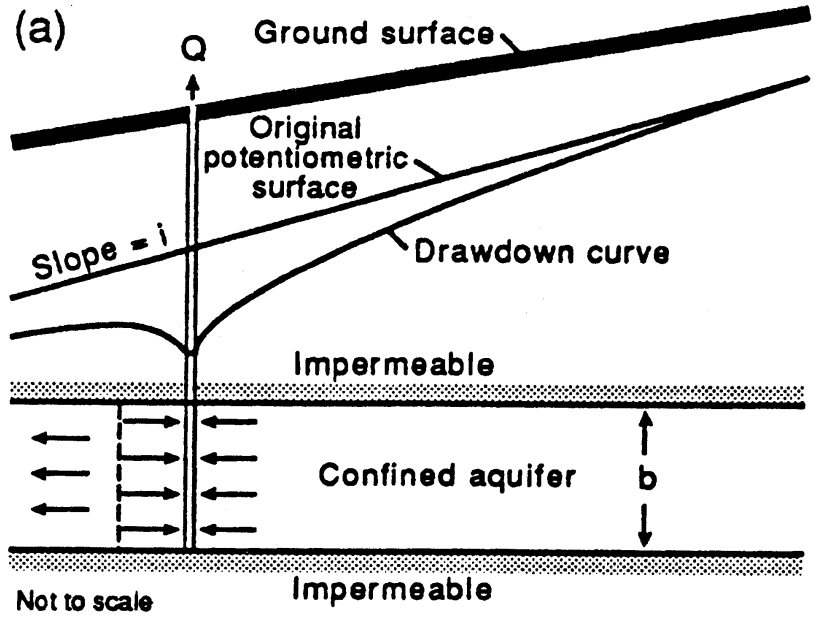
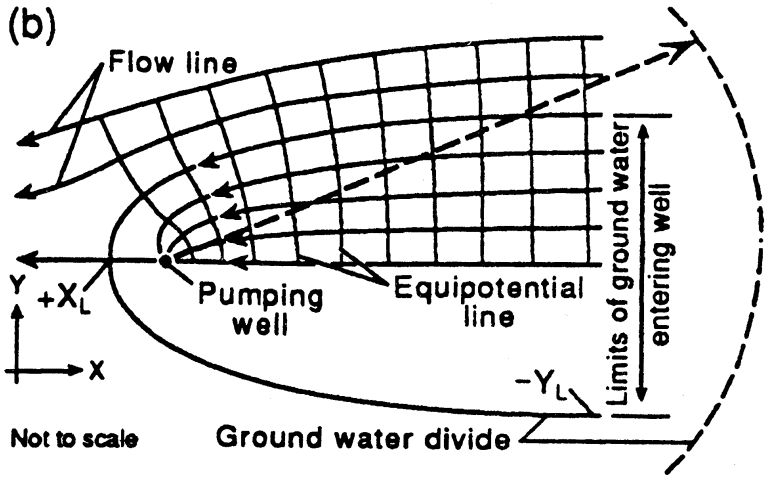


Figure 6-6. Conceptual illustration of the modified calculated fixed radius method.





Uniform flow equation: $$-\frac{Y}{X} = \tan\left(\frac{2\pi Kbi}{Q} Y\right)$$

Distance to down-gradient null point: $$X_L = -\frac{Q}{2\pi Kbi}$$

Boundary limit: $$Y_L = \pm\frac{Q}{2Kbi}$$

Where: Q = Well pumping rate
K = Hydraulic conductivity
b = saturated thickness

Figure 6-7. Uniform flow equations for determining area of contribution to a pumping well (adapted from Todd, 1980)

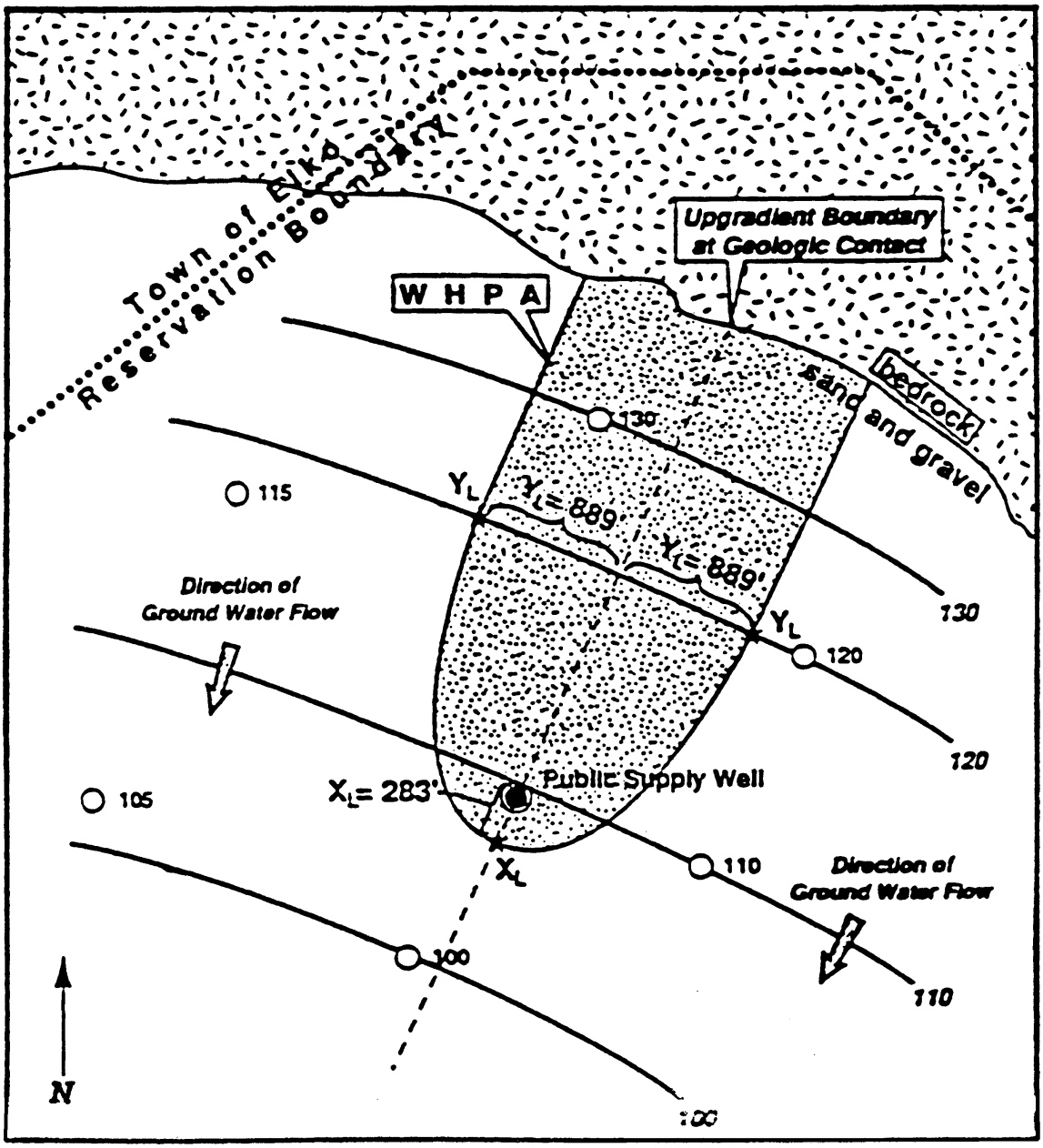


Figure 6-8. Delineation of a drinking water source protection area by analytical methods.

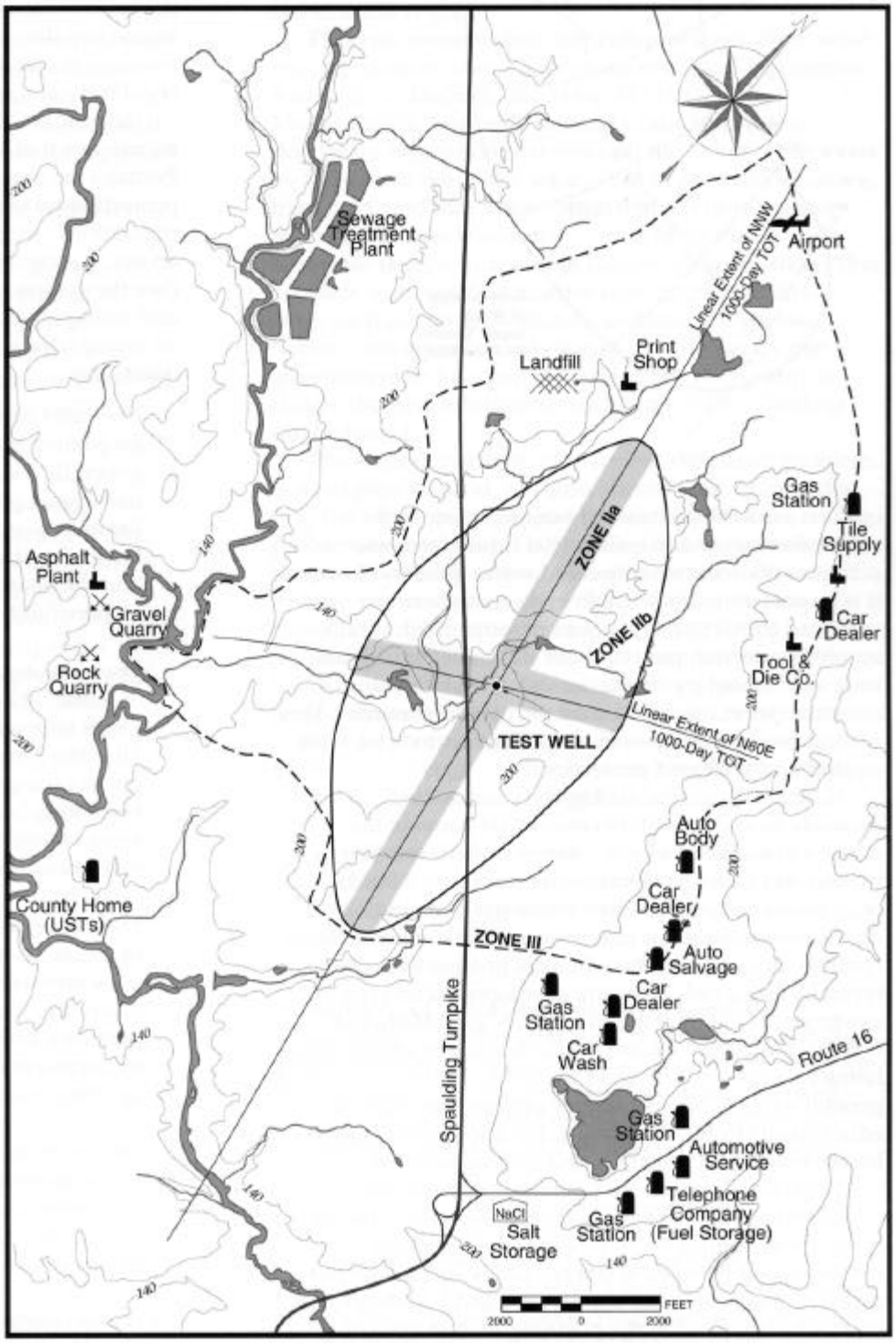


Figure 6-9. Conceptual example of source area and zones using hydrogeologic mapping (From Witten and Horsley, 1995)

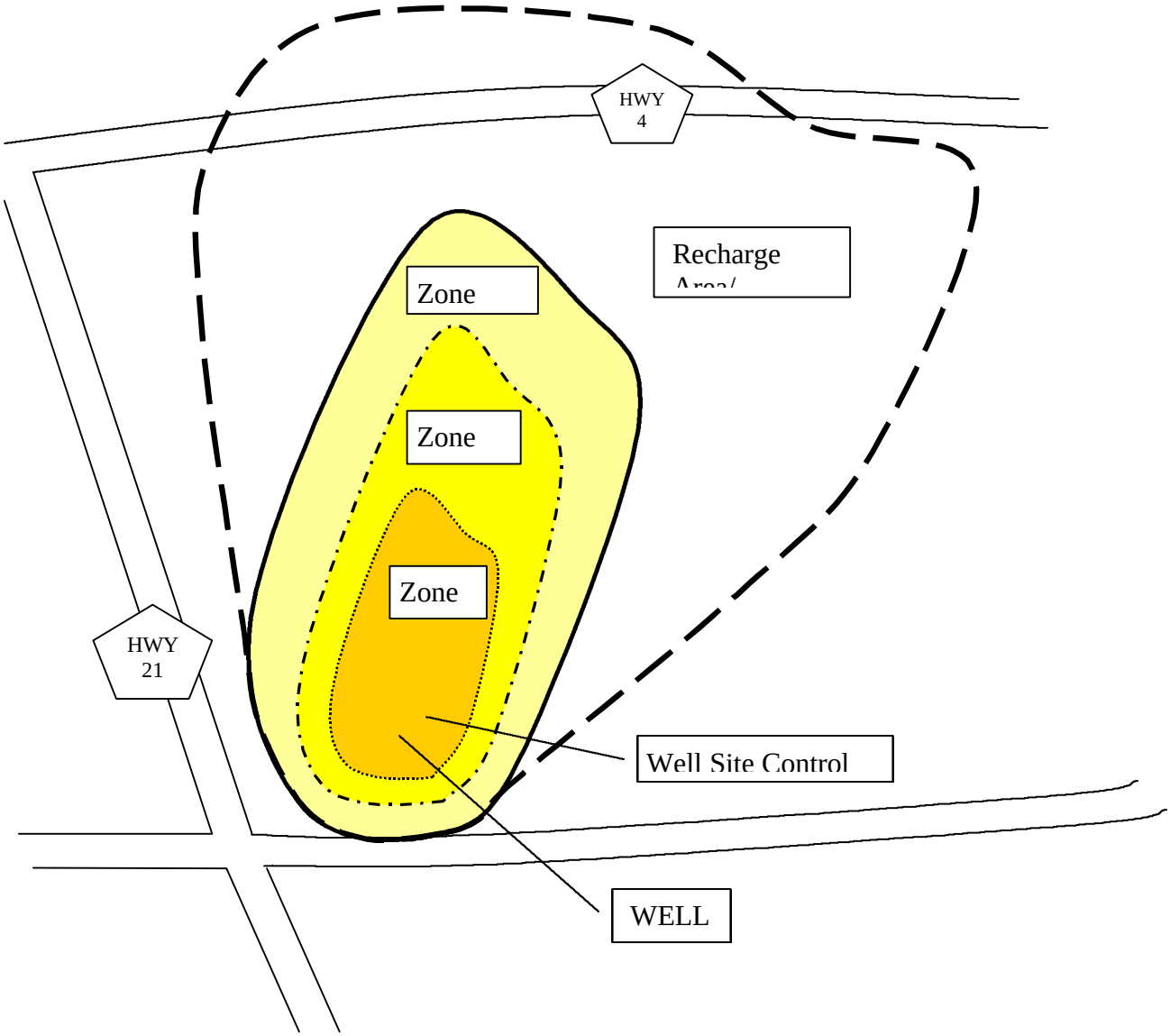


Figure 6-10. Illustration of conceptual ground water source area and protection zones (Adapted from Witten and Horsley, 1995)

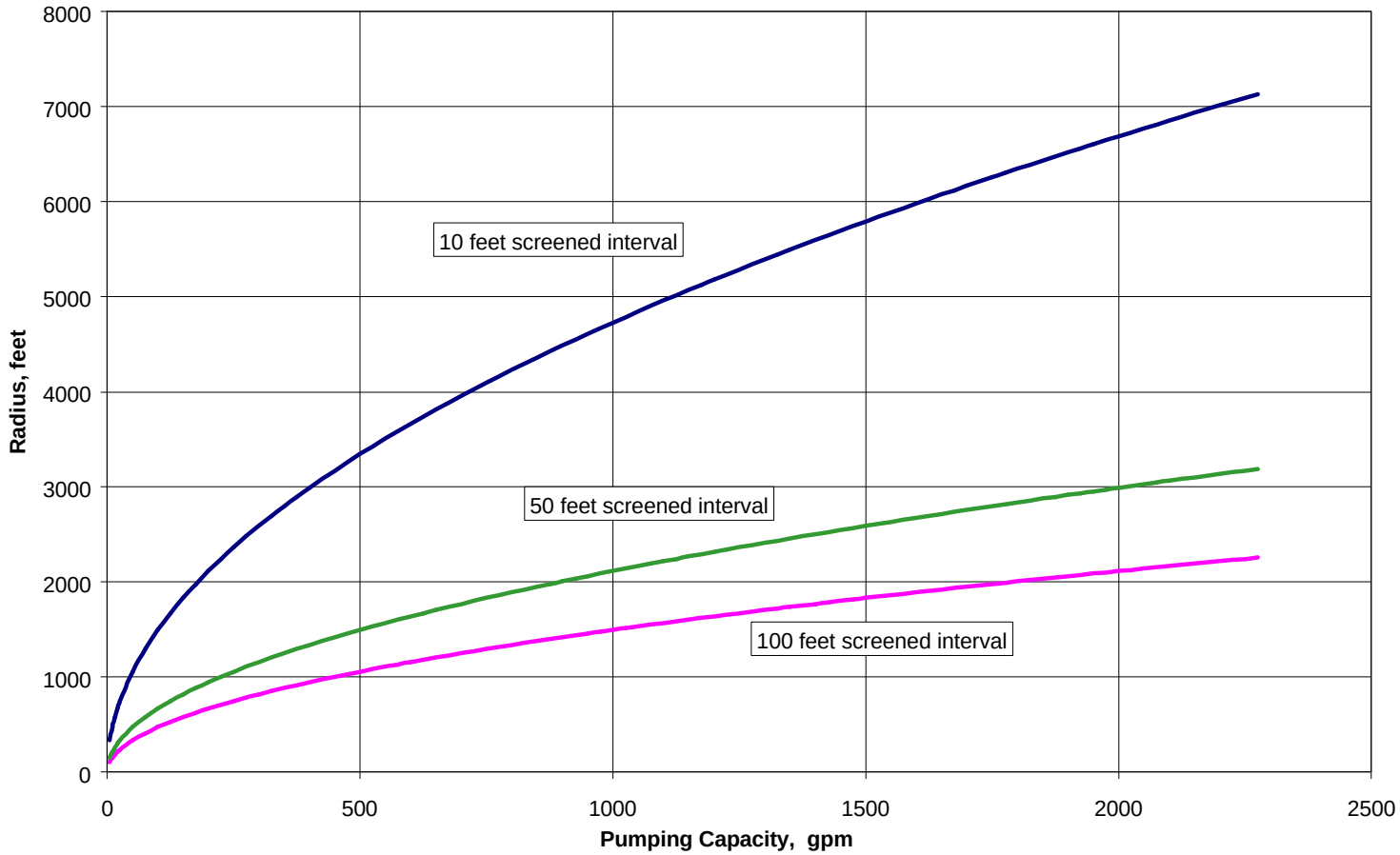


Figure 6-11. Radius of microbiological Zone A (2-year time of travel), using calculated fixed radius method (assumes porosity = 0.2)

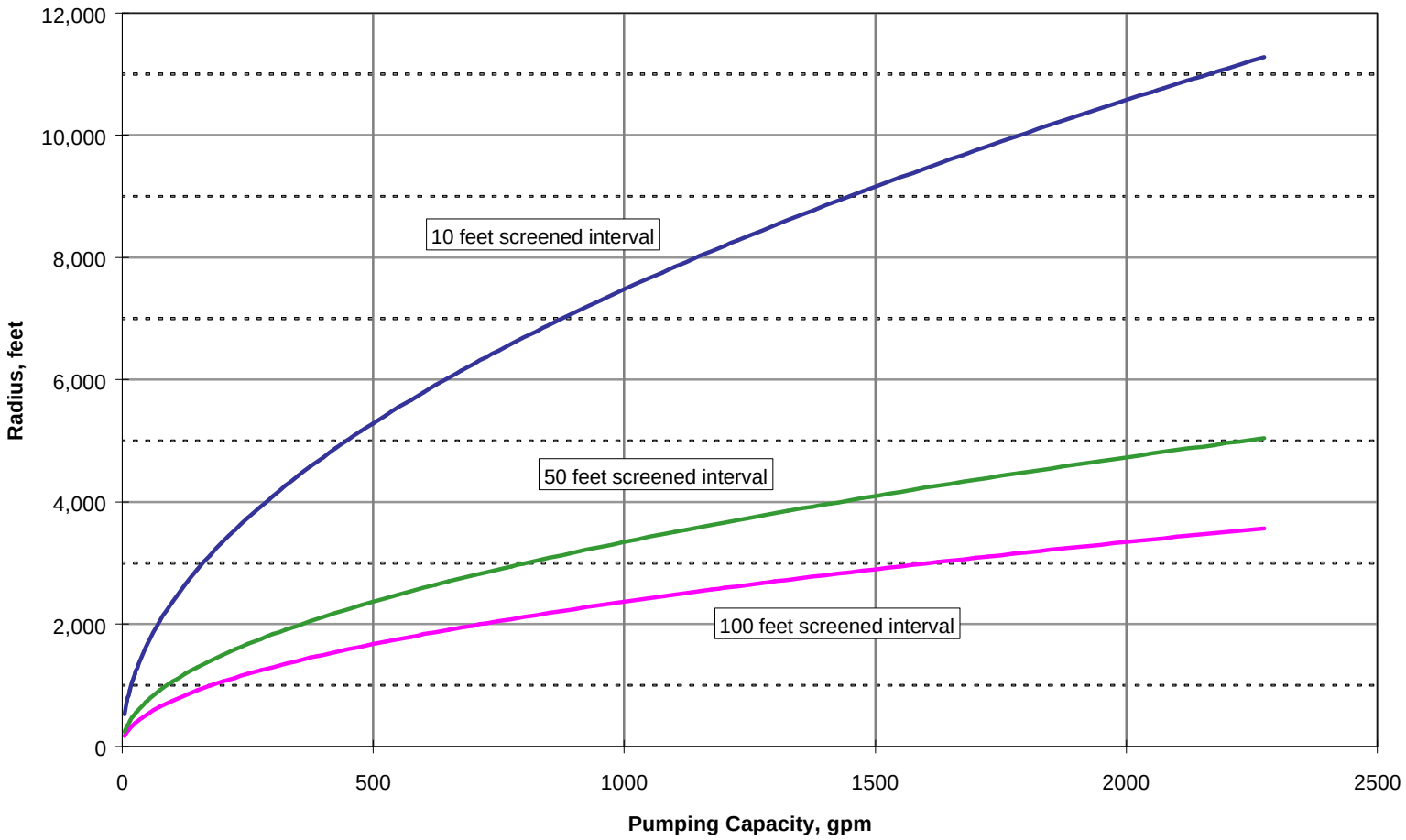


Figure 6-12. Radius of Zone B5 (5-year time of travel), using calculated fixed radius method (assumes porosity =0.2)

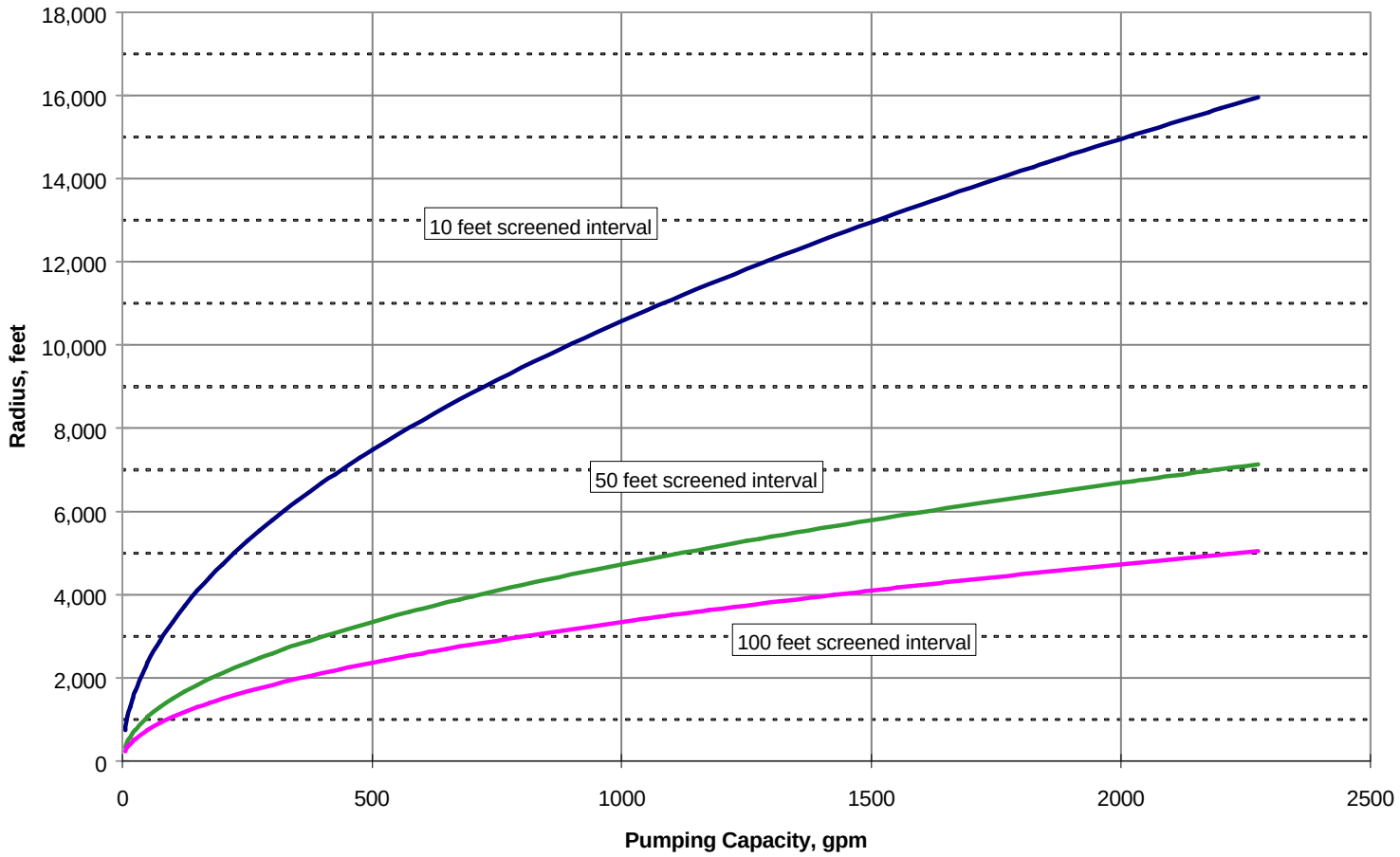


Figure 6-13. Radius of Zone B10 (10-year time of travel), using calculated fixed radius method (assumes porosity =0.2)

page intentionally blank

7.0 Inventory of Possible Contaminating Activities (PCAs) within Source Areas and Protection Zones

An essential element of the drinking water source assessment program is an inventory of possible contaminating activities, industries, or land use. PCAs are considered to be potential origins of contamination in drinking water source areas and protection zones.

An inventory of PCAs can serve at least three important functions:

- Identify past and present activities -- and others that are proposed (to the extent feasible) -- that may pose a threat to the drinking water supply, based on their potential for contamination of ground water or surface water. These activities may include transporting, storing, manufacturing, producing, using, or disposing of potential contaminants. Historic activities are also important to include, as are activities that may contribute to a cumulative impact by a potential contaminant that may otherwise be considered somewhat innocuous.

- Provide information on the existence of PCAs and their proximity to the drinking water source, especially those that present the greatest risks to the water supply.

- Provide an effective means of educating the local public about potential problems.

Although there are various steps in developing the PCA inventory, the process should be viewed as an iterative one. If a type of activity occurs within a zone, then there is a potential origin of contamination, and this would be indicated in the initial phases of the source assessment. Additional review may provide site-specific information that indicates that the activity is not a potential origin of significant contamination. For example, a septic system that is far away from a well may be of less importance than one nearby, in terms of its microbiological significance. A PCA may be important even though it is a great distance away from the source because of the particular contaminant(s) associated with it, other characteristics of the PCA, or characteristics of the drinking water source.

The information obtained in the PCA inventory may be helpful in refining the delineation process described in Section 6.0. In addition, iterations of the PCA inventory and delineations of the source area and protection zones are important in voluntary protection programs.

Contaminants of concern. If any of the following contaminants of concern are associated with an activity, then that activity needs to be in the PCA inventory.

- Microorganisms of drinking water importance, including fecal coliform bacteria, *Escherichia coli*, viruses, *Giardia lambia*, and *Cryptospordium*.

- Chemicals for which maximum contaminant levels (MCLs) or California drinking water action levels have been established, and unregulated chemicals in drinking water for which monitoring is required (Table 7-1).

- Turbidity and total organic carbon (TOC). Turbidity can affect treatment and monitoring for microbiological contaminants, while TOC can influence the presence of disinfection byproducts, which have an attendant carcinogenic concern.

7.1 Alternative Approaches for Conducting a PCA Inventory

For the minimum program, a PCA inventory focuses on identifying whether a type of activity (PCA) exists within a source area or protection zone. Neither the exact location nor the number of sites of that type of PCA need be determined for the minimum assessment. For a more detailed assessment specific PCA locations and the density (number of facilities) for a PCA type can be included in the inventory. This is particularly useful if a source protection program is anticipated.

7.2 Information for PCA Inventories

PCA inventories should be coordinated with work done to comply with requirements of various state, local and federal agencies. Information may be obtained from permitting agencies, such as the state Department of Toxic Substances Control, the Regional Water Quality Control Boards, the Integrated Waste Management Board, the Department of Pesticide Regulation, the Department of Food and Agriculture, the local air pollution control districts, or other local agencies.

To assist in the PCA inventory process, DHS is preparing a list of agencies that have data available, some of it electronically accessible. This list will include agencies with data on topography, soils, watersheds, drinking water sources, permitted waste dischargers, hazardous waste and other waste sites, leaking underground fuel tanks, pesticide use, and others (see Section 5.0).

DHS will include on its Internet site a list of agencies and other locations that have or may have pertinent data, and DHS will have Internet links to them when possible. DHS will update and maintain the listing, but will not be responsible for the quality of, or for updating the data of, other agencies. Accessing this listing and the data other agencies have available could be an initial step in conducting a PCA inventory.

Information from the state-wide data sources will need to be supplemented with local information: septic systems, land application of biosolids (sewage sludge), livestock operations, wildlife refuges, storm water runoff, recreational bathing beaches, and various hazardous substances data bases maintained by local fire departments, county environmental health departments, and county agricultural commissioners.

7.3 Steps in Developing an Inventory of PCAs

The purpose of the PCA inventory is to identify the existence and proximity to the water source of past, present and proposed activities that might be a potential threat to the water supply.

The steps involved in a PCA inventory are detailed below.

7.3.1 Develop an Initial List of Types of PCAs of Concern that May Exist Within or Near the Source Area or Protection Zone

The initial list of types of PCAs should include known sources of contamination, significantly high risk activities within or near the recharge area or watershed, and other activities that should not be overlooked in the inventory process. Table 7-2 is a list of activities that may possibly release contaminants.

Before proceeding with the inventory, resources should be assembled that will assist in locating activities; the DHS Internet site data directory, land use maps, files, and contacts for people that may have current and historical knowledge of the area.

7.3.2 Prepare a PCA Inventory Form

DHS has developed PCA Inventory Forms for surface water sources (Appendix D) and for ground water sources (Appendix K). The PCA inventory forms presented in the appendices should not be considered complete lists of all potential origins of contamination. If a type of PCA of concern from the initial list (Section 7.2.1) is not on an inventory form, it should be added to the appropriate inventory form. Other forms may be acceptable for the PCA inventory; this should be determined in consultation with DHS.

Tables 7-3, 7-4, 7-5 and 7-6 list activities differentiated by potential risk to a water supply (very high, high, moderate, and low). The lists in those tables provide a means of ranking types of PCAs for the vulnerability analysis (Section 8.0). The inventory forms (Appendix D for surface water sources and Appendix K for ground water sources) incorporate the information from Tables 7-3, 7-4, 7-5 and 7-6.

The list of PCAs and the associated risk rankings were developed based on EPA guidance materials, other state programs, input from advisory committees and comments on the program. The risk ranking for a type of PCA is based on the relative risk of a drinking water supply to the contaminants associated with that PCA. The risk ranking may change based on the zone in which the PCA occurs. For example, PCAs associated with microbiological contamination (septic systems, animal facilities, sewer lines) are a very high risk if located within Zone A. Outside of this area they are considered less of a risk because the bacteria and viruses die off over time.

7.3.3 Conduct the PCA Inventory within the Source Area and/or Protection Zones

The initial review of the PCA inventory may be best performed by an individual or group with knowledge of activities around the drinking water source. The initial review could be done with

the Assessment Map (showing drinking water source, source area and zones) and additional maps that may be available.

The initial review allows those doing the assessment to narrow the PCA inventory lists, eliminating types of PCAs that do not occur, and noting the proximity (zone) of types of PCAs whose existence is known.

After the initial review, the PCA inventory should be completed using readily available resources. This may include consultation with various government agency or water system staff (especially for historical information), review of maps and files, access to electronic data sources, and field visits.

Again, it is not the intent of the assessment program to identify the exact location of each and every PCA within the source area and protection zones. The assessments are intended as a first step in an on-going iterative process. The initial PCA inventory should be considered an identification of the types of PCAs that exist within the delineated area(s). A water purveyor may desire to do a more detailed PCA inventory for purposes of a protection program (see Section 11.0). When more detailed information is available it is useful to include this in the assessment.

7.3.4 Attach a List of PCAs to the Assessment Map

As a minimum, a list of the types of PCAs and the area or zone(s) in which they occur should be attached to the assessment map. If the information is available, the locations of some PCAs may be shown as points or symbols on the assessment map. If a water system has a map that more clearly indicates the location of PCAs (e.g., parcel, land use, or service area maps) this may be submitted in addition to the Assessment Map.

It should be noted that the assessment map may be based on general information and approximations. It should not be used as an endpoint for targeting source protection efforts and resources but as a starting point for further investigation. It should never be assumed that an assessment map and the attached list contains all possible contaminating activities or activity types, nor should it be assumed that all possible contaminating activities on the list are actual contamination sources.

7.4 Names and Addresses Associated with PCAs

During the development of the DWSAP, DHS received a number of comments on whether or not specific names and addresses of PCAs should be identified in the PCA inventory.

Considerable concern was expressed about labeling a specific business as a "polluter," when in fact, inclusion of a PCA only refers to an activity that is "possibly contaminating."

Concern was also expressed about lumping together all facilities of an activity as one PCA without taking into account whether an individual facility is small or large, or whether it poses an

actual risk (based on historical contamination), or a potential risk, based on its specific business operations.

DHS determined that specific identification of a PCA in terms of name and address is not needed for the minimum assessment. For example, if one or more gas stations are located within Zone A, B5 or B10 of a well, for purposes of the DWSAP, the presence of the facilities and the general proximity to the water source are the most significant.

Information about ownership and other specifics about any property site or business activity can be readily accessed from other public agencies, if it is needed for local protection programs or other reasons.

page intentionally blank

Table 7-1. California Drinking Water Primary and Secondary Maximum Contaminant Levels, Action Levels, and Unregulated Chemicals Requiring Monitoring.

Maximum Contaminant Levels. MCLs are primary and secondary drinking water standards. They are enforceable regulatory levels, under the Safe Drinking Water Act, and must be met by all public drinking water systems to which they apply.

Primary MCLs are established for a number of chemical and radioactive contaminants. Primary MCLs can be found in Title 22 California Code of Regulations (CCR) for inorganic chemicals (§64431), trihalomethanes (§64439), radioactivity (§64441 and §64443) and organic chemicals (§64444).

Lead and copper have specific regulations in 22 CCR, Chapter 17.5 §64670 *et seq*. The lead and copper regulations use the term "action level" for each substance, for purposes of regulatory compliance.

Secondary MCLS, which are set for taste, odor, or appearance of drinking water, are presented in 22 CCR §64449. Secondary MCLs exist for more than a dozen chemicals/characteristics.

Action Levels (ALs). Except for lead and copper, as described above, ALs are advisory levels for unregulated chemicals, and are not enforceable standards. The ALs are listed below. DHS recommends that drinking water utilities provide public notification if ALs are exceeded. If sources exceeding ALs are taken out of service, notification is not needed.

Unregulated chemicals requiring monitoring. Some chemicals, (e.g., MtBE) are "unregulated" but have certain monitoring requirements, as set forth in 22 CCR §64450. There are a number of unregulated chemicals that are or may be required to be monitored, depending on the vulnerability of drinking water systems.

PRIMARY MAXIMUM CONTAMINANT LEVELS
[All values in milligrams per liter (mg/L), unless otherwise noted.]

Constituent	Primary MCL
22 CCR §64431, Table 64431-A--Inorganic Chemicals	
Aluminum	1
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL[a]
Barium	1
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.2
Fluoride	2.0
Mercury	0.002
Nickel	0.1
Nitrate (as NO_3)	45
Nitrate + Nitrite (sum as nitrogen)	10

Nitrite (as nitrogen)	1
Selenium	0.05
Thallium	0.002

22 CCR §64433.2, Table 64433.2-A—Optimal Fluoride Levels
See also the Fluoride MCL, 22 CCR §64431, Table 64431-A

Annual average of maximum daily air temperature	Optimal Level (Range)
50.0 to 53.7 degrees Fahrenheit (ºF)	1.2 (1.1–1.7)
53.8 to 58.3 ºF	1.1 (1.0–1.6)
58.4 to 63.8 ºF	1.0 (0.9–1.5)
63.9 to 70.6 ºF	0.9 (0.8–1.4)
70.7 to 79.2 ºF	0.8 (0.7–1.3)
79.3 to 90.5 ºF	0.7 (0.6–1.2)

22 CCR §64441 and §64443--Radioactivity

Gross alpha particle activity[b]	15 pCi/L[c]
Gross beta particle activity	50 pCi/L
Combined Radium-226 and Radium-228	5 pCi/L
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L
Uranium	20 pCi/L

22 CCR §64439--Total Trihalomethanes

Sum of bromodichloromethane, dibromochloromethane, bromoform, and chloroform	0.1

22 CCR §64444--Organic Chemicals

Alachlor (Alanex)	0.002
Atrazine (Aatrex)	0.003
Bentazon (Basagran)	0.018
Benzene	0.001
Benzo(a)pyrene	0.0002
Carbofuran (Furadan)	0.018
Carbon tetrachloride	0.0005
Chlordane	0.0001
2,4-D	0.07
Dalapon	0.2
1,2-Dibromo-3-chloropropane (DBCP)	0.0002
1,2-Dichlorobenzene (o-Dichlorobenzene)	0.6
1,4-Dichlorobenzene (p-DCB)	0.005
1,1-Dichloroethane (1,1-DCA)	0.005
1,2-Dichloroethane (1,2-DCA)	0.0005
1,1-Dichloroethylene (1,1-DCE)	0.006
cis-1,2-Dichloroethylene	0.006
trans-1,2-Dichloroethylene	0.01
Dichloromethane (Methylene chloride)	0.005
1,2-Dichloropropane (Propylene dichloride)	0.005
Di(2-ethylhexyl)adipate	0.4
1,3-Dichloropropene	0.0005
Di(2-ethylhexylphthalate (DEHP)	0.004
Dinoseb	0.007
Diquat	0.02
Endrin	0.002
Endothal	0.1
Ethylbenzene (Phenylethane)	0.7

Ethylene dibromide (EDB)	0.00005
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor epoxide	0.00001
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Lindane (gamma-BHC)	0.0002
Methoxychlor	0.04
Molinate (Ordam)	0.02
Monochlorobenzene (Chlorobenzene)	0.07
Oxamyl	0.2
Pentachlorophenol	0.001
Picloram	0.5
Polychlorinated biphenyls (PCBs)	0.0005
Simazine (Princep)	0.004
Styrene (Vinylbenzene)	0.1
2,4,5-TP (Silvex)	0.05
2,3,7,8-TCDD (Dioxin)	0.00000003
1,1,2,2-Tetrachloroethane	0.001
Tetrachloroethylene (PCE)	0.005
Thiobencarb (Bolero)[d]	0.07
Toluene (Methylbenzene)	0.15
Toxaphene	0.003
1,2,4-Trichlorobenzene (Unsym-Trichlorobenzene)	0.07
1,1,1-Trichloroethane (1,1,1-TCA)	0.200
1,1,2-Trichloroethane (1,1,2-TCA)	0.005
Trichloroethylene (TCE)	0.005
Trichlorofluoromethane (Freon 11)	0.15
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2
Vinyl chloride	0.0005
Xylenes (single isomer or sum of isomers)	1.750

_____

[a] MFL = million fibers per liter, MCL is for fibers exceeding 10 microns in length.
[b] Including radium-226 but excluding radon and uranium.
[c] pCi/L = picocuries per liter.
[d] Also listed with a Secondary MCL of 0.001 mg/L.

LEAD AND COPPER, 22 CCR §64672.3
[All values in milligrams per liter (mg/L).]

Constituent	Action Level
Copper (Level to be met at customer tap)	1.3[e]
Lead (Level to be met at customer tap)	0.015[e]

[e] The action levels for copper and lead are used to determine the treatment requirements that a water system is required to complete. The action level for copper is exceeded if the concentration of copper in more than 10 percent of tap water samples collected during any monitoring period conducted in accordance with 22 CCR §64682-§64685 is greater than 1.3 mg/L. Similarly, the action level for lead is exceeded if the concentration of lead in more than 10 percent of tap water samples collected in accordance with 22 CCR §64682-§64685 is greater than 0.015 mg/L. Failure to comply with the applicable requirements for lead and copper (22 CCR Chapter 17.5) is a violation of primary drinking water standards for these substances.

SECONDARY MAXIMUM CONTAMINANT LEVELS, 22 CCR §64449
[All values in milligrams per liter (mg/L), unless otherwise noted.]

CONSUMER ACCEPTANCE LIMITS

Constituent	Secondary MCL
Aluminum	0.2
Color	15 units
Copper	1.0
Corrosivity	Non-corrosive
Foaming agents (MBAS)	0.5
Iron	0.3
Manganese	0.05
Methyl tertiary Butyl Ether (MTBE) [f]	0.005
Odor-Threshold	3 units
Silver	0.1
Thiobencarb (Bolero)[g]	0.001
Turbidity	5 units
Zinc	5.0

[f] Also listed with an Action Level of 0.035 mg/L.
[g] Also listed with a Primary MCL of 0.07 mg/L.

Constituent	Secondary MCL Ranges		
	Recommended	Upper	Short Term
Total Dissolved Solids	500	1,000	1,500
or			
Specific Conductance, micromhos	900	1,600	2,200
Chloride	250	500	600
Sulfate	250	500	600

ACTION LEVELS
[All values in milligrams per liter (mg/L).]

Constituent	Action Level
Inorganic Chemicals	
Boron	1
Perchlorate	0.018
Organic Chemicals	
Aldicarb (Temik) [h]	0.01
Aldrin [h]	0.00005
Baygon	0.090
a-Benzene Hexachloride (a-BHC)	0.0007
b-Benzene Hexachloride (b-BHC)	0.0003
n-Butylbenzene (1-Butylpropane) [h]	0.045
Captan	0.350
Carbaryl (Sevin) [g]	0.060
Chloropicrin	0.050(0.037)[j]
2-Chlorotoluene (o-Chlorotoluene) [g]	0.045
4-Chlorotoluene (p-chlorotoluene) [g]	0.045
Diazinon (Basudin, Neocidol)	0.014
1,2-Dichlorobenzene (o-Dichlorobenzene)	0.130(0.010)[k]
1,3-Dichlorobenzene (m-Dichlorobenzene)	0.130(0.020)[k]
Dichlorodifluoromethane (Difluorodichloromethane) [g]	1.0
Dieldrin [h]	0.00005
1,4-Dioxane	0.003
Dimethoate (Cygon) [h]	0.140
2,4-Dimethylphenol	0.40
Diphenamide	0.040
Ethion	0.035
Formaldehyde	0.030
Isopropyl N (3-Chlorophenyl) Carbamate (CIPC)	0.350
Malathion	0.160
Methyl Isobutyl Ketone (MIBK)	0.040
Methyl Parathion	0.030
Methyl-tert-butyl ether (MTBE) [h,i]	0.035
N-Nitrosodimethylamine (NDMA)	0.000002
Parathion	0.030
Pentachloronitrobenzene (Terrachlor)	0.0009
Phenol	0.0050[j]
Trithion	0.0070

[h] Chemical is identified as "unregulated" for purposes of monitoring.
[i] Chemical also has secondary MCL
[j] Taste and odor threshold.
[k] Taste and odor threshold either for a single isomer or the sum of the two isomers.
[j] Taste and odor threshold for chlorinated systems.

UNREGULATED CHEMICALS REQUIRING MONITORING, 22 CCR §64450

Monitoring is required for chemicals designated "a". If a system is determined to be vulnerable, monitoring is required for chemicals designated "b,"c," and "d."

Constituent	Unregulated category
Inorganic Chemicals	
Perchlorate	d
Organic Chemicals	
Aldicarb (Temik) [l]	c
Aldicarb sulfone	c
Aldicarb sulfoxide	c
Aldrin [l]	c
Bromacil (Hyvar X, Hyvar XL)	b
Bromobenzene (Monobromobenzene)	a
Bromochloromethane (Chlorobromomethane)	b
Bromodichloromethane (Dichlorobromomethane)	a
Bromoform (Tribromomethane)	a
Bromomethane (Methyl bromide)	a
Butachlor (Butanex, Lambast, Machete)	c
n-Butylbenzene (1-Butylpropane) [l]	b
sec-Butylbenzene (2-Phenylbutane)	b
tert-Butylbenzene (2-Methyl-2-phenylpropane)	b
Carbaryl (Sevin) [l]	c
Chlorodibromomethane (Dibromochloromethane)	a
Chloroethane (Ethyl chloride)	a
Chloroform (Trichloromethane)	a
Chloromethane (Methyl chloride)	a
Chlorothalonil (Bravo)	b
2-Chlorotoluene (o-Chlorotoluene) [l]	a
4-Chlorotoluene (p-chlorotoluene) [l]	a
Dibromochloromethane (Chlorodibromomethane)	a
Dibromomethane (Methylene bromide)	a
Dicamba (Banax, Banvel, Dianat)	c
1,3-Dichlorobenzene (m-Dichlorobenzene) [l]	a
Dichlorodifluoromethane (Difluorodichloromethane)	a
1,3-Dichloropropane	a
2,2-Dichloropropane	a
1,1-Dichloropropene	a
Dieldrin [l]	c
Dimethoate (Cygon) [l]	b
Diuron (Karmex, Krovar)	b
Ethyl tertiary butyl ether (ETBE)	b
Hexachlorobutadiene (Perchlorobutadiene)	b
3-Hydroxycarbofuran	c
Isopropylbenzene (Cumene)	b
p-Isopropyltoluene (p-Cymene)	b
Methoxychlor (Lannate)	c
Methyl-tert-butyl ether (MTBE) [m]	b
Metolachlor (Metelilachlor)	c
Metribuzin (Lexone, Sencor, Sencoral)	c
Naphthalene (Naphthalin)	b

1-Phenylpropane (n-Propylbenzene)	b
Prometryn (Caparol)	b
Propachlor (Albrass, Ramrod)	c
Tertiary amyl methyl ether (TAME)	b
1,1,1,2-Tetrachloroethane	a
1,2,3-Trichlorobenzene (vic-Trichlorobenzene)	b
1,2,3-Trichloropropane (Allyl Trichloride)	a
1,2,4-Trimethylbenzene (Pseudocumene)	b
1,3,5-Trimethylbenzene (Mesitylene)	b

[l] Chemical also has a California drinking water action level.
[m] Chemical also has a California secondary MCL and a drinking water action level.

Table 7-2. Potential sources of surface water and ground water contaminants.

Potential Sources of Surface Water and Ground Water Contaminants	
Source	*Groundwater Contaminants* [1,2,3]
Commercial / Industrial	
Automobile Body shops/repair shops Car washes Gas stations/sumps	 Waste oils; solvents; acids; paints; automotive wastes;[4] miscellaneous cutting oils Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons Oils; solvents; miscellaneous wastes
Boat Services/repair/refinishing	Diesel fuels; oil; septage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes[4]
Cement/concrete plants	Diesel fuels; solvents; oils; miscellaneous wastes; salts, high pH
Chemical/petroleum processing/storage	Hazardous chemicals; solvents; hydrocarbons; heavy metals; asphalt
Dry cleaners	Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Electrical/electronic manufacturing	Cyanides; metal sludges; caustic (chromic acid); solvents; oils; alkalis; acids; paints and paint sludges; calcium fluoride sludges; methylene chloride; perchloroethylene; trichloroethane; acetone; methanol; toluene; PCBs
Fleet/trucking/bus terminals	Waste oil; solvents; gasoline and diesel fuel from vehicles and storage tanks; fuel oil; other automotive wastes[4]
Food processing	Nitrates; salts; phosphorus; miscellaneous food wastes; chlorine; ammonia; ethylene glycol
Funeral services/graveyards	Formaldehyde; wetting agents; fumigants; solvents; leachate; lawn and garden maintenance chemicals[5]
Furniture repair/manufacturing	Paints; solvents; degreasing and solvent recovery sludges; lacquers; sealants
Hardware/lumber/parts stores	Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes
Home manufacturing	Solvents; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy wastes; miscellaneous chemical wastes
Junk/scrap/salvage yards	Automotive wastes [4]; PCB contaminated wastes; any wastes from businesses[6] and households[7]; oils; lead
Machine shops	Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (tetrachloroethylene); metal marking fluids; mold-release agents
Medical/vet offices	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; dental acids; miscellaneous chemicals
Metal plating/finishing/ fabricating	Sodium and hydrogen cyanide; metallic salts; hydrochloric acid; sulfuric acid; chromic acid; boric acid; paint wastes; heavy metals; plating wastes; oils; solvents

Mines/gravel pits	Mine spills or tailings that often contain metals; acids; highly corrosive mineralized waters; metal sulfides; metals; acids; minerals sulfides; other hazardous and nonhazardous chemicals[9]
Office buildings/complexes	Building wastes[6]; lawn and garden maintenance chemicals[5]; gasoline; motor oil
Parking lots/malls (> 50 spaces)	Hydrocarbons; heavy metals; building wastes[6]
Photo processing/printing	Biosludges; silver sludges; cyanides; miscellaneous sludges; solvents; inks; dyes; oils; photographic chemicals
Plastics/synthetics producers	Solvents; oils; miscellaneous organic and inorganics (phenols, resins); paint wastes; cyanides; acids; alkalis; wastewater treatment sludges; cellulose esters; surfacant; glycols; phenols; formaldehyde; peroxides; etc.
Research laboratories	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes, disinfectants; asbestos; beryllium; solvents; infectious materials; drugs; disinfectants; (quaternary ammonia, hexachlorophene, peroxides, chlornexade, bleach); miscellaneous chemicals
Recreational vehicle (RV)/mini storage	Automobile wastes[4]; gasoline and diesel fuel from vehicles and storage tanks
Sewer lines	Sewage
Wood preserving/treating	Wood preservatives; creosote, pentachlorophenol, arsenic
Wood/pulp/paper processing and mills	Metals; acids; minerals; sulfides; other hazardous and nonhazardous chemicals[9]; organic sludges; sodium hydroxide; chlorine; hypochlorite; chlorine dioxide; hydrogen peroxide; treated wood residue (copper quinolate, mercury, sodium bazide); tanner gas; paint sludges; solvents; creosote; coating and gluing wastes
Agricultural/Rural	
Confined animal feeding operations	Livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral and fungal pests on livestocks; coliform[10] and noncoliform bacteria; viruses; protozoa; total dissolved solids
Grazing animals, other animal operations	Livestock sewage wastes; nitrates; phosphates; coliform and noncoliform bacteria; protozoa, viruses; total dissolved solids;
Dairies	Livestock sewage wastes; nitrates; total dissolved solids; salts; phosphates; potassium.
Farm chemical distributor/application service	Pesticides[11]; fertilizers[12]; hydrocarbons from motor vehicles and storage tanks
Farm machinery repair	Automotive wastes[4]; welding wastes
Irrigated crops	Pesticides[11]; fertilizers [12]; nitrates; phosphates; potassium (can be worsened by over-watering)
Lagoons	Nitrates; Livestock sewage wastes; salts; pesticides[11]; fertilizers[17]; bacteria
Nonirrigated crops	Pesticides[11]; fertilizers[12]; nitrates; phosphates; potassium
Pesticide/fertilizer/petroleum storage & transfer areas	Pesticides[11]; fertilizers[12]; petroleum residues
Rural homesteads	*Machine shops:* Automotive wastes[4]; welding wastes; solvents; metals; lubricants; sludges *Septic systems:* Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking

	and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals;[15] elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate
Sludge application to land	Organic and inorganic chemicals, coliform and noncoliform bacteria, viruses, protozoa[16]
Agricultural Drainage	Pesticides[11]; fertilizers[12]; total dissolved solids; total organic carbon; nitrates
Residential / Municipal	
Airports (maintenance/fueling areas)	Jet fuels; deicers; diesel fuel; chlorinated solvents; automotive wastes;[4] heating oil; building wastes[6]
Apartments and condominiums	Swimming pool maintenance chemicals[14]; pesticides for lawn and garden maintenance and cockroach, termite, ant, rodent, and other pest control[5,13], wastes from on-site sewage treatment plants; household hazardous wastes[7]
Camp grounds/RV parks	Septage; gasoline; diesel fuel from boats; pesticides for controlling mosquitoes, ants, ticks, gypsy moths, and other pests[11,13]; household hazardous wastes from RVs[7]
Drinking water treatment plants	Treatment chemicals; pesticides[11]
Fire stations	General building wastes[6]; hydrocarbons from test burn areas
Golf courses	Fertilizers[12]; herbicides[11]; pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests[5]
Housing	*Household hazardous wastes*[7] Household cleaners; oven cleaners; drain cleaners; toilet cleaners; disinfectants; metal polishes; jewelry cleaners; shoe polishes; synthetic detergents; bleach; laundry soil and stain removers; spot removers and dry cleaning fluid; solvents; lye or caustic soda; household pesticides;[13] photo chemical; printing ink, paints; varnishes; stains; dyes; wood preservatives (creosote); paint and lacquer thinners; paint and varnish removers and deglossers; paint brush cleaners; floor and furniture strippers *Mechanical Repair and Other Maintenance Products:* Automotive wastes;[4] waste oils; diesel fuel; kerosene; #2 heating oil; grease; degreasers for driveways and garages; metal degreasers; asphalt and roofing tar; tar removers; lubricants; rustproofers; car wash detergents; car waxes and polishes; rock salt; refrigerants *Lawn/garden care:* Fertilizers;[11] herbicides and other pesticides used for lawn and garden maintenance[5] (can be worsened by over-watering) *Swimming pools:* Swimming pool maintenance chemicals[14] *Urban runoff/stormwater*[3]: Gasoline; oil; other petroleum products; microbiological contaminants
Landfills/dumps	Leachate; organic and inorganic chemical contaminants; waste from households[7] and businesses[6]; nitrates; oils; metals; solvents; sludge

Motor pools	Automotive wastes[4]: solvents; waste oils; hydrocarbons from storage tanks
Parks	Fertilizers[12]; herbicides[5]; insecticides[11,13]; (can be worsened by over-watering)
Railroad yards/maintenance/fueling areas	Diesel fuel; herbicides for rights-of-way [11]; creosote for preserving wood ties; solvents; paints; waste oils
Recreational use of surface water sources (body contact)	Microbiological contamination from swimmers
Recreational use of surface water sources (motorized watercraft)	Gasoline fuel from watercraft; marinas.

Schools	Machinery/vehicle serving wastes; gasoline and heating oil from storage tanks; general building wastes[6]; pesticides[11,13]:
Septic systems	Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals[15] ; elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate; other household hazardous wastes[7] ;
Sewer lines	Sewage
Utility stations/maintenance areas	PCBs from transformers and capacitors; oils; solvents; sludges; acid solution; metal plating solutions (chromium, nickel, cadmium); herbicides from utility rights-of-way
Waste transfer/recycling stations	Residential and commercial solid waste residues
Wastewater	Municipal wastewater; sludge[16]; treatment chemicals[17]; nitrates; heavy metals; coliform[10] and noncoliform bacteria; nonhazardous wastes[16]
Other	
Above ground storage tanks	Heating oil; diesel fuel; gasoline; other chemicals
Construction/demolition areas (plumbing, heating, and air conditioning, painting, paper hanging, decorating, drywall and plastering, acoustical insulation, carpentry, flooring, roofing, and sheet metal etc.)	Solvents; asbestos; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy waste; miscellaneous chemical wastes
Historic gas stations	Diesel fuel; gasoline; kerosene
Historic waste dumps/landfills	Leachate; organic and inorganic chemicals; waste from households [7]; and businesses [6]; nitrates; oils; heavy metals; solvents
Hospitals	Various chemical and radiological substances, and microorganisms.
Injection wells/drywells/sumps	Stormwater runoff [3]; spilled liquids; used oils; antifreeze; gasoline; solvents; other petroleum products; pesticides[11]; and a wide variety of other substances
Managed forests	Pesticides; fertilizers; total dissolved solids
Medical/dental offices and clinics	Various chemical substances.
Military installations	Wide variety of hazardous and nonhazardous wastes depending on the nature of the facility and operation[3,9]; diesel fuels; jet fuels; solvents; paints; waste oils; heavy metals; radioactive wastes
Seawater intrusion	Salinity, disinfection byproducts
Silviculture	Pesticides, fertilizers, total dissolved solids
Surface water - stream/lakes/rivers	(Directly related to surface water quality in the stream, lake, or river which is recharging groundwater)
Transportation corridors	Herbicides in highway right-of-way[11,5]; road salt (sodium and calcium chloride); road salt, anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); automotive wastes[4]

Underground storage tanks	Diesel fuel; gasoline; heating oil; other chemical and petroleum products
Veterinary offices/clinics	Various chemical and radiological substances and microorganisms.
Wells, agricultural (such as irrigation wells, abandoned wells)	Storm water runoff, irrigation water runoff, nitrates, pesticides, and other substances
Wells, gas, oil, geothermal	Various petroleum-related substances, inorganics
Wells (such as water supply wells, monitoring wells, unsealed or abandoned wells, and test holes)	Storm water runoff [3]; solvents; nitrates; septic tanks; hydrocarbons; and other substances

SOURCE: Adapted from EPA (1993), and from the Oregon Wellhead Protection Program

[1]In general, source water contamination stems from the *misuse and improper disposal* of liquid and solid wastes; the *illegal dumping or abandonment* of household, commercial, or industrial chemicals; the *accidental spilling* of chemicals from trucks, railways, aircraft, handling facilities, and storage tanks; or the *improper siting, design, construction, operation, or maintenance* of agricultural, residential, municipal, commercial, and industrial drinking water wells and liquid and solid waste disposal facilities. Contaminants also can stem from *atmospheric pollutants*, such as airborne sulfur and nitrogen compounds, which are created by smoke, flue dust, aerosols, and automobile emissions, and which are removed from the atmosphere by wet or dry deposition, and runoff from or percolate through the soil. ***When the sources listed in this table are used and managed properly, contamination is not likely to occur, or is likely to occur at low levels.***

[2]Contaminants can reach groundwater from activities occurring on the land surface, such as industrial waste storage; from sources below the land surface but above the water table, such as septic systems; from structures beneath the water table, such as wells; or from contaminated recharge water.

[3]This table lists the most common wastes, but not all potential wastes. For example, it is not possible to list all potential contaminants contained in stormwater runoff or from military installations.

[4]Automobile wastes can include gasoline; antifreeze; automatic transmission fluid; battery acid; engine and radiator flushes; engine and metal degreasers; hydraulic (brake) fluid; and motor oils.

[5]Common pesticides used for lawn and garden maintenance (i.e., weed killers, and mite, grub, and aphid controls) include such chemicals as 2,4-D; chlorpyrifos; diazinon; benomyl; captan; dicofol; and methoxychlor.

[6]Common wastes from public and commercial buildings include automotive wastes; and residues from cleaning products that may contain chemicals such a xylenols, glycol esters, isopropanol, 1,1,1,-trichloroethane, sulfonates, chlorinated phenols, and cresols.

[7] Household hazardous wastes are common household products that contain a variety of toxic or hazardous components.

[8]X-ray developers and fixers may contain reclaimable silver, glutaldehyde, hydroquinone, potassium bromide, sodium sulfite, sodium carbonate, thiosulfates, and potassium alum.

[9]The Resource Conservation and Recovery Act (RCRA) defines a hazardous waste as a solid waste that may cause an increase in mortality or serious illness or pose a substantial threat to human health and the environment when improperly treated, stored, transported, disposed of, or otherwise managed. A waste is hazardous if it exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. Not covered by RCRA regulations are domestic sewage; irrigation waters or industrial discharges allowed by the Clean Water

Act; certain nuclear and mining wastes; household wastes; agricultural wastes (excluding some pesticides); and small quantity hazardous wastes (i.e., less than 220 pounds per month) generated by businesses.

[10]Coliform bacteria can indicate the presence of pathogenic (disease-causing) microorganisms that may be transmitted in human feces. Diseases such as typhoid fever, hepatitis, diarrhea, and dysentery can result from sewage contamination of water supplies.

[11]Pesticides include herbicides, insecticides, rodenticides, fungicides and avicides. EPA has registered approximately 50,000 different pesticide products for use in the United States. Many are highly toxic and quite mobile in the subsurface. An EPA survey found that the most common pesticides found in drinking water wells were DCPA (dacthal) and atrazine, which EPA classifies as *moderately toxic* (class 3) and *slightly toxic* (class 4) materials, respectively

[12]The EPA National Pesticides Survey found that the use of fertilizers correlates to nitrate contamination of groundwater supplies.

[13]Common household pesticides for controlling pests such as ants, termites, bees, wasps, flies, cockroaches, silverfish, mites, ticks, fleas, worm, rates, and mice can contain active ingredients include naphthalene, phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons, arsenic, strychnine, kerosene, nitrosamines, and dioxin.

[14]Swimming pool chemicals can contain free and combined chlorine; bromine; iodine; mercury-based, copper-based, and quaternary algaecides; cyanuric acid; calcium or sodium hypochlorite; muriatic acid; sodium carbonate.

[15]Septic tank/cesspool cleaners include synthetic organic chemicals such as 1,1,1 trichloroethane, tetrachloroethylene, carbon tetrachloride, and methylene chloride.

[16]Municipal wastewater treatment sludge can contain organic matter, nitrates; inorganic salts, heavy metals; coliform and noncoliform bacteria; protozoa (giardia and cryptosporidium) and viruses.

[17]Municipal wastewater treatment chemicals include calcium oxide; alum; activated alum, carbon, and silica; polymers; ion exchange resins; sodium hydroxide; chlorine; ozone; and corrosion inhibitors.

Table 7-3. Possible Contaminating Activities (PCAs) associated with Very High potential risks. Very High risk PCAs are considered to have the highest potential for drinking water contamination, greater than those designated High risk (Table 7-4), Moderate risk (Table 7-5), or Low risk (Table 7-6). The risk rankings are based on the general nature of activities and the contaminants associated with them (refer to Table 7-2), not on facility-specific management practices. Instead, such management practices may be considered in the vulnerability analysis, and should be considered in a protection program. (An asterisk [*] indicates PCAs that may be associated with microbiological contamination.)

COMMERCIAL/INDUSTRIAL

Automobile-related activities
Gas stations
Chemical/petroleum processing/storage
Dry cleaners
Metal plating/ finishing/fabricating
Plastics/synthetics producers

AGRICULTURAL/RURAL

* Animal Feeding Operations (VH in Zone A, otherwise H)
* Concentrated Aquatic Animal Production Facilities (VH for surface water in Zone A, otherwise H)
* Managed Forests (VH for surface water in Zone A, otherwise H)

RESIDENTIAL/MUNICIPAL

Airports - maintenance/fueling areas
Landfills/dumps
*Septic systems - High density (>1/acre) (VH if in Zone A, otherwise M)
*Wastewater Treatment Plants (VH in Zone A, otherwise H)

OTHER

Underground injection of commercial/ industrial discharges
Historic gas stations
Historic waste dumps/landfills
Injection wells/dry wells/sumps
Known contaminant plumes
Military installations
Mining operations
- Historic
- Active

Underground storage tanks
- Confirmed leaking tanks

Table 7-4. Possible Contaminating Activities (PCAs) associated with High potential risks. High risk PCAs are considered to have less potential for drinking water contamination than those designated Very High risk (Table 7-3), but greater potential for contamination than those designated Moderate risk (Table 7-5), or Low risk (Table 7-6). The risk rankings are based on the general nature of activities and the contaminants associated with them (refer to Table 7-2), not on facility-specific management practices. (An asterisk [*] indicates PCAs that may be associated with microbiological contamination.)

COMMERCIAL/INDUSTRIAL

Automobile related Activities
- Body shops
- Repair shops

Boat services/repair/refinishing
Chemical/petroleum pipelines
Electrical/electronic manufacturing
Fleet/trucking/bus terminals
Furniture repair/manufacturing
Home manufacturing
Junk/scrap/salvage yards
Machine shops
Photo processing/printing
Research laboratories
Wood preserving/treating
Lumber processing and manufacturing
Wood/pulp/paper processing and mills
*Sewer collection systems (H, if in Zone A, otherwise L)

RESIDENTIAL/MUNICIPAL

Railroad yards/maintenance/fueling areas
*Sewer collection systems (H, if in Zone A, otherwise L)
Utility stations - maintenance areas
*Wastewater Treatment Plants (VH in Zone A, otherwise H)

AGRICULTURAL/RURAL

* Grazing (> 5 animals/acre) (H in Zone A, otherwise M)
* Animal Feeding Operations (VH in Zone A, otherwise H)
* Other animal operations (H in Zone A, otherwise M)
Concentrated Aquatic Animal Production Facilities (VH in Zones for surface water, otherwise H)
Other aquatic animal operations (H in Zones for surface water, otherwise M)
Farm chemical distributor/ application service
Farm machinery repair
*Septic systems- low density (<1/acre) (H if in Zone A, otherwise L)
*Lagoons/liquid wastes
Machine shops
Pesticide/fertilizer/petroleum storage and transfer areas
Managed Forests (VH in Zones for surface water, otherwise H)
Agricultural Drainage (H in Zone A, otherwise M)
Wells- Agricultural, Irrigation

OTHER

NPDES/WDR permitted discharges
Illegal activities/unauthorized dumping
Mining – Sand/Gravel
Wells- Oil, Gas, Geothermal
Salt water intrusion
*Recreational area - surface water source
Underground storage tanks:
Non-regulated tanks (tanks smaller than regulatory limit)
Not yet upgraded or registered tanks
Snow Ski Areas (H in Zones for surface water, otherwise M)
Recent (< 10 years) Burn Areas (H in Zones for surface water, otherwise M)
Dredging (H in Zones for surface water, otherwise M)

Table 7-5. Possible Contaminating Activities (PCAs) associated with Moderate potential risks. Moderate risk PCAs are considered to have a lower potential for drinking water contamination than those designated Very High risk (Table 7-3) and High risk (Table 7-4), and a greater potential for drinking water contamination than activities designated Low risk (Table 7-6). The risk rankings are based on the general nature of activities and the contaminants associated with them (refer to Table 7-2), not on facility-specific management practices. (An asterisk [*] indicates activities that may be associated with microbiological contamination.)

COMMERCIAL/INDUSTRIAL
Car washes
Parking lots/malls (>50 spaces)
Cement/concrete plants
*Food processing
Funeral services/graveyards
Hardware/lumber/parts stores

RESIDENTIAL/MUNICIPAL
*Septic systems - High density (>1/acre) (VH if in Zone A, otherwise M)
Drinking water treatment plants
Golf courses
Housing - High density (>1 house/0.5 acres)
Motor pools
Parks
Waste transfer/recycling stations

AGRICULTURAL/RURAL
* Grazing (> 5 animals/acre) (H in Zone A, otherwise M)
* Other animal operations (H in Zone A, otherwise M)
Other aquatic animal operations (H in Zones for surface water, otherwise M)
Crops, irrigated (berries, hops, mint, orchards, sod, greenhouses, vineyards, nurseries, vegetables)
NOTE: Drip-irrigated crops are considered Low risks.
*Sewage sludge (biosolids) land application
Fertilizer, pesticide/herbicide application
Managed Forests (M for ground water)
Agricultural Drainage (H in Zone A, otherwise M)

OTHER
Above ground storage tanks
Wells – water supply
Construction/demolition staging areas
Contractor or government agency equipment storage yards
Managed forests
Transportation corridors
Freeways/state highways
Railroads
Historic railroad right-of-ways
Road right-of-ways (herbicide use areas)
Hospitals
Storm drain discharge points
Storm water detention facilities
Artificial recharge projects – non-potable water (includes recycled, storm, and untreated imported water)
Injection wells
Spreading basins
Snow Ski Areas (H in Zones for surface water, otherwise M)
Recent (< 10 years) Burn Areas (H in Zones for surface water, otherwise M)
Dredging (H in Zones for surface water, otherwise M)

Table 7-6. Possible Contaminating Activities (PCAs) associated with Low potential risks. Low risk PCAs are considered to have a lower potential for drinking water contamination than those designated Very High risk (Table 7-3), High risk (Table 7-4) or Moderate risk (Table 7-5). The risk rankings are based on the general nature of activities and the contaminants associated with them (refer to Table 7-2), not on facility-specific management practices. Instead, such management practices may be considered in the vulnerability analysis, and should be considered in a protection program. (An asterisk [*] indicates PCAs that may be associated with microbiological contamination.)

COMMERCIAL/INDUSTRIAL

*Sewer collection systems (H, if in Zone A, otherwise L)
Appliance/Electronic repair
Office buildings/complexes
Rental yards
RV/mini storage

RESIDENTIAL/MUNICIPAL

*Sewer collection systems (H, if in Zone A, otherwise L)
Apartments and condominiums
Campgrounds/Recreational areas
Fire stations
RV parks
Schools
Hotels, Motels

AGRICULTURAL/RURAL

Crops, non-irrigated (e.g. Christmas trees, grains, grass seeds, hay) (or drip-irrigated crops)
* Septic systems – low density (<1/acre) (H if in Zone A, otherwise L)

OTHER

Underground storage tanks
- Decommissioned - inactive
- Upgraded and/or registered – active

Roads/Streets
Artificial recharge projects - potable water
- Injection wells
- Spreading basins

Medical/dental offices/clinics
Veterinary offices/clinics
*Surface water - streams/lakes/rivers
Wells – Monitoring, test holes, borings

page intentionally blank

8.0 Vulnerability of Drinking Water Sources to Contamination

After the initial inventory of Possible Contaminating Activities (PCAs) has been completed (Section 7), a vulnerability analysis is conducted to determine the types of PCAs to which the drinking water source is most vulnerable by prioritizing the list of activities identified in the inventory. The analysis factors in the source and/or site characteristics that may affect the vulnerability of the source to contamination from the types of PCAs identified in the inventory.

8.1 Definition

Vulnerability: A determination of the most significant threats to the quality of the water supply that takes into account the physical barrier effectiveness of the drinking water source. The vulnerability determination also considers the type and proximity to the water supply of activities that could release contaminants.

Vulnerability, as defined in the DWSAP Program, is consistent with existing California regulations (see Section 8.4).

8.2 Vulnerability Analysis Procedures

The vulnerability analysis evaluates the types of PCAs identified in the inventory within the context of the characteristics of the source and its site. The first step in the analysis is to determine the Physical Barrier Effectiveness (PBE) for the drinking water source. The PBE can be determined using site-specific information on hydrogeology, hydrology and soils. Additional information is required depending upon whether the source is ground water or surface water.

8.2.1 Drinking Water Source and Site Characteristics

8.2.1.1 Drinking Water Source Information

The information needed to determine the Physical Barrier Effectiveness should be compiled using readily available data and reports. A minimum level of information is necessary to make the initial determination, but additional information may be useful in refining the determination.

For surface water sources, Appendix C shows the minimum water body and watershed information necessary to determine Physical Barrier Effectiveness. Most of this information can be found in the Watershed Sanitary Survey for the source.

For ground water sources, the minimum information necessary to determine Physical Barrier Effectiveness is shown in Appendix J. The information to be collected should be available from well logs, soil survey maps, some general knowledge of the hydrogeology of the area, and well operation information.

8.2.1.2 Determination of Physical Barrier Effectiveness

The Physical Barrier Effectiveness is essentially an estimate of the ability of the natural geologic materials, hydraulic conditions, and construction features of the well or intake to prevent the movement of contaminants to the drinking water source.

A qualitative rating of low, moderate or high Physical Barrier Effectiveness (PBE), based on the drinking water source and site characteristics, is determined for each source. A simple approach to determining PBE for surface water is shown in Appendix C, and for ground water in Appendix J. In the DWSAP approach, the reviewer collects some basic information on the water body and watershed for surface water, and on the drinking water source and aquifer for ground water. This information is then evaluated with parameters that indicate the relative effectiveness of the source and site in preventing the migration of contaminants to the water supply.

In general, the intent of the Physical Barrier Effectiveness determination is to highlight the sources that have "high" or "low" effectiveness. Most sources will have "moderate" PBE. A more detailed review of the Physical Barrier Effectiveness at a site can be done during the development of a local source water protection program (see Section 11.0).

Surface Water

For surface water, the PBE evaluation considers several parameters including the size of, and detention time in, the reservoir, topography, geology, soils, vegetation, precipitation and ground water recharge. The size of the watershed is also important to consider, in terms of its potential for dilution or retardation of contaminants.

As shown in Appendix C, in order to get a high PBE ranking, all the parameters for a source must have values that indicate an effective barrier. For example, a source with a high PBE would be in flat terrain, with low precipitation and non-erosive soils covered by grassland.

A source is considered to have low PBE (i.e. high potential for contamination), if any of the parameters have values that do not indicate an effective barrier. For example, a source would be considered to have a low PBE if the watershed has steep slopes or if the soils are erodible or have high runoff potential.

For surface water, all sources that do not clearly have a low or high PBE are considered to have a moderate PBE. To be conservative (i.e., health protective), if any of the parameters is unknown, the drinking water source is considered to have low physical barrier effectiveness.

Ground Water

For ground water, the evaluation of Physical Barrier Effectiveness first considers the degree of confinement of the aquifer. An aquifer is classified as confined or unconfined (which includes semi-confined, leaky, and unknown). Detailed review is necessary to determine that an aquifer is confined. Table 6-1 lists indicators to consider in determining the presence or degree of confinement of an aquifer. In general, DHS will assume that an aquifer is unconfined unless detailed hydrogeologic information is available that clearly indicates that the aquifer is confined. Fractured rock aquifers, for purposes of the PBE analysis, are included in the unconfined aquifers, due to the complexity of their flow patterns.

PBE of Confined Aquifers

Confined aquifers generally are considered highly effective in preventing the migration of contaminants. However, the PBE may be diminished if abandoned or improperly destroyed wells are present that corrupt the integrity of the confining layer. The PBE may be improved if the hydraulic head in the confined aquifer is higher than the hydraulic head of aquifers above (i.e., the well exists under artesian conditions). The construction of the well can impact the effectiveness in retarding contaminants, particularly the presence of a properly constructed sanitary seal.

PBE of Unconfined Aquifers

For aquifers that are unconfined, semi-confined or of unknown confinement, the PBE evaluation next considers the soil materials in the aquifer. Wells in fractured rock are always considered to have low PBE due to the high transport velocities that can occur within fractures. Sources in porous media that have a thick continuous layer of clay above the water table have more effective barriers, similar to confined aquifers.

Abandoned or improperly destroyed wells within the protection zones for a source can decrease the effectiveness of the barrier. Because of the prevalence of abandoned and improperly destroyed wells, and the difficulty of locating them, they are considered to decrease the effectiveness of all ground water sources unless their absence can be assured.

In unconfined aquifers, water level conditions of a well can impact the likelihood that contaminants may be drawn to the well. Greater depths to ground water are more effective at preventing contamination. Wells with high production rates, short screened

intervals and perforations located close to the top of the water table are more likely to pull contaminants towards the well.

As with unconfined aquifers, the construction of the well in a confined aquifer can impact its effectiveness in retarding contaminants, particularly the presence of a properly constructed sanitary seal.

The procedures for determining PBE for ground water use the checklist in Appendix J. A ground water source is assigned points for each parameter on the Physical Barrier Effectiveness checklist. The points are totaled to arrive at a PBE score for the source, ranging from a low of 0 points to a high of 100 points. The PBE points in themselves are not a quantitative value; rather they are used to determine the overall PBE rating for the source: low, moderate or high.

Physical Barrier Effectiveness
Score Interpretation

Point Total	PBE
0 to 35	Low (includes all sources in fractured rock)
36 to 69	Moderate
70 to 100	High

Notes on Physical Barrier Effectiveness checklist for ground water:

- **The highest score a source in a confined aquifer can get is 100 (High PBE). The lowest score a source in a confined aquifer can get is 40 (Moderate PBE).**

  - The highest score a source in an unconfined aquifer can get is 70 (High PBE). Without having a clay layer 25' thick, the highest score for a source in an unconfined aquifer is 60 (Moderate PBE).

- The only sources that can get High PBE are those in confined aquifers, and those in unconfined aquifers with a clay layer, with no abandoned or improperly destroyed wells in the protection zones.

- All sources in fractured rock are considered to have Low PBE.

8.2.2 Modifying the Risk Ranking for a PCA

As described in Section 7.0, the PCA inventory includes a ranking of the potential risk or threat of contamination to a drinking water source for each type of PCA. In the inventory, activities that are considered to have a high potential for pollution of drinking

water sources are designated "very high" or 'high" risk. Other activities having lower potential for drinking water pollution are designated "moderate" or "low" risk.

The risk ranking provides a simple approach to comparing the relative risk of types of PCAs. The risk rankings are based on the general nature of the activities and the contaminants associated with them (refer to Table 7-2), not on the density (number of facilities) or facility-specific information, such as management practices.

Comments were received regarding the ability to modify the risk ranking for an individual facility for a type of PCA. The DWSAP program is intended to be a simple, first-cut screening tool. Further detail, such as modifying the risk ranking of types of PCAs (Appendix E or L), is an optional part of the minimum drinking water source assessment. Evaluation of site-specific information may best be performed during the development of a local protection program (see Section 11.0).

8.2.3 Determination of Vulnerability

DHS has developed a simple approach to substitute for a detailed vulnerability determination. The vulnerability analysis uses the PCA inventory and the Physical Barrier Effectiveness determination to prioritize the list of types of PCAs in order to determine to which the drinking water source is <u>most</u> vulnerable.

The vulnerability ranking process is shown in Appendix F for surface water sources and Appendix K for ground water sources. The process involves reviewing each type of PCA identified in the inventory (and those types of PCAs whose presence is unknown) and assigning points based on the risk ranking of the type of PCA, the zone in which it occurs, and the Physical Barrier Effectiveness of the drinking water source. The points are added together, and the types of PCAs are prioritized according to points from highest to lowest, with the highest points representing the types of PCAs to which the source is most vulnerable. Finally, a cutoff point is identified, and the source is not considered vulnerable to types of PCAs with points below the cutoff.

As with the PBE scores, the vulnerability points in and of themselves do not have a quantitative value. Rather, the points are used to relatively rank the types of PCAs for an individual source. The ranking is intended as a preliminary tool to facilitate local source water protection programs that are site-specific.

The steps in the vulnerability ranking are listed below. The points for each element and the process for adding the points and assessing the relative vulnerability can be found following the steps.

1. Determine if any contaminants have been detected in the water supply (the information collected for use in the Consumer Confidence Report may be used for this purpose).

2. Determine, to the extent practical, the types of PCAs associated with detected contaminants.

3. For each type of PCA identified as existing in the protection zone(s), or as unknown, determine the number of points for the associated risk ranking.

4. For each type of PCA, determine the zone in which it occurs and add the points associated with that zone. If that type of PCA exists within more than one zone, repeat the process for each zone.

5. For each drinking water source, determine the Physical Barrier Effectiveness (PBE) and add the points associated with that PBE (these points are for Low, Moderate and High PBE as shown below).

6. Prioritize the types of PCAs by the vulnerability points, from the most points to the least.

7. The drinking water source is vulnerable to all types of PCAs with vulnerability points above the cutoff. Refer to the appropriate Vulnerability Matrix below.

8. The drinking water source is <u>most</u> vulnerable to PCA types with the highest vulnerability points, and to those PCA types associated with a contaminant detected in the water source, regardless of the vulnerability points.

9. The drinking water source is considered vulnerable to types of PCAs whose existence is Unknown, if the vulnerability points are equal to or greater than the cutoff.

Points for Vulnerability Analysis

PCA Risk Ranking Points:

Very High	7
High	5
Moderate	3
Low	1

Zone Points:

Surface Water (Zones defined)		Surface Water (Zones not defined)		**Ground Water**	
Zone A	= 5	Watershed	= 5	Zone A	= 5
Zone B	= 3			Zone B5	= 3
Remainder of Watershed	= 1			Zone B10	= 1
Unknown	= 0	Unknown	= 0	Unknown	= 0

Physical Barrier Effectiveness points:

Low	5
Moderate	3
High	1

Vulnerability Matrix for SURFACE WATER SOURCES

The cutoff point for vulnerability is **11**. The drinking water source is considered Vulnerable to all PCA's with Vulnerability Score greater than or equal to **11** (shaded boxes).

PCA points	**Zone points**		**PCA + Zone points**	PBE Points			**Vulnerability Score PCA + Zone + PBE points**		
Risk Ranking	Zones Defined	Zones Not Defined		Low	Med	High	PBE Low	PBE Med	PBE High
VH (7)	A (5)	Watershed (5)	12	5	3	1	17	15	13
VH (7)	B (3)		10	5	3	1	15	13	11
VH (7)	Watershed (1)		8	5	3	1	13	11	9
VH (7)	Unknown (0)*	Unknown (0)*	7	5	3	1	12	10	8
H (5)	A (5)	Watershed (5)	10	5	3	1	15	13	11
H (5)	B (3)		8	5	3	1	13	11	9
H (5)	Watershed (1)		6	5	3	1	11	9	7
H (5)	Unknown (0)*	Unknown (0)*	5	5	3	1	10	8	6
M (3)	A (5)	Watershed (5)	8	5	3	1	13	11	9
M (3)	B (3)		6	5	3	1	11	9	7
M (3)	Watershed (1)		4	5	3	1	9	7	5
M (3)	Unknown (0)*	Unknown (0)*	3	5	3	1	8	6	4
L (1)	A (5)	Watershed (5)	6	5	3	1	11	9	7
L (1)	B (3)		4	5	3	1	9	7	5
L (1)	Watershed (1)		2	5	3	1	7	5	1
L (1)	Unknown (0)*	Unknown (0)*	1	5	3	1	6	4	2

* Source is considered vulnerable to types of PCAs that are Unknown, if the Vulnerability Score is 11 or higher.

Vulnerability Matrix for GROUND WATER SOURCES

The cutoff point for vulnerability is **8**. The drinking water source is considered Vulnerable to all PCA's with Vulnerability Score greater than or equal to **8** (shaded boxes).

PCA points	**Zone points**	**PCA + Zone points**	PBE Points			**Vulnerability Score PCA + Zone + PBE points**		
Risk Ranking	A, B5, B10		Low	Med	High	PBE Low	PBE Med	PBE High
VH (7)	A (5)	12	5	3	1	17	15	13
VH (7)	B5 (3)	10	5	3	1	15	13	11
VH (7)	B10 (1)	8	5	3	1	13	11	9
VH (7)	Unknown (0) *	7	5	3	1	12	10	8
H (5)	A (5)	10	5	3	1	15	13	11
H (5)	B5 (3)	8	5	3	1	13	11	9
H (5)	B10 (1)	6	5	3	1	11	9	7
H (5)	Unknown (0) *	5	5	3	1	10	8	6
M (3)	A (5)	8	5	3	1	13	11	9
M (3)	B5 (3)	6	5	3	1	11	9	7
M (3)	B10 (1)	4	5	3	1	9	7	5
M (3)	Unknown (0) *	3	5	3	1	8	6	4
L (1)	A (5)	6	5	3	1	11	9	7
L (1)	B5 (3)	4	5	3	1	9	7	5
L (1)	B10 (1)	2	5	3	1	7	5	1
L (1)	Unknown (0) *	1	5	3	1	6	4	2

* Source is considered vulnerable to types of PCAs that are Unknown, if the Vulnerability Score is 8 or higher.

8.3 Uses of Vulnerability Analyses

The prioritized list from the vulnerability analysis may be used by a water system in developing protection measures to address activities that are most significant to the water supply.

In addition, the prioritized list will be useful to DHS to determine drinking water sources that may be eligible for chemical monitoring relief.

The prioritized list may also be useful on a statewide basis in determining the types of activities that represent the greatest threats to drinking water supplies, their proximity to drinking water sources, and an estimate of their prevalence.

The PBE determination may be useful for a water system in comparing water sources to each other, and identifying the ones that are at greater risk. The PBE determination may be useful on a state-wide basis in determining areas where sources with high or low effectiveness may be concentrated.

8.4. Vulnerability Assessment Procedures in California Regulations

Existing California regulations detail the vulnerability assessment procedures required to obtain a waiver for monitoring certain organic and inorganic chemicals in drinking water supplies.

California Code of Regulations (CCR), Title 22, Chapter 15, Section 64432(l) addresses vulnerability waivers for cyanide:

> (l) A water system may be eligible for a waiver from the monitoring frequencies for cyanide specified in paragraph (b)(1) of this section without any prior monitoring if it is able to document that it is not vulnerable to cyanide contamination pursuant to the requirements in section 64445(d)(1) or (d)(2). *(See below).*

CCR, Title 22, Chapter 15, Section 64432.2 addresses vulnerability waivers for asbestos for ground water systems:

> The Department will determine the vulnerability of ground water sources on the basis of historical monitoring data and possible influence of serpentine formations.

CCR, Title 22, Chapter 15, Section 64445(d)(1) and (2) addresses waivers for organic chemicals based on use and susceptibility:

(d) A water system may apply to the Department for a monitoring waiver for one or more of the organic chemicals on Table 64444-A in accordance with the following:

(1) A source may be eligible for a waiver if it can be documented that the chemical has not been previously used, manufactured, transported, stored, or disposed of within the watershed or zone of influence and therefore, that the source can be designated non-vulnerable.

(2) If previous use of the chemical locally is unknown or the chemical is known to have been used previously and the source cannot be designated non-vulnerable pursuant to Paragraph (d)(1), it may still be eligible for a waiver based on a review related to susceptibility to contamination. The application to the Department for a waiver based on susceptibility shall include the following:

(A) Previous monitoring results;
(B) user population characteristics;
(C) proximity to sources of contamination;
(D) surrounding land uses;
(E) degree of protection of the water source;
(F) environmental persistence and transport of the chemical in water, soil and air;
(G) elevated nitrate levels at the water supply source; and
(H) historical system operation and maintenance data including previous Departmental inspection results.

page intentionally blank

9.0 Implementation of the Drinking Water Source Assessment Program

California is mandated by federal law to conduct the assessment portion of DWSAP Program. However, time and financial resources are not sufficient to enable DHS to perform comprehensive, detailed assessments, though the state will provide guidance, recommendations and technical assistance to water systems that choose to do more detailed assessments on their own.

A completed drinking water source assessment will likely be a future requirement for water systems to obtain or continue chemical monitoring waivers. Existing regulations require a vulnerability analysis for waivers (see Section 8.4). The assessment procedures will fulfill the vulnerability analysis requirements.

DHS encourages large systems to do their own source water assessments. Large public water systems with surface water sources should make use of their watershed sanitary surveys to satisfy the requirement for a drinking water source assessment. DHS considers a watershed sanitary survey completed in accordance with existing watershed sanitary survey guidance to satisfy most of the assessment components of the Program.

Systems that have performed evaluations for their ground water sources (e.g., work done for Assembly Bill 3030 Groundwater Management Plans) may find that, depending on the extent of those evaluations, they may satisfy all or portions of the components of the DWSAP Program.

DHS plans to conduct source water assessments for those sources not voluntarily assessed by public water systems or by local primacy agency (LPA) counties. The methods herein describe DHS' approach to conducting the assessments; this defines the minimum components of a source water assessment.

9.1 Source Location

In the course of routine inspection and permitting activities, DHS will determine locations (latitude and longitude) of wells and surface water intakes as accurately as possible, via Global Position System (GPS), using GPS units with a sensitivity (accuracy) of 25 meters or less. The 25-meter accuracy goal is based on US EPA's Locational Data Policy.

Each drinking water source may not receive a site visit during EPA's time frame for source water assessments (1999 – May 2003). For purposes of completing the assessments, DHS will determine interim locations through the use of USGS quadrangle maps (7.5 minute series), and make use of locational data from other sources (i.e., public water systems). The method for determining locations and the associated accuracy of the method will be recorded.

9.2 Source Area and Protection Zone Delineation

Because of limited resources and time constraints, DHS does not anticipate using the more sophisticated models described in Section 6.0, and instead will use simplified methods. However, drinking water systems that choose to do their own assessments may utilize more complex models, with DHS concurrence.

For surface water sources, DHS will delineate the entire watershed as a source area, and will define protection zones if warranted.

For ground water sources, the source area will be comprised of the recharge area and delineated protection zones. DHS will generally delineate protection zones by using the calculated fixed radius method.

For noncommunity water systems with ground water sources, DHS may use the arbitrary fixed radius method. For transient-noncommunity water systems, DHS may establish only one protection zone for acute contaminants (bacteriological and nitrate) at the minimum distance for Zone A (600' in porous media, 900' in fractured rock).

Recharge areas will be identified to the extent that they can be determined from readily available information.

9.3 Inventory of PCAs

Details of the PCA inventory are presented in Section 7.0.

DHS will use readily available information from state and local programs. As part of the DWSAP program, DHS will collaborate in improving the accessibility of data from state agencies. Some of this data may currently be accessible electronically, as mentioned in Section 7.1.

For transient-noncommunity water systems, DHS may limit the inventory to activities associated with bacteriological and nitrate contamination. Readily available state-wide databases may also be reviewed.

9.4 Vulnerability Analyses

Details of the vulnerability analysis procedures are presented in Section 8.0.

DHS will use information in water system files to evaluate Physical Barrier Effectiveness (PBE), and will rank types of PCAs based on risk rankings and proximity to the source. DHS will not include the density of facilities or facility-specific information in the vulnerability analysis.

For transient-noncommunity water systems, DHS may use a default PBE of Low, and the source will be considered most vulnerable to all activities identified in the reduced inventory.

9.5 Completion of Assessments and Summary

A checklist for a completed source water assessment is presented in Appendix G for a surface water source and Appendix K for a ground water source.

DHS will prepare a summary of each assessment that includes the assessment map and the prioritized list of the types of PCAs identified in the inventory, noting the ones to which the source is most vulnerable.

DHS will prepare vulnerability summary for assessments using standardized language. Specific information for each source, or a group of sources if appropriate, will be inserted in the summary. The language is not yet developed, but it will probably be similar to the following:

> *"An assessment of the drinking water source(s) for XYZ water system was completed in month and year. The source(s) are considered most vulnerable to the following activities associated with contaminants detected in the water supply: _____, _____, _____. In addition, the source is considered most vulnerable to these activities: _____, _____, _____.*
>
> *"A copy of the complete assessment is available at DHS District Office address or Water System Address. You may request a summary of the assessment be sent to you by contacting DHS district engineer or Water System Representative at phone number."*

9.6 Availability of Assessment Results to the Public

Copies of completed assessment results (including inventory forms, maps, and other information described in Appendices G and K) will be available for public review in DHS district field offices and are recommended to be available for public review at the office of the public water system. The means of providing results of assessments at other locations will be dictated by the size and complexity of the assessments, and by local interest.

DHS will send out the summary of an assessment upon request.

If DHS conducts the assessment, DHS will send the vulnerability summary for the assessment to the water system for inclusion in the annual consumer confidence report.

9.7 Updating Information

DHS recommends that assessments be reviewed and updated every five years. DHS will update assessments, to the extent possible, in the course of routine activities.

Water systems, as part of an assessment update, may solicit comments from local agencies and the public, or others who may have suggestions of additional information that should be included or other possible improvements. Where a local drinking water source protection program has been put in place, DHS anticipates that information from that program would be included in any assessment updates.

9.8 Anticipated Schedule for Drinking Water Source Assessments

As mentioned above, a number of activities required under existing law (e.g., watershed sanitary surveys for surface water sources) are related to surface water and ground water assessment and protection. These activities will proceed and can be incorporated easily into the DWSAP Program.

There are approximately 16,000 active drinking water sources in California (Table 9.1), and several thousand standby and inactive sources. Given the resource limitations (approximately $7.5 million from the federal Drinking Water State Revolving Fund, or roughly a few hundred dollars per source), DHS envisions scheduling its assessments according to its normal three- to five-year cycle for water system inspections. Further, since public water systems with surface water sources need to update watershed sanitary surveys on a five-year cycle, that requirement will dictate the schedule for surface water sources. To the extent that public water systems elect to conduct their own assessments, the schedule will be modified (See Section 9.9).

DHS intends to expeditiously conduct assessments throughout the time period 1999 - May 2003 generally according to the following priortized list:

1. Community water systems with more than 1,000 and up to 10,000 service connections, approximately 660 ground water sources (100 systems) and 50 surface water sources (30 systems) per year.

2. Community water systems with 200 to 1,000 service connections, approximately 280 ground water sources (90 systems) and 30 surface water sources (25 systems) per year.

3. Community water systems with fewer than 200 service connections, approximately 670 ground water sources (540 systems) and 60 surface water sources (50 systems) per year.

4. Nontransient-noncommunity water systems, approximately 280 ground water sources (240 systems) and 10 surface water sources (10 systems) per year.

5. Transient-noncommunity water systems: approximately 980 ground water sources (approximately 940 systems) and 80 surface water sources (80 systems) per year.

6. Community water systems with more than 10,000 service connections, approximately 840 ground water sources (40 systems) and 50 surface water sources (20 systems) per year.

Standby and inactive sources will not be scheduled for a source water assessment during this period, unless they are activated. If activated after April 1, 2003, public water systems will need to complete a source water assessment for standby and inactive sources before they can be used.

New sources will be assessed by the public water systems that intend to bring them on line (see Section 10.0).

DHS intends assessments to be completed by May 2003, in order to meet the federally-required completion deadline.

The overall order for conducting drinking water source assessments will change if some public water systems complete their own assessments, as discussed in the next section.

9.9 Assessments Done Voluntarily by Drinking Water Systems

As mentioned previously, conducting drinking water source assessments is the responsibility of DHS. However, drinking water systems are not precluded from conducting their own, upon notification to DHS, and they may voluntarily choose to do so.

A number of public water systems have already performed evaluations that may satisfy many of the components of the drinking water assessment. A watershed sanitary survey, for example, has been mentioned throughout this document as an example of previously conducted work for surface water sources that will largely satisfy the assessment components of the DWSAP program. Some public water systems may have already conducted similar kinds of evaluations for their ground water sources of drinking water.

Those systems should contact the DHS district office to determine whether their prior work or portions of it are sufficient to satisfy the needs of the DWSAP Program.

There are a number of benefits to a drinking water system that has a complete comprehensive assessment of its sources. These include:

- DHS will incorporate the DWSAP approach for assessing vulnerability into its determination for monitoring waivers (see Section 8.4). A deadline will likely be established beyond which any waiver renewals will be subject to the new approach.

- Source water assessments will be a prerequisite for gaining access to State Revolving Fund monies for local source water protection projects and programs (see Section 11.0).

- DHS will incorporate assessment procedures into the permit requirements for new sources (see Section 10.0).

- A drinking water system may be qualified for some relief of regulatory requirements under the anticipated Ground Water Rule if it has completed a comprehensive source water assessment.

- A comprehensive assessment can serve as a document to share with land use planning agencies.

- For communities interested in source water protection activities, the DWSAP assessments provide the basic information to begin those activities.

- A comprehensive assessment will contribute to the institutional memory of a drinking water system.

- A comprehensive assessment brings a variety of information together in a single place.

- A comprehensive assessment can provide a drinking water system with a useful public relations and public information tool.

Based on the history of implementing other drinking water-related programs in California, DHS believes that some systems will proceed with conducting their own source water assessments. Those water systems that plan to conduct their own assessments will need to notify DHS by December 31, 2000, submit a progress report to DHS no later than February 2002, and submit the final assessment to DHS no later than

January 1, 2003, to enable departmental review. Those systems intending to incorporate the drinking water source assessment into their scheduled watershed sanitary survey update cycle should inform DHS and indicate when the update will be available (no later than January 1, 2003).

An estimate of the possible implementation is as follows:

Large water systems (>10,000 service connections). DHS expects that these systems will voluntarily conduct all the elements of a source water assessment, with some data tools provided by DHS and other agencies.

Medium water systems (>1,000 to 10,000 service connections). DHS expects that most of these systems will voluntarily conduct some of the elements of a source water assessment (location of drinking water sources, delineation of source areas and protection zones, PCA inventory, dissemination of assessment results to the public). Roughly half of these systems are expected to conduct their vulnerability analyses with technical support by DHS and other agencies. The remainder will be performed by DHS.

Small water systems (<1,000 service connections). DHS and LPA counties are expected to conduct all of the source water assessments for these systems, using State Revolving Fund monies. Some may be able to conduct their own PCA inventories.

For drinking water systems or communities that want to immediately embark on voluntary source water protection programs (see Section 11.0), incorporation of the source water assessment steps into those programs is appropriate, and is encouraged by DHS.

DHS will have to conduct the assessments if they are not completed by public water systems.

Table 9-1. Distribution of California's 15,984 active drinking water sources by public drinking water system size and source type.

System Size, by Service Connections (SCs)	Ground Water		Surface Water	
	Systems	Sources	Systems	Sources
>10,000 SCs	152	3,362	74	165
1,000–10,000 SCs	394	2,656	130	192
200–1,000 SCs	359	1,130	102	134
<200 SCs	2,151	2,689	209	226
Non-Transient	964	1,135	47	48
Transient	3,773	3,929	313	318
Total	7,793*	14,901	875*	1,083

* Some systems have both ground water and surface water sources, and are included in each column. Therefore, the total of 8,668 ground water and surface water systems presented in this table exceeds the actual number of systems.

10.0 New Drinking Water Sources

New water systems, or existing water systems that add a source of supply, are required to submit a permit application to DHS (California Health and Safety Code, Section 116525, et seq.). As part of the permit application, the water system is required to submit a technical report. DHS will incorporate the DWSAP assessment procedures into the permit requirements for new drinking water sources. The assessment will be considered in the permitting of the source.

Assessment work that has been done for existing drinking water sources may be useful in fulfilling these requirements.

As part of the permit application the water system will be required to submit the minimum components for an assessment as described in Section 3.0 and listed here (pertinent sections of this document are noted):

✓**Location of the Drinking Water Source.** Section 9.1 and Appendix A or H.

✓**Delineation of Source Areas and Protection Zones.** Section 6.0, and Appendix B or I.

✓**Inventory of Possible Contaminating Activities (PCAs).** Section 7.0 and Appendix D or K.

✓**Physical Barrier Effectiveness Checklist.** Section 8.0 and Appendix C or J.

✓**Vulnerability Ranking – Prioritized Listing of PCAs.** Section 8.0 and Appendix F or M.

✓**Assessment Map.** Section 6.3 and Appendix G or N.

✓**Drinking Water Source Assessment Checklist.** Appendix G or N.

Water systems are encouraged to conduct a preliminary assessment before constructing new drinking water sources.

Voluntary protection activities for new sources would be similar to those for existing sources, as discussed in Section 11.0.

page intentionally blank

PART FOUR

Voluntary Drinking Water Source Protection Programs

A description of the approach public water systems and communities may wish to use in developing source water protection programs

Section 11—Implementation of a voluntary source water protection program

Section 12—Management approaches within source areas and protection zones

Section 13—Contingency planning for drinking water supplies

page intentionally blank

11.0 Implementation of A Voluntary Source Water Protection Program

A voluntary drinking water source water protection plan offers a public water system or community an opportunity to build on work done for drinking water source assessments.

The goal of a local source protection program is to identify, develop and implement local measures that advance the protection of the drinking water supply. A local program should maximize use of existing data and develop more detailed information, drawing on local knowledge.

The following steps are recommended for drinking water systems or communities that choose to implement a voluntary source water protection program.

- Review the State's DWSAP Program
- Establish a local advisory committee
- Review the initial drinking water source assessment and determine if and where to expand and refine it. Activities that may be appropriate include:
    - Gathering additional information
    - Revising delineations of the source area and protection zones, if necessary
    - Refining and updating the inventory of possible contaminating activities (PCAs)
    - Reviewing the vulnerability analysis and vulnerability ranking
    - Prioritizing the contaminant activities that need to be studied more closely based on vulnerability of the drinking water source
- Prepare reports and maps
- Develop a protection program based on revised assessment
- Submit the protection program (and revised assessment) to DHS, other agencies, and the public
- Implement the protection program and its management approaches
- Conduct contingency planning

The sharing of information is encouraged, especially among drinking water systems or communities with common delineated source areas or protection zones, or those that share aquifers or watersheds. DHS recommends that communities and systems with common interests work together on protection programs. The DHS' local offices can provide examples of groups of water systems that have joined together to work on similar projects (e.g., watershed surveys).

Smaller systems, whose source areas and protection zones lie within the source areas and/or protection zones of a larger system, may be able to make use of the information developed by the larger system, as well as provide information to the larger system.

More detail about some of the steps is provided below.

11.1 Involve the Public during Development of a Source Water Protection Program

A successful source water protection program requires that drinking water systems or communities involve the public. Such involvement may be through local public advisory groups or the use of volunteers for information collection, to name two examples. Representatives from a variety of stakeholder groups (See Table 4-1) may be appropriate to include in forming local advisory groups.

11.2 Review initial source water assessment and determine whether revisions are appropriate

The source water assessment for the drinking water source should be reviewed to determine whether it should be updated or revised. Revisions of the assessment, if appropriate, could be made on the delineation, the PCA inventory, the vulnerability analysis or a combination of these elements.

Delineation

Local drinking water systems or communities may revise the source areas or protection zones that were used in the initial assessment, based on more detailed or more accurate data. Various methods for delineating source areas and protection zones are described in Section 6.0.

PCA Inventory

As with the original assessment, gathering supplemental information should be coordinated with the work of various state, local and federal agencies. It should also make use of the permits issued and the enforcement actions taken. Some examples of these are presented in Sections 5.0 and Sections 7.0 of this document. Some communities have inventoried PCAs on a parcel-by-parcel basis, sometimes by using volunteers from the community.

As part of a local protection program, other potential contaminants associated with particular activities could be considered besides those subject to drinking water

regulation (see Section 7.0). Those could include the following: US EPA's priority pollutants; chemicals that are subject to the Toxic Release Inventory; California's list of hazardous substances; chemicals identified as causing cancer or birth defects or other reproductive harm for purposes of California's Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65"); or chemicals for which permits are issued by the Regional Water Quality Control Board.

Supplemental inventories could include research of written documents, review of land use data, conducting surveys, and field reconnaissance. Each of these methods is described in more detail below.

Written documents include those maintained by federal, state, and local agencies, such as lists, inventories, records and other items that would identify the following: underground or above ground storage tanks, federal Superfund sites, contamination sites, landfill locations, septic systems, and other state and locally regulated activities. Other documents include telephone directories, business records, property tax records, news articles, and historical or archival information.

Land use data can help identify possible contaminant activities or sources of pollution. These can often be identified from information that may be available from the local planning or building departments. These may include aerial photographs, topographic maps, zoning maps, and building permits.

Surveys may also be done to confirm or supplement information collected by other means. The surveys can be prioritized by type of PCA or by zone. Types of surveys include mail questionnaires, telephone surveys, personal interviews, and automobile windshield surveys.

A field review may be done to identify land uses and to look for potential sources of contamination not clearly identified by the previous methods. Items to document could include: abandoned or improperly destroyed wells, closely spaced septic systems, point source and non-point source contaminants, unauthorized activities and changes in business use.

Vulnerability Analysis

The objective of the vulnerability analysis in a protection program is to more accurately determine which of the types of PCAs pose the greatest threat to the water supply. Procedures for the minimum assessment are described in Section 8.0.

The physical barrier effectiveness determination could be modified based upon more detailed information on the hydrology or hydrogeology of the watershed or aquifer, and the source. Water systems may choose to use a different method to evaluate physical barrier effectiveness, provided that it considers the same factors as the DWSAP method.

The vulnerability ranking could be modified by considering additional information on some or all of the PCAs. The density (number of facilities) and the quantity and/or extent of the area that the type of PCA occupies in the protection zone could be included in determining potential risk.

In addition, facility-specific information (compliance, construction, operation, etc.) could be considered. Appendix E or L may be useful for this purpose.

Update of assessment maps

Results of the revised assessment could be illustrated on an updated map that identifies the drinking water source, source areas and protection zones, and PCAs to which the source is most vulnerable. Such a map is helpful in the development of a protection program and in describing the program to the public.

Follow-Up Iterations

Iterations are important in this process, particularly since, for many drinking water systems, a simple approach will be used for the initial assessment. A simple delineation and inventory may suggest that a drinking water source is at risk of contamination, while a more detailed approach may show that the "risk" initially identified reflected the assumptions used and not the actual situation.

11.3 Initiate Protection Measures, If Appropriate

If the drinking water source is vulnerable to contamination, protection measures may be taken. These might include increased monitoring, abatement or remediation of the contaminant source, planning for an alternative source of supply, or other management activities, as described in Sections 12.0 and 13.0.

11.4 Provide Information to the Public

When the drinking water system or community decides to make the findings of its protection efforts available to the public, the following methods are examples of those that may be used.

- Provide documents for review in public libraries
- Provide documents for review at county health/environmental health department
- Issue press releases that refer public to locations of documents for public review
- Mail notice to organizations identifying locations of documents for public review
- Mail notice to customers of locations of documents for public review

- Hold a public meeting that describes the findings of the protection program and refers to locations of documents for public review
- Mail assessment map and summary to customers/public
- Provide results or a summary in annual consumer confidence report to customers/public
- Make results available by electronic access (e.g., Internet)

In all cases, copies of source water assessment and protection reports should be provided to DHS.

11.5 Update Source Water Assessment and Protection Information

The public water system or community should develop a schedule for updating its protection program. To be consistent with source water assessments, the protection program should be reviewed for possible update every five years.

Information for the public should be updated based on revised assessment maps and follow-up iterations as described in Section 11.2. This will ensure that the public receives the most up-to-date and accurate information.

page intentionally blank

12.0 Management Approaches within Source Areas and Protection Zones

Source water protection is not a mandated element of the EPA's Source Water Assessment Program requirements. However, protection is required for a complete wellhead protection program. EPA and DHS encourage development of protection programs for all sources, recognizing that prevention of contamination is of greater benefit to the public and to drinking water utilities than dealing with it after the fact, through expensive drinking water monitoring and treatment and other expensive environmental cleanup activities.

A drinking water system with a completed source water assessment and a protection program may be eligible for waivers from monitoring. As mentioned previously for the assessment program, the State could require protection programs to be in place for permitting and waivers, particularly for water systems with sources that have detected levels of a regulated or unregulated chemical.

Drinking water systems and communities are encouraged to develop management strategies to mitigate the impact and risk of contamination of the drinking water supply. Another activity related to the DWSAP is contingency planning, which is discussed in Section 13.0

Management within source water protection areas is primarily the responsibility of local governments and public drinking water systems, supported and guided by State policies and programs. Source water protection activities in California can be divided into three categories. Each category is described below:

1. State programs related to drinking water source protection
2. Recommended guidelines for management in protection areas
3. Local management activities

12.1 State Programs Related to Drinking Water Source Protection

Existing state programs to protect water supplies and to inventory, regulate, and clean up contaminant sources are described in Section 5.0, Roles and Responsibilities of Government Agencies.

DHS will actively promote the development of local drinking water source protection programs. DHS' activities to promote protection of drinking water supplies include technical assistance, financial assistance, training, education, and demonstration projects.

As each assessment performed by DHS is completed, the information will be shared with the public water system along with guidance for local protection programs.

Technical Assistance

The DHS Drinking Water Program has a source water (wellhead) protection coordinator available to assist local agencies with protection programs. In addition, staff at Drinking Water Program district offices are available for assistance, if requested. These DHS personnel can make presentations to water suppliers and community groups about source water protection, and can review technical elements of proposed programs.

Financial Assistance

California is establishing a State Revolving Fund (SRF) for drinking water. These funds will be primarily targeted to water system infrastructure improvements. However, some portion of the funding will be available for source water protection activities. The state is currently developing guidelines for the SRF program.

Training

DHS, in conjunction with EPA, is preparing a training program in source water protection for utility operators, managers and board members. This training will be offered for the first time in 1999, and on a repeating basis thereafter throughout the state. Other organizations may offer training as well.

Education

DHS will be preparing educational materials for use by water utilities, community groups, and other interested parties. These materials may include additional guidance documents for implementation of the DWSAP Program.

Demonstration Projects

DHS is participating in several demonstration projects. The first community demonstration project is focused on ground water sources of the City of Sebastopol in Sonoma County. The project is funded by the City of Sebastopol, with DHS providing project coordination and technical assistance. Another demonstration project is a drinking water source protection program for Yosemite National Park, funded by the US EPA and DHS. Additional ground water (wellhead) demonstration projects may develop, including some in conjunction with the California Rural Water Association.

Directory of Source Water Protection-Related Activities

DHS has prepared a directory of agency programs (see Section 5.0) to enable drinking water systems and communities to access pertinent information for drinking water source protection activities. The data directory will be available through the Internet.

12.2 Recommended Guidelines for Management in Source Areas and Protection Zones

The protection areas and zones mentioned in the following subsections refer to those identified in Section 6.0 for surface water and ground water sources.

12.2.1 Surface Water Sources

Surface water intakes, and land areas near surface water sources should be managed to reduce the possibility of contamination. Potential origins of contamination such as septic systems should be designed and used with appropriate precautions to ensure protection of surface water from microbial organisms. Chemicals capable of contaminating surface water should not be stored or used near surface water intakes or near surface water sources of drinking water, or should be stored and used with appropriate precautions to eliminate the possibility of spills or discharges.

If zones are established within a surface water source area (i.e., watershed), the zones that are farther from the source, yet still within the watershed, allow the community to appropriately plan and site future high risk and medium risk PCAs. These zones also serve as an educational tool for industry, the general public, and others to understand the source of their drinking water and the significance of their actions within a watershed or surface water source area.

12.2.2 Ground Water Sources

Recharge Areas

Where ground water recharge areas can be identified, they should be managed in a manner generally similar to that described above for surface water sources, using primary and secondary recharge areas (Section 6.3) to represent source areas and protection zones.

Protection Zones

Protection zones within the source area of a ground water source allow the community to appropriately plan and site future high risk and medium risk PCAs. These zones also serve as an educational tool for industry, the general public, and others to understand the

source of their drinking water and the significance of their actions upgradient or within the protection zones of their drinking water wells, and for the entire aquifer and recharge area, too.

Well Site Control Zone

The well site control zone should be managed to reduce the possibility of surface flows reaching the wellhead and traveling down the casing. It is recommended that the water purveyor own this area, or have a permanent easement. Within this zone, the immediate vicinity of the well should be fenced and locked, or may include a well house or other building. It is not necessary for the entire zone to be fenced.

Zone A - Microbial/Direct Chemical Contamination Protection Zone

Within Zone A, the protection zone established on the basis of the two-year time of travel, activities that could be potential sources of microbial or direct chemical contamination should be strictly managed to eliminate or reduce the risk of contamination of the water supply.

Potential sources of contamination such as septic systems and animal facilities should be designed and used with appropriate precautions to ensure appreciable reduction in nitrates and microbial organisms before reaching ground water or surface water.

Activities should be managed so that chemicals capable of contaminating ground water would not be stored or used, or would be stored and used with appropriate precautions to eliminate the possibility of spills or discharges.

Zones B5 and B10 - Chemical Contamination Protection Zones

Zone B5, the area within the five-year time-of-travel, should be actively managed for control of potential chemical contaminants. Within Zone B5, chemicals capable of contaminating ground water should be stored and used with appropriate precautions to eliminate the possibility of spills or discharges.

Zone B10, the area between the five- and ten-year time-of-travel, allows the community to plan and site future high risk and medium risk sources of ground water contamination at a distance from the source where they are less likely to contaminate the water supply.

Buffer Zone - Additional Chemical Contamination Zone

A buffer zone enables additional planning for particular activities that may affect the community's ground water supplies.

12.3 Local Management Measures

After identifying source areas, protection zones, and types of PCAs, and developing a vulnerability ranking, the local community or water supplier may choose to develop a management strategy for protecting the water supply. The strategy could identify measures to be accomplished at the local level, and may affect agencies, districts or other communities besides the community served by the water supply. The cooperation of the entire community is vital for source water protection management measures to work.

A source water protection management strategy could include measures that are already undertaken, and ones to implement in the future.

There are both non-regulatory and regulatory management measures that can be effective as part of a source water protection program. The easiest ones to implement are non-regulatory, such as public education, and they may be very successful. If, however, as a result of the PCA inventory and vulnerability analysis, a local community determines that the water supply is at high risk of contamination, then land use planning, permitting, and possibly more restrictive regulatory methods may be necessary to ensure protection of the water supply. Potential local management measures are listed in Table 12-1.

In assessing the merits of protection measures, consideration should be given to the costs to parties of implementing the measures, the probable effects of implementing the measures, and the benefits associated with those effects. Source water protection is a valuable tool in water quality management, but not all source water protection measures will be cost effective.

There have been a number of documents published that can assist water systems and communities in developing local protection programs. Several organizations assist with source water protection efforts. Water systems and communities are encouraged to review the resource documents listed in Table 12-2 and to contact the organizations listed in Table 12-3. In addition, DHS intends to develop state-specific guidance for local protection programs.

Table 12-1. Potential management measures for local source water protection programs.

Regulatory

Zoning

Overlay Source Water Protection Districts
Prohibition of Various Land Uses
Special Permitting
Large-Lot Zoning
Transfer of Development Rights
Cluster/PUD Design
Growth Controls/Timing
Performance Standards

Land Use Permit Conditions

New Uses – Review for ground or surface water contamination potential
Existing Uses – Require review for change in chemical type/quantity/handling
Underground Storage Tank requirements

Subdivision Control

Drainage Requirements
Impact Fees

Other

Septic System Upgrades
Toxic and Hazardous Materials Handling Regulations
Private Well Protection
Sewer system hookups

Non-Regulatory

Land Transfer and Voluntary Restrictions

Sale/Donation
Conservation Easements
Limited Development

Other

Watershed Restoration Efforts
Storm Water Monitoring
Ground Water Monitoring
- Review existing monitoring wells
- Install new monitoring wells
- Conduct sampling of existing private wells

Contingency Plans
Hazardous Waste/Used Oil Collection
Public Education
Identify Underground Injection Sources or Abandoned Wells
Notify Other Agencies with Land Use or Regulatory Authority
Groundwater Guardian *(contact Groundwater Foundation)*
Storm Drain Labeling
Fencing/ Access Restriction

Legislative

Regional Wellhead Protection Area Districts
Land Banking

Table 12-2. Documents related to source water protection and wellhead protection

California Well Standards, DWR Bulletin 74-90 and DWR Bulletin 74-81

A Guide to Wellhead Protection, Witten, J. and Horsley, S., American Planning Association, Planning Advisory Service, Report #457/458, August, 1995,

Basic Ground-Water Hydrology, USGS Publication #2220

California Groundwater Management, Groundwater Resources Association of California

Delineation of Wellhead Protection Areas in Fracture Rocks, EPA Publication EPA570991009

Ground Water and Wellhead Protection, EPA Handbook EPA625/R94001

Guide to Groundwater Supply Contingency Planning for Local and State Government, EPA Technical Assistance Document EPA4404690003

Guidelines for Delineation of Wellhead Protection Areas, EPA Publication EPA440593001

Protecting Local Ground-water Supplies through Wellhead Protection, EPA Publication EPA570991007

Wellhead Protection : A Guide for Small Communities, EPA Seminar Publication EPA625R93002

Wellhead Protection in Confined, Semi-Confined, Fractured, Aquifer Settings, EPA Publication ERIC: G-127, EPA813K93001, NTIS:PB94-109402

Wellhead Protection Programs: Tools for Local Governments, EPA Publication EPA440/6-89/002

Wellhead Protection Strategies for Confined Aquifer Settings, EPA Publication EPA570991008

Why Do Wellhead Protection? Issues and Answers in Protecting Public Drinking Water Supply Systems, EPA Publication EPA813K95001

GroundWater and Surface Water – A Single Resource, USGS Circular 1139

Table 12-3. Organizations that may assist with source water protection efforts

California Groundwater Association
P.O. Box 14369
Santa Rosa, California 95402-6369
(707) 578-4408

California Rural Water Association
8300 Fair Oaks Boulevard, Suite 302
Carmichael, California 95608
1-800-833-0322

Groundwater Resources Association of California
601 Villanova Drive
Davis, California 95616
(530) 758-3656

Water Education Foundation
717 K Street, Suite 517
Sacramento, California 95814
(916) 444-6240

The GroundWater Foundation
P.O. Box 22558
Lincoln, Nebraska 68542-2558
(402) 434-2740

National Rural Water Association
2915 South 13th Street
Duncan, Oklahoma 73533
(405) 252-0629

Farm*A*Syst / Home*A*Syst
(assessment procedures for farms and homes)
B142 Steenbock Library
550 Babcock Drive
Madison, WI 53706-1293
(608)262-0024

13.0 Contingency Planning for Drinking Water Supplies

Contingency planning to protect drinking water supplies is an essential element of a complete source water protection program. It is also required by the Safe Drinking Water Act (SDWA) and the Emergency Planning and Community Right-to-Know Act of 1986, enacted as Title III of the Superfund Amendments and Re-authorization Act (SARA).

Local governments are typically given responsibility for implementing components of a drinking water source protection program. While program requirements may vary, a public water supplier should develop a contingency plan to locate and provide alternate drinking water supplies in the event of contamination. A contingency plan should not be limited to planning for alternative supplies; it should be used to identify and to prevent both physical and operational threats from contaminating or closing a public water supply.

The following are minimum components for local contingency plans. These will ensure adequate planning, encourage reliability and consistency, and create uniform response protocols. Any local plan should be consistent with Urban Water Plans.

A contingency plan could be made a condition of a public water system's water supply permit. Such a plan is required for a complete wellhead protection program.

13.1 Contingency Planning at the State Level

Contingency planning at the state level is also an important component of the State Drinking Water Source Assessment and Protection Program. A state plan would identify state roles, responsibilities, and resources.

A State Contingency Plan could include the following activities: Analysis of the characteristics of water systems statewide; analysis of the vulnerability of surface and ground water supplies statewide; review of existing State emergency response plans; analysis of water supply replacement options statewide; evaluation of the State's technical, logistical, and financial resources to support local response activities; development of guidance and standards to direct local plan development; identification of future steps that should be taken to prevent or mitigate future disruptions; improvement of the State's ability to respond to major supply disruptions; and organization of a process for reviewing and updating the plan.

A State Contingency Plan would provide the overall framework for state and local responses and integrate other state and federal programs, and provide direction for local plans. A State

Contingency Plan could be developed after EPA approval of the State Drinking Water Source Assessment and Protection Program.

13.2 Minimum Components of Local Contingency Plans

A local contingency plan should include an assessment of the water system's ability to function with a loss of major supply, and it should address alternate supplies in case they are needed. Specific steps are identified in this section.

13.2.1 Assessment of the Ability of the Water System to Function with the Loss of the Largest Source of Supply

In order to assess the ability to function with the loss of the largest source of supply, the water supplier should do the following: (1) Identify the water system's maximum capacity considering the source, distribution system, and water rights or other restrictions; and (2) re-evaluate this capacity if the largest supply source were to be lost.

13.2.2 Development of a Plan for Alternate Water Supplies

To develop a plan for alternate water supplies, the water supplier should determine both short-term and long-term supplies, the additional capacity that would be provided from the alternate supplies, and the associated costs. The plan should consider such alternatives as: increasing production from existing sources, identifying existing and potential inter-ties with other public water systems, and installing treatment on sources not currently used because of water quality problems.

13.2.3 Development of a Spill/Incident Response Plan

Using the results of the PCA inventory, a response plan for spills and emergencies should be developed with local emergency responders. Emergency response actions to be taken should consider protection of the water supply. For example, chemical spills within the protection area should be soaked up with absorbent materials rather than being washed away to drainage systems. Similarly, in the event of a fire it may be best to allow certain facilities to burn rather than have contaminated runoff that could pollute the community water supply.

References

American Water Works Association, California-Nevada Section, 1993. *Watershed Sanitary Survey Guidance Manual*. Source Water Quality Committee, December.

California Department of Water Resources, California Well Standards, DWR Bulletin 74-81.

California Department of Water Resources, California Well Standards, DWR Bulletin 74-90.

Massachusetts Department of Environmental Protection, 1996. *Developing a Local Surface Water Supply Protection Plan.*

Todd, D.K. 1980. *Groundwater Hydrology*. 2nd Ed. New York: John Wiley & Sons.

Washington State Department of Health, Environmental Health Programs. 1995. *Washington State Wellhead Protection Program Guidance Document*. Olympia, Washington. DOH Publication 331-018, April.

US Environmental Protection Agency, 1997. *State Methods for Delineating Source Water Protection Areas for Surface Water Supplied Sources of Drinking Water*, EPA 816-R-97-008, August.

US Environmental Protection Agency, 1997. *State Source Water Assessment and Protection Programs Guidance*, Final Guidance, Office of Water, EPA 816-R-97-009, August.

Witten, J. and Horsley, S., 1995. *A Guide to Wellhead Protection*. American Planning Association, Planning Advisory Service, Report #457/458. August.

page intentionally blank

Appendices

Drinking water systems and communities that choose to perform their own source water assessments as part of a drinking water source assessment and protection program should contact their regional DHS drinking water office to make sure they are using the up-to-date version of the forms and checklists contained in the Appendices.

APPENDICES TO BE USED FOR A SURFACE WATER SOURCE

Appendix A — Drinking Water Source Location – Surface Water

Appendix B — Delineation of Surface Water Protection Zones

Appendix C — Physical Barrier Effectiveness Checklist – Surface Water Source

Appendix D — Possible Contaminating Activity (PCA) Inventory Form – Surface Water Source

Appendix E — Possible Contaminating Activities Evaluation – Surface Water Source

Appendix F — Vulnerability Analysis Procedures – Surface Water Source

Appendix G — Checklist for Drinking Water Source Assessment – Surface Water Source

APPENDICES TO BE USED FOR A GROUND WATER SOURCE

Appendix H — Drinking Water Source Location – Ground Water

Appendix I — Delineation of Ground Water Protection Zones

Appendix J — Physical Barrier Effectiveness Checklist and Well Data Sheet – Ground Water Source

Appendix K— Possible Contaminating Activity (PCA) Inventory Form – Ground Water Source

Appendix L — Possible Contaminating Activities Evaluation – Ground Water Source

Appendix M — Vulnerability Analysis Procedures – Ground Water Source

Appendix N — Checklist for Drinking Water Source Assessment – Ground Water Source

page intentionally blank

APPENDICES TO BE USED FOR A SURFACE WATER SOURCE

page intentionally blank

Appendix A

Drinking Water Source Location – Surface Water

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Location date: _____ Source located by (name of person): _____

Method of determining location:

_____ USGS quad map (7.5 minute series, 1:24,000 scale), hand calculated

_____ USGS quad map (7.5 minute series, 1:24,000 scale), computer calculated

_____ Global Positioning System (GPS)

Unit (manufacturer/model): _____

Accuracy of GPS unit (+/- _____ ft.)

_____ Other Method _____

Accuracy of method (+/- _____ ft.)

Location of intake (decimal degrees): Latitude: _____

Longitude: _____

Physical description of location [Name of surface water body, pertinent landmarks, address, or approximate address (cross streets, etc.)]:

NOTE: Indicate location of the surface water intake on the drinking water source assessment map. Map should also indicate the source area (watershed) and protection zones, if established (See other Appendices).

page intentionally blank

Appendix B

Delineation of Surface Water Protection Zones

Public water system: _____ID No.:_____

Name of source:_____ID No.:_____

Delineation date:_____Delineation conducted by _____

The delineation of protection zones for a surface water source is optional. The source area for a surface water source is the watershed.

If protection zones are established, the recommended distances are as follows:

Zone A:	400 feet from reservoir banks or primary stream boundaries
	200 feet from tributaries
Zone B:	2,500 feet from intakes

Protection zones established for this source are:

Zone A: _____feet from reservoir banks or primary stream boundaries

_____feet from tributaries

Zone B: _____feet from intakes

page intentionally blank

Appendix C

Physical Barrier Effectiveness Checklist -- Surface Water Source

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

Drinking Water Source/ Watershed Information

Note: Other methods of determine Physical Barrier Effectiveness may be acceptable. Consult with DHS.

Note: Most of the following information should be available from the Watershed Sanitary Survey of the water source.

1. Is the source an impounded reservoir or a direct stream intake?
    a. Reservoir
    b. Stream intake
    c. Other, describe: _____

2. Source Characteristics
    a. Area of tributary watershed: _____ acres or square miles
    b. Area of water body within watershed: _____ acres or square miles
    c. Volume of water body: _____ acre-feet
    d. Maximum rate of withdrawal through intake: _____ gallons per day
    e. Are the primary tributaries seasonal, perennial or both? _____

3. What is the approximate travel time to the intake for water at farthest reaches of the impounded water body?
    a. Source is direct intake, no impounded water body
    b. Less than 30 days, or unknown
    c. More than 30 days and less than 1 year
    d. More than 1 year

4. What is the general topography of the watershed?
    a. Flat terrain (<10% slopes)
    b. Hilly (10 to 30% slopes)
    c. Mountainous (> 30% slopes)
    d. Not sure

5. What is the general geology of the watershed?
    a. Materials prone to landslides
    b. Materials not prone to landslides
    c. Not sure

6. What general soil types are on the watershed?
    a. Rock
    b. Loams, sands
    c. Clay
    d. Not sure

7. What type of vegetation covers most of the watershed?
    a. Grasses
    b. Low growing plants and shrubs
    c. Trees
    d. Not sure

8. What is the mean seasonal precipitation on the watershed?
    a. More than 40 inches/year
    b. 10 to 40 inches/year
    c. Less than 10 inches/year
    d. Not sure

9. Is there significant ground water recharge to the water body?
    a. Yes
    b. No
    c. Not sure

Physical Barrier Effectiveness Determination

Parameters indicating **Low Physical Barrier Effectiveness** (LE)
(A source with <u>any</u> of the parameters listed below would be considered to have less effective physical barrier properties)

3a
4c or 4d
5a or 5c
7c or 7d
8a or 8d
9a

Parameters indicating **High Physical Barrier Effectiveness** (HE)
(A source would need to have <u>all</u> of the parameters listed below to be considered to have highly effective physical barrier properties)

3d and
4a and
5b and
7a and
8c and
9b

All other sources are considered to have **Moderate Physical Barrier Effectiveness**

Determination for this source:

Low (LE)

Moderate (ME)

High (HE)

page intentionally blank

Appendix D

Possible Contaminating Activities (PCA) Inventory Form

Surface Water Source

Public water system name:_____ ID No. _____

Name of drinking water source:_____ ID No._____

Inventory date:_____ Inventory conducted by:_____

Name of Surface Water Body :_____

Indicate PCAs pertinent to the drinking water source, its source area (watershed) and protection zones (if established), from the following tables, as applicable:

Commercial/Industrial (Table D-1) _____

Residential/Municipal (Table D-2) _____

Agricultural/Rural (Table D-3) _____

Other (required for all) (Table D-4) _____

Are zones established? YES or NO

Attach map of Drinking Water Source with watershed boundaries and zones (if established) indicated.

Proceed to appropriate checklist or checklists. Place a mark in the appropriate boxes. Example:

		X

Risk Ranking of PCAs (see Tables 7-2, 7-3, 7-4 and 7-5 for separate category lists), where VH = Very High Risk, H = High Risk, M = Moderate Risk, L = Low Risk

Note: If zones are not established use higher risk ranking. If zones are established, use higher risk ranking in zones, lower risk ranking for remainder of watershed.

page intentionally blank

PCA Checklist **Table D-1, page 1 of 2**						
COMMERCIAL/INDUSTRIAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Automobile-related activities						
Body shops (H)						
Car washes (M)						
Gas stations (VH)						
Repair shops (H)						
Boat services/repair/ refinishing (H)						
Chemical/petroleum processing/storage (VH)						
Chemical/petroleum pipelines (H)						
Dry cleaners (VH)						
Electrical/electronic manufacturing (H)						
Fleet/truck/bus terminals (H)						
Furniture repair/ manufacturing (H)						
Home manufacturing (H)						
Junk/scrap/salvage yards (H)						
Machine shops (H)						
Metal plating/ finishing/fabricating (VH)						
Photo processing/printing (H)						
Plastics/synthetics producers (VH)						
Research laboratories (H)						

PCA Checklist **Table D-1, page 2 of 2**						
COMMERCIAL/INDUSTRIAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Wood preserving/treating (H)						
Wood/pulp/paper processing and mills (H)						
Lumber processing and manufacturing (H)						
Sewer collection systems (H, if in Zones, otherwise L)						
Parking lots/malls (>50 spaces) (M)						
Cement/concrete plants (M)						
Food processing (M)						
Funeral services/graveyards (M)						
Hardware/lumber/parts stores (M)						
Appliance/Electronic Repair (L)						
Office buildings/complexes (L)						
Rental Yards (L)						
RV/mini storage (L)						
Other (list)						

PCA Checklist **Table D-2, page 1 of 2**						
RESIDENTIAL/MUNICIPAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Airports - Maintenance/ fueling areas (VH)						
Landfills/dumps (VH)						
Railroad yards/ maintenance/ fueling areas (H)						
Septic systems - high density (>1/acre) (VH if in Zones, otherwise M)						
Sewer collection systems (H, if in Zones, otherwise L)						
Utility stations - maintenance areas (H)						
Wastewater treatment and disposal facilities (VH in Zones, otherwise H)						
Drinking water treatment plants (M)						
Golf courses (M)						
Housing - high density (>1 house/0.5 acres) (M)						
Motor pools (M)						
Parks (M)						
Waste transfer/recycling stations (M)						

PCA Checklist
Table D-2, page 2 of 2

RESIDENTIAL/MUNICIPAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Apartments and condominiums (L)						
Campgrounds/ Recreational areas (L)						
Fire stations (L)						
RV Parks (L)						
Schools (L)						
Hotels, Motels (L)						
Other (list)						

PCA Checklist **Table D-3, page 1 of 3**						
AGRICULTURAL/RURAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Grazing (> 5 large animals or equivalent per acre) (H in Zones, otherwise M)						
Concentrated Animal Feeding Operations (CAFOs) as defined in federal regulation[1] (VH in Zones, otherwise H)						
Animal Feeding Operations as defined in federal regulation[2] (VH in Zones, otherwise H)						
Other Animal operations (H in Zones, otherwise M)						
Concentrated Aquatic Animal Production Facilities, as defined in federal regulation (VH in Zones, otherwise H)						
Other Aquatic Animal production operations (H in Zones, otherwise M)						
Managed Forests (VH in Zones, otherwise H) (unless additional detail provided*)						
Farm chemical distributor/ application service (H)						
Farm machinery repair (H)						

PCA Checklist **Table D-3, page 2 of 3**						
AGRICULTURAL/RURAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Septic systems – Low density (<1/acre) (H in Zones, otherwise L)						
Lagoons / liquid wastes (H)						
Machine shops (H)						
Pesticide/fertilizer/ petroleum storage & transfer areas (H)						
Agricultural Drainage (H in Zones, otherwise M)						
Wells - Agricultural/ Irrigation (H)						
Crops, irrigated (Berries, hops, mint, orchards, sod, greenhouses, vineyards, nurseries, vegetable) (M)						
Sewage sludge/biosolids application (M)						
Fertilizer, Pesticide/ Herbicide Application (M)						
Crops, nonirrigated (e.g., Christmas trees, grains, grass seeds, hay, pasture) (L) (includes drip-irrigated crops)						
Other (list)						

PCA Checklist Table D-3, page 3 of 3						
AGRICULTURAL/RURAL						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
* Additional Detail for Managed Forests The following categories can be used in lieu of the default risk ranking for Managed Forests:						
* Managed Forests - Broadcast fertilized areas (M in Zones, otherwise L)						
* Managed Forests - Clearcut harvested <30 years (VH in Zones, otherwise H)						
* Managed Forests - Partial harvested <10 years (H in Zones, otherwise M)						
* Managed Forests - Road density > 2 mi/sq. mi) (H in Zones, otherwise M)						

1. Concentrated Animal Feeding Operation: Animal Feeding Operation (requires NPDES permit) with greater than:

If pollutants discharged (directly or indirectly) to navigable waters	**If pollutants not discharged**
300 slaughter or feeder cattle	1,000 slaughter or feeder cattle
200 mature dairy cows	700 mature dairy cows
750 swine	2500 swine
150 horses	500 horses
3000 sheep or lambs	10,000 sheep or lambs
16,500 turkeys	55,000 turkeys
9,000 laying hens or broilers (liquid manure system)	30,000 laying hens or broilers (liquid manure system)
1500 ducks	5000 ducks
300 animal units	1000 animal units

2. Animal Feeding Operation: lot or facility where animals (other than aquatic) have been or will be stabled or confined and fed or maintained for total of 45 days or more in any 12 month period.

page intentionally blank

PCA Checklist **Table D-4, page 1 of 3**						
OTHER ACTIVITIES						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
NPDES/WDR permitted discharges (H)						
Underground Injection of Commercial/Industrial Discharges (VH)						
Historic gas stations (VH)						
Historic waste dumps/ landfills (VH)						
Illegal activities/ unauthorized dumping (H)						
Injection wells/ dry wells/ sumps (VH)						
Known contaminant plumes (VH)						
Military installations (VH)						
Mining operations - Historic (VH)						
Mining operations – Active (VH)						
Mining - Sand/Gravel (H)						
Wells – Oil, Gas, Geothermal (H)						
Salt Water Intrusion (H)						
Recreational area – surface water source (H)						
Snow Ski Areas (H in Zones, otherwise M)						
Recent (< 10 years) Burn Areas (H in Zones, otherwise M)						

PCA Checklist **Table D-4, page 2 of 3**						
OTHER ACTIVITIES						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Dredging (H in Zones, otherwise M)						
Underground storage tanks						
Confirmed leaking tanks (VH)						
Decommissioned - inactive tanks (L)						
Non-regulated tanks (tanks < than regulatory limit) (H)						
Not yet upgraded or registered tanks (H)						
Upgraded and/or registered - active tanks (L)						
Above ground storage tanks (M)						
Wells – Water supply (M)						
Construction/demolition staging areas (M)						
Contractor or government agency equipment storage yards (M)						
Transportation corridors						
Freeways/state highways (M)						
Railroads (M)						
Historic railroad right-of-ways (M)						
Road Right-of-ways (herbicide use areas) (M)						
Roads/ Streets (L)						

PCA Checklist **Table D-4, page 3 of 3**						
OTHER ACTIVITIES						
	IF ZONES ESTABLISHED					
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B?	PCA in Watershed	Unknown	Comments
Hospitals (M)						
Storm Drain Discharge Points (M)						
Storm Water Detention Facilities (M)						
Artificial Recharge Projects						
Injection wells (potable water) (L)						
Injection wells (non-potable water) (M)						
Spreading Basins (potable water) (L)						
Spreading Basins (non-potable water) (M)						
Medical/dental offices/clinics (L)						
Veterinary offices/clinics (L)						
Surface water - streams/ lakes/rivers (L)						
Other (list)						

page intentionally blank

Appendix E

Possible Contaminating Activities Evaluation – Surface Water Source

(Note: This form is OPTIONAL. It should be completed if a modification of the risk ranking for a type of PCA is desired)

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

PCA/Potential Contaminant Information

1. Type of Activity (from contaminant inventory checklist):

2. Type of potential contaminant associated with this activity (refer to Table 7-2):
   a. Microbiological
   b. Chemical
   c. Both or Other

3. Potential Risk (from PCA contaminant inventory checklist):
   a. Low
   b. Medium
   c. High
   d. Very High

4. Location:
   a. Within a zone (if defined) or within DHS minimum setback distances
   b. On the watershed outside of zones (if defined) or outside DHS minimum setback distances
   c. On the watershed (if no zones defined)

5. Spatial Area occupied by activity as percentage of watershed area:
   a. Small (<1% of area)
   b. Moderate (1% to 10% of area)
   c. High (>10% of area)
   d. Unknown

6. Volume of potential contaminant *(not applicable for microbiological contaminants)*:
   If the maximum quantity of potential contaminant stored at the facility were discharged into

the quantity of water produced by the drinking water supply in a day would the concentration be:

a. Small (less than one part per billion)
b. Moderate (between one part per thousand and one part per billion)
c. High (more than one part per thousand)
d. Unknown

7. Magnitude of potential acute or chronic health effects associated with the contaminant:
   a. Low
   b. High
   c. Unknown

8. Likelihood of potential contaminant to migrate to drinking water supply:
a. Low
b. High
c. Unknown

9. Has the potential contaminant been detected in the drinking water supply or near-by monitoring wells?

a. Yes
b. No
c. Unknown

10. Compliance of facility (demonstrated performance to keep potential contaminant from being discharged)

a. Good
b. Poor
c. Unknown

Determination of revised risk ranking for PCAs

Microbiological Contamination

If the PCA is categorized as **2a or 2c**, the risk ranking would be LOW if the PCA meets all of the parameters in the table below for **Low.** The risk ranking would be HIGH if the PCA meets all of the parameters in the table for **High**. Otherwise the risk ranking is MODERATE.

Microbiological Contamination
PCA Risk Ranking

Parameter	Low	High
3	**a**	**c or d**
4	**b**	**a or c**
5	**a**	**c or d**
7	**a**	**b or c**
8	**a**	**b or c**
9	**b**	**a or c**
10	**a**	**b or c**

Chemical Contamination

If the PCA is categorized as **2b or 2c**, the risk ranking would be LOW if the PCA meets all of the parameters in the table below for **Low.** The risk ranking would be HIGH if the PCA meets all of the parameters in the table for **High**. Otherwise the risk ranking is MODERATE.

Chemical Contamination
PCA Risk Ranking

Parameter	Low	High
3	**a**	**c or d**
4	**b**	**a or c**
5	**a**	**c or d**
6	**a**	**c or d**
7	**a**	**b or c**
8	**a**	**b or c**
9	**b**	**a or c**
10	**a**	**b or c**

page intentionally blank

Appendix F

Vulnerability Analysis Procedures – Surface Water Source

The Vulnerability analysis incorporates the types of Possible Contaminating Activities (PCAs) identified in the inventory, their respective Risk Rankings, the Zone and the Physical Barrier Effectiveness determination. These factors are used to develop a prioritized listing of types of PCAs and to determine the types of PCAs to which the drinking water source is most vulnerable.

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

Vulnerability analysis steps:

1. For each type of PCA identified as existing in the watershed and/or zones, or unknown, determine the number of PCA risk ranking points for that type of PCA. (If the risk ranking for a type of PCA has been modified, Appendix E should be attached). (*For example, Very High (VH) risk activities are 7 points.)*

2. For each type of PCA determine the zone in which it occurs (if zones are defined, or within the watershed if zones are not defined). Add the points associated with that zone to the PCA risk ranking points. If the type of PCA exists within more than one zone, repeat the process for each zone. (*For example, if a type of PCA exists in Zone A add 5 points. For a VH risk PCA in Zone A, the PCA Risk Ranking points + Zone points = 7 + 5 = 12 points*.)

3. Determine the Physical Barrier Effectiveness (PBE) for the drinking water source (from Appendix C). Add the points associated with that PBE to the PCA risk ranking and zone points. The total is the Vulnerability Score. (*For example, if the PBE is Low add 5 points. For a VH risk PCA in Zone A, the Vulnerability Score = PCA Risk Ranking points + Zone points + PBE points = 7 + 5 + 5 = 17 points.)*

4. Prioritize all types of PCAs by the Vulnerability Score, from the most points to the least. A sample form is shown below.

5. The drinking water source is vulnerable to all types of PCAs with a Vulnerability Score of **11** or greater. Refer to the Vulnerability Matrix below. The source is <u>most</u> vulnerable to the types of PCAs with the highest score.

6. **In addition, the Drinking Water Source is <u>most</u> vulnerable to all types of PCAs associated with a contaminant detected in the water source, regardless of Vulnerability Score.**

Vulnerability Matrix for SURFACE WATER SOURCES

INDICATE WHICH APPLIES:

WITHIN ZONES (if defined) OR
WITHIN ENTIRE WATERSHED (if zones are not defined)

The cutoff point for surface water vulnerability is **11**. The drinking water source is considered Vulnerable to all types of PCAs with Vulnerability Score greater than or equal to **11** (shaded boxes).

PCA points	**Zone points**		**PCA + Zone points**	**PBE Points**			**Vulnerability Score PCA + Zone + PBE points**		
Risk Ranking	Zones Defined	Zones Not Defined		Low	Mod	High	PBE Low	PBE Mod	PBE High
VH (7)	A (5)	Watershed (5)	12	5	3	1	17	15	13
VH (7)	B (3)		10	5	3	1	15	13	11
VH (7)	Watershed (1)		8	5	3	1	13	11	9
VH (7)	Unknown (0)*	Unknown (0)*	7	5	3	1	12	10	8
H (5)	A (5)	Watershed (5)	10	5	3	1	15	13	11
H (5)	B (3)		8	5	3	1	13	11	9
H (5)	Watershed (1)		6	5	3	1	11	9	7
H (5)	Unknown (0)*	Unknown (0)*	5	5	3	1	10	8	6
M (3)	A (5)	Watershed (5)	8	5	3	1	13	11	9
M (3)	B (3)		6	5	3	1	11	9	7
M (3)	Watershed (1)		4	5	3	1	9	7	5
M (3)	Unknown (0)*	Unknown (0)*	3	5	3	1	8	6	4
L (1)	A (5)	Watershed (5)	6	5	3	1	11	9	7
L (1)	B (3)		4	5	3	1	9	7	5
L (1)	Watershed (1)		2	5	3	1	7	5	1
L (1)	Unknown (0)*	Unknown (0)*	1	5	3	1	6	4	2

* Source is considered vulnerable to type of PCAs that are Unknown, if the Vulnerability Score is 11 or higher.

Format for Prioritized Listing of type of PCAs

List type of PCAs in order by Vulnerability Score from highest to lowest.

Zone	Type of PCA	PCA Points VH = 7 H = 5 M = 3 L = 1	Zone Points Watershed = 5 (*or A = 5, B = 3, Watershed = 1 See vulnerability matrix)* Unknown = 0	PBE Points L= 5 M = 3 H = 1	Vulnerability Score PCA points + Zone points + PBE points

page intentionally blank

Appendix G

Checklist for Drinking Water Source Assessment – Surface Water Source

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

The following information should be contained in the drinking water source assessment submittal.

If another report that is the functional equivalent to the drinking water assessment (e.g., Watershed Sanitary Survey) is included in this assessment, the part of that report that fulfills the components of the source water assessment should be clearly indicated.

_____ Source name, system name, source and system identification numbers, date of assessment, name of person and/or organization conducting the assessment (Appendix G, this form)

_____ Assessment map with source location, source area (watershed), and protection zones (if defined).

_____ Drinking water source location coordinates and accuracy of method used (Appendix A or equivalent)

_____ Delineation of protection zones, if applicable (Appendix B or equivalent)

_____ Drinking water Physical Barrier Effectiveness Checklist (Appendix C)

_____ Possible contaminating activities (PCA) inventory form (Appendix D).

_____ Possible contaminating activities evaluation (optional) (Appendix E)

_____ Vulnerability ranking (Appendix F)

_____ Additional maps (optional) (e.g. local maps of zones and PCAs, recharge area maps, or maps indicating direction of ground water flow)

_____ Means of Public Availability of Report (indicate those that will be used)

- _____ Notice in the annual water quality/consumer confidence report* (minimum)
- _____ Copy in DHS district office (minimum)
- _____ Copy in public water system office (recommended)
- _____ Copy in public library/libraries
- _____ Internet (indicate Internet address: _____)
- _____ Other (describe)

*The annual report should indicate where customers can review the assessments.

page intentionally blank

APPENDICES TO BE USED FOR A GROUND WATER SOURCE

page intentionally blank

Appendix H

Drinking Water Source Location – Ground Water

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Location date: _____ Source located by (name of person): _____

Method of determining location:

_____ USGS quad map (7.5 minute series, 1:24,000 scale), hand calculated

_____ USGS quad map (7.5 minute series, 1:24,000 scale), computer calculated

_____ Global Positioning System (GPS)

Unit (manufacturer/model): _____

Accuracy of GPS unit (+/- _____ ft.)

_____ Other Method _____

Accuracy of method (+/- _____ ft.)

Location of well (decimal degrees): Latitude: _____

Longitude: _____

Physical description of location [Pertinent landmarks, address, or approximate address (cross streets, etc.)]:

General description of recharge area, if known:

NOTE: Indicate location of the well on the drinking water source assessment map. The map should also indicate locations of the source area and protection zones. (See other Appendices).

page intentionally blank

Appendix I

Delineation of Ground Water Protection Zones

Public water system: _____ID No.:_____

Name of source:_____ID No.:_____

Delineation date:_____Delineation conducted by _____

Indicate the method used to delineate the zones:

_____Calculated Fixed Radius (Default) (Show calculations below)

_____Modified Calculated Fixed Radius (Show calculations below and attach documentation for direction of ground water flow)

_____More detailed methods
Type used (i.e., analytical methods, hydrogeologic mapping, modeling):

_____Arbitrary Fixed Radius (For use only by or with permission of DHS—use minimum distances shown below)

Calculated Fixed Radius Equation

The equation for the calculated fixed radius (R) is $R_t = \sqrt{Q\,t / \pi\,\eta\,H}$

$R_t = R_2$, R_5, or R_{10} corresponding to t (Calculate R for each of three times of travel, TOT)
Q = maximum pumping capacity of well
(ft^3/year = gpm x 70,267):_____
t = time of travel (years), 2, 5 and 10 years
π = 3.1416
η = effective porosity (decimal percent) (If unknown, assume 0.2):
_____
H = screened interval of well (feet) (If unknown, assume 10% of Q gpm, 10 ft minimum):
_____

Specific methods follow on next page

Calculated Fixed Radius Delineation Method (Default)

Using the equation presented above, calculate the size of zones for the appropriate aquifer setting of the source.

Porous Media Aquifer

Zone A (2 year TOT) R_2 = _____ft, minimum = 600 ft —use larger: _____ft
Zone B5 (5 year TOT) R_5 = _____ft, minimum = 1,000 ft—use larger: _____ft
Zone B10 (10 year TOT) R_{10} = _____ft, minimum = 1,500 ft—use larger: _____ft

Fractured Rock Aquifer

(Increase size of zones by 50%)

Zone A (2 year TOT) $1.5R_2$ = _____ft, minimum = 900 ft—use larger: _____ft
Zone B5 (5 year TOT) $1.5R_5$ = _____ft, minimum = 1,500 ft—use larger: _____ft
Zone B10 (10 year TOT) $1.5R_{10}$ = _____ft, minimum = 2,250 ft—use larger: _____ft

Modified Calculated Fixed Radius Delineation Method

In porous media aquifers, if the direction of ground water flow is known (see Section 6.2.3), the default zone circle may be shifted upgradient by $0.5R_t$. The upgradient and downgradient limits of the zone are determined below.

Zone A (2-year TOT)

upgradient distance = $1.5R_2$ = _____ft, minimum = 900 ft, use larger: _____ft
downgradient distance = $0.5R_2$ = _____ft, minimum = 300 ft, use larger: _____ft

Zone B5 (5-year TOT)

upgradient distance = $1.5R_5$ = _____ft, minimum = 1,500 ft, use larger: _____ft
downgradient distance = $0.5R_5$ = _____ft, minimum = 500 ft, use larger: _____ft

Zone B10 (10-year TOT)

upgradient distance = $1.5R_{10}$ = _____ft, minimum = 2,250 ft, use larger: _____ft
downgradient distance = $0.5R_{10}$ = _____ft, minimum = 750 ft, use larger: _____ft

Appendix J

Physical Barrier Effectiveness Checklist and Well Data Sheet - Ground Water Source

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

Complete DHS Well Data Sheet (attached) and include with Assessment submittal.

Directions:

1. Read through the form and collect the information needed to complete the form. (Hydrogeology, Soils, Presence of abandoned or improperly destroyed wells, Well construction and operation.)

2. Determine Parameter A, Type of Aquifer.
   - If the aquifer is confined, use the right-hand column, and evaluate only the parameters indicated for confined aquifers.
   - If the aquifer is unconfined, semi-confined, or the degree of confinement is unknown, or if the aquifer is fractured rock, use the left-hand column and evaluate only the parameters for unconfined aquifers.

3. For each parameter appropriate for the source, place a check in the box for the answer that most closely applies to that source. If more than one answer is possible, select the more conservative (i.e., lower points) answer. *[For example, if the depth to static water (Parameter D) has varied between 45 and 55 feet, choose answer 2 (20 to 50 feet).]*

4. Add the points in the column appropriate for the source and interpret the score as shown on the bottom of the last page.
   - Determine whether the source has a High, Moderate or Low Physical Barrier Effectiveness. Use this in the Vulnerability analysis. The higher the points, generally the more effective the source and site are to retarding the movement of contaminants to the water supply.

NOTE: If the source is located in fractured rock the source is considered to have a Low Physical Barrier Effectiveness, regardless of the point total. So, if Parameter B, Aquifer Material is 3, the remainder of the form does not need to be completed.

Physical Barrier Effectiveness (PBE) – Ground Water, page 1 of 2
Source Name:_____ Source No.:_____

PARAMETER	*POINTS*			
	Unconfined		Confined	
A. TYPE OF AQUIFER Confinement *(up to **50** points maximum)* choose one				
a. Unconfined, Semi-confined, Fractured Rock, Unknown	0			
b. Confined			50	
B. AQUIFER MATERIAL (Unconfined Aquifer) Type of materials within the aquifer *(up to **20** points maximum)* choose one				
1. Porous Media (Interbedded sands, silts, clays, gravels) with continuous clay layer minimum 25' thick above water table within Zone A	20			
2. Porous Media (Interbedded sands, silts, clays, and gravels)	10			
3. Fractured rock * (* Low Physical Barrier Effectiveness - no further questions required)	0			
C. PATHWAYS OF CONTAMINATION (All Aquifers) Presence of Abandoned or Improperly Destroyed Wells *(up to **10** points maximum)*				
1. Are they present within Zone A (2-year time of travel (TOT) distance)?				
a. Yes or unknown	0		0	
b. No	5		5	
2. Are they present within Zone B5 (2- to 5-year TOT distance)?				
a. Yes or unknown	0		0	
b. No	3		3	
3. Are they present within Zone B10 (5- to 10-year TOT distance)?				
a. Yes or unknown	0		0	
b. No	2		2	
D. STATIC WATER CONDITIONS (Unconfined Aquifer) Depth to static Water (DTW) = _____ feet *(up to **10** points maximum)* choose one				
1. 0 to 20 feet	0			
2. 20 to 50 feet	2			
3. 50 to 100 feet	6			
4. > 100 feet	10			
E. WELL OPERATION (Unconfined Aquifer) Depth to Uppermost Perforations (DUP) DUP = _____ feet Maximum Pumping Rate of Well (Q) Q = _____ gallons/minute Length of screened interval (H) H = _____ feet				
[(DUP – DTW) / (Q/H)] = *(up to **10** points maximum*) choose one				
1. < 5	0			
2. 5 to 10	5			
3. > 10	10			

Physical Barrier Effectiveness – Ground Water, page 2 of 2
Source Name:_____Source No._____

PARAMETER	*POINTS*			
	Unconfined		Confined	
F. HYDRAULIC HEAD (Confined Aquifer) What is the relationship in hydraulic head between the confined aquifer and the overlying unconfined aquifer? (i.e., does the well flow under artesian conditions?) *(up to **20** points maximum)* choose one				
1. head in confined aquifer is higher than head in unconfined aquifer under all conditions			20	
2. head in confined aquifer is higher than head in unconfined aquifer under static conditions			10	
3. head in confined aquifer is lower than or same as head in unconfined aquifer			0	
4. unknown			0	
G. WELL CONSTRUCTION (All Aquifers) 1. Sanitary Seal (Annular Seal) Depth = _____ feet *(up to **10** points maximum)* choose one				
a. None or less than 20 feet deep	0		0	
b. 20 to 50 ft deep	6		10	
c. 50 ft or greater	10		10	
2. Surface seal (concrete cap) *(up to **4** points maximum)* choose one				
a. Not present or improperly constructed	0		0	
b. Watertight, slopes away from well, at least 2' laterally in all directions	4		4	
3. Flooding potential at well site *(up to **1** point maximum)* choose one				
a. Subject to localized flooding (i.e. in low area or unsealed pit or vault) or Within 100 year flood plain	0		0	
b. Not subject to flooding	1		1	
4. Security at well site *(up to **5** points maximum)* choose one				
a. Not secure	0		0	
b. Secure (i.e. housing, fencing, etc.)	5		5	
Maximum Points Possible	70		100	
POINT TOTAL FOR THIS SOURCE				

Physical Barrier Effectiveness SCORE INTERPRETATION

Point Total		**Effectiveness**	
_____**0 to 35**	**=**	**Low**	(includes all sources in Fractured Rock)
_____**36 to 69**	**=**	**Moderate**	
_____**70 to 100**	**=**	**High**	

page intentionally blank

WELL DATA SHEET (Sheet 1 of 3)

Complete as much information as possible. Leave blank if information is not available, use N.A. if not applicable.		
** Indicates items required for Source Water Assessment* *** Indicates additional items required for Ground Water Rule*		
		Actual or Estimated?
DATA SHEET GENERAL INFORMATION		
System Name		
System Number		
Source of Information *(See Note 1)*		
Personnel Collecting Information		
Date		
WELL IDENTIFICATION		
* Well Number or Name		
* DHS Source Identification Number (FRDS ID No.)		
DWR Well Log on File? (yes or no)		
State Well Number (from DWR)		
Well Status (Active, Standby, Inactive)		
Date of Inactive Status (if applicable)		
WELL LOCATION		
Latitude		
Longitude		
Elevation		
Street Address		
* Neighborhood/Surrounding Area *(see Note 2)*		
Site plan on file? (yes or no)		
DWR Ground Water Basin		
DWR Ground Water Sub-basin		
SANITARY CONDITIONS		
** Distance to: Sewer Line, Sewage Disposal, or Septic tank		
Distance to: Other sanitary concerns		
Distance to: Other Wells (Active)		
Distance to: Other Wells (Abandoned)		
** Size of controlled area around well (square feet)		
* Type of access control to well site *(See Note 3)*		
* Surface Seal? (Concrete slab) (yes or no)		
* Dimensions of concrete surface slab (ft)		
* Within 100 year flood plain? (yes or no)		
* Drainage away from well? (yes or no)		
ENCLOSURE/HOUSING		
Type		
Condition		
Pit depth (if applicable)		
Pit Drained? (if applicable)		
Floor (material)		

WELL DATA SHEET (Sheet 2 of 3)

WELL CONSTRUCTION		Actual or Estimated?
Date drilled		
Drilling Method		
Depth of Bore Hole (feet below ground surface)		
Casing Depth (feet below ground surface)		
Casing Diameter (inches)		
Casing Material		
Additional casing depth (if applicable)		
Additional casing diameter (if applicable)		
Additional casing material (if applicable)		
Conductor casing used? (yes or no) *(See Note 4)*		
Conductor casing removed? (yes or no)		
* Depth to highest perforations/screens(ft below surface)		
Depth(s) and Length(s) of screened interval(s)		
* Total length of screened interval		
* Annular Seal? (yes, no, or not sure) *(See Note 5)*		
* Depth of Annular Seal (ft)		
Material of Annular Seal (cement grout, bentonite, etc.)		
Gravel pack, Depth to top (ft below ground surface)		
Total length of gravel pack (ft)		
AQUIFER		
* Aquifer Materials *(See Note 6)*		
* Confining layer (impervious strata) above aquifer? (yes, no or not sure)		
Thickness of confining layer, if known (ft)		
Depth to confining layer, if known (ft below ground)		
Sanitary Seal terminates in impervious strata? (yes or no)		
* Static water level (ft below ground surface)		
Pumping water level (ft below ground surface)		
Date water level measured		
WELL PRODUCTION		
Well Yield (gpm)		
Well Yield Based On (i.e., pump test, etc.)		
Date measured		
Production (gallons per year)		
Frequency of Use (hours/year)		
Typical pumping duration (hours/day)		
PUMP		
Make		
Type		
Size (hp)		
* Capacity (gpm)		
Depth to suction intake (ft below ground surface)		

WELL DATA SHEET (Sheet 3 of 3)

		Actual or Estimated?
Lubrication Type		
Type of Power: (i.e., electric, diesel, etc.)		
Auxiliary power available? (yes or no)		
Operation controlled by: *(See Note 7)*		
Pump to Waste capability? (yes or no)		
Discharges to: (i.e., distribution system, storage, etc.)		
(Use or note these items as appropriate)		
Raw Water Quality concerns? (coliform, chemicals, other)		
Continuous Chlorination provided?		
Pitless Adapter? Make and Model		
Height of pump base (inches)		
Casing Vent? (yes or no)		
Air/Vacuum Release? (yes or no)		
Sampling Taps? (yes or no)		
Location of sampling taps		
Wellhead Riser? (yes or no) height above well		
NOTES		
1. Sources of information: well log, DHS or County files, system files, personnel, etc.		
2. Neighborhood/Surrounding Area (list all that apply): A= Agricultural, Ru = Rural, Re = Residential, Co = Commercial, I = Industrial, Mu = Municipal, P = Pristine, O = Other		
3. Access Control: fencing, building, etc.		
4. Annular Seal - Seal of grout in the space between the well casing and the wall of the drilled hole. Sometimes called "sanitary seal".		
5. Conductor Casing - Oversized casing used to stabilize bore hole during well construction. Usually removed during installation of annular seal.		
6. Aquifer materials (list all that apply): sands, silts, clays, gravel, rocks, fractured rock		
7. Operation controlled by: level in tank, system demand, pressure, etc.		

page intentionally blank

Appendix K

Possible Contaminating Activity (PCA) Inventory Form

Ground Water Source

Public water system name:_____ ID No._____

Name of drinking water source:_____ ID No._____

Inventory date:_____ Inventory conducted by:_____

Indicate PCAs pertinent to the drinking water source, its source area and protection zones, from the following tables, as applicable:

Commercial/Industrial (Table K-1) _____

Residential/Municipal (Table K-2) _____

Agricultural/Rural (Table K-3) _____

Other (required for all) (Table K-4) _____

Is this for a ground water recharge area? YES/NO _____ (If YES, also use Appendix D, Tables D-1 through D-4, as appropriate)

Attach map of Drinking Water Source with Zones A, B5 and B10 indicated, and buffer zones (if defined).

Proceed to appropriate checklist or checklists. Place a mark in the appropriate boxes. Example:

		X

Risk Ranking of PCAs (see Tables 7-2, 7-3, 7-4 and 7-5 for separate category lists), where VH = Very High Risk, H = High Risk, M = Moderate Risk, L = Low Risk

page intentionally blank

PCA Checklist **Table K-1, page 1 of 2**						
COMMERCIAL/INDUSTRIAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Automobile-related activities						
Body shops (H)						
Car washes (M)						
Gas stations (VH)						
Repair shops (H)						
Boat services/repair/ refinishing (H)						
Chemical/petroleum processing/storage (VH)						
Chemical/petroleum pipelines (H)						
Dry cleaners (VH)						
Electrical/electronic manufacturing (H)						
Fleet/truck/bus terminals (H)						
Furniture repair/ manufacturing (H)						
Home manufacturing (H)						
Junk/scrap/salvage yards (H)						
Machine shops (H)						
Metal plating/ finishing/fabricating (VH)						
Photo processing/printing (H)						
Plastics/synthetics producers (VH)						
Research laboratories (H)						

PCA Checklist **Table K-1, page 2 of 2**						
COMMERCIAL/INDUSTRIAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Wood preserving/treating (H)						
Wood/pulp/paper processing and mills (H)						
Lumber processing and manufacturing (H)						
Sewer collection systems (H, if in Zone A, otherwise L)						
Parking lots/malls (>50 spaces) (M)						
Cement/concrete plants (M)						
Food processing (M)						
Funeral services/graveyards (M)						
Hardware/lumber/parts stores (M)						
Appliance/Electronic Repair (L)						
Office buildings/complexes (L)						
Rental Yards (L)						
RV/mini storage (L)						
Other (list)						

PCA Checklist **Table K-2, page 1 of 2**						
RESIDENTIAL/MUNICIPAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Airports - Maintenance/ fueling areas (VH)						
Landfills/dumps (VH)						
Railroad yards/ maintenance/ fueling areas (H)						
Septic systems - high density (>1/acre) (VH if in Zone A, otherwise M)						
Sewer collection systems (H, if in Zone A, otherwise L)						
Utility stations - maintenance areas (H)						
Wastewater treatment and disposal facilities (VH in Zone A, otherwise H)						
Drinking water treatment plants (M)						
Golf courses (M)						
Housing - high density (>1 house/0.5 acres) (M)						
Motor pools (M)						
Parks (M)						
Waste transfer/recycling stations (M)						

PCA Checklist Table K-2, page 2 of 2						
RESIDENTIAL/MUNICIPAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Apartments and condominiums (L)						
Campgrounds/ Recreational areas (L)						
Fire stations (L)						
RV Parks (L)						
Schools (L)						
Hotels, Motels (L)						
Other (list)						

PCA Checklist Table K-3, page 1of 2						
AGRICULTURAL/RURAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Grazing (> 5 large animals or equivalent per acre) (H in Zone A, otherwise M)						
Concentrated Animal Feeding Operations (CAFOs) as defined in federal regulation[1] (VH in Zone A, otherwise H)						
Animal Feeding Operations as defined in federal regulation[2] (VH in Zone A, otherwise H)						
Other Animal operations (H in Zone A, otherwise M)						
Farm chemical distributor/ application service (H)						
Farm machinery repair (H)						
Septic systems – low density (<1/acre) (H in Zone A, otherwise L)						
Lagoons / liquid wastes (H)						
Machine shops (H)						
Pesticide/fertilizer/ petroleum storage & transfer areas (H)						
Agricultural Drainage (H in Zone A, otherwise M)						
Wells - Agricultural/ Irrigation (H)						

PCA Checklist Table K-3, page 2 of 2						
AGRICULTURAL/RURAL						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Managed Forests (M)						
Crops, irrigated (Berries, hops, mint, orchards, sod, greenhouses, vineyards, nurseries, vegetable) (M)						
Fertilizer, Pesticide/ Herbicide Application (M)						
Sewage sludge/biosolids application (M)						
Crops, nonirrigated (e.g., Christmas trees, grains, grass seeds, hay, pasture) (L) (includes drip-irrigated crops)						
Other (list)						

3. Concentrated Animal Feeding Operation: Animal Feeding Operation (requires NPDES permit) with greater than:

If pollutants discharged (directly or indirectly) to navigable waters	**If pollutants not discharged**
300 slaughter or feeder cattle	1,000 slaughter or feeder cattle
200 mature dairy cows	700 mature dairy cows
750 swine	2500 swine
150 horses	500 horses
3000 sheep or lambs	10,000 sheep or lambs
16,500 turkeys	55,000 turkeys
9,000 laying hens or broilers (liquid manure system)	30,000 laying hens or broilers (liquid manure system)
1500 ducks	5000 ducks
300 animal units	1000 animal units

4. Animal Feeding Operation: lot or facility where animals (other than aquatic) have been or will be stabled or confined and fed or maintained for total of 45 days or more in any 12 month period.

PCA Checklist **Table K-4, page 1 of 3**						
OTHER ACTIVITIES						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
NPDES/WDR permitted discharges (H)						
Underground Injection of Commercial/Industrial Discharges (VH)						
Historic gas stations (VH)						
Historic waste dumps/ landfills (VH)						
Illegal activities/ unauthorized dumping (H)						
Injection wells/ dry wells/ sumps (VH)						
Known Contaminant Plumes (VH)						
Military installations (VH)						
Mining operations - Historic (VH)						
Mining operations – Active (VH)						
Mining - Sand/Gravel (H)						
Wells – Oil, Gas, Geothermal (H)						
Salt Water Intrusion (H)						
Recreational area— surface water source (H)						

PCA Checklist **Table K-4 , page 2 of 3**						
OTHER ACTIVITIES						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Underground storage tanks						
Confirmed leaking tanks (VH)						
Decommissioned - inactive tanks (L)						
Non-regulated tanks (tanks smaller than regulatory limit) (H)						
Not yet upgraded or registered tanks (H)						
Upgraded and/or registered - active tanks (L)						
Above ground storage tanks (M)						
Wells – Water supply (M)						
Construction/demolition staging areas (M)						
Contractor or government agency equipment storage yards (M)						
Dredging (M)						
Transportation corridors						
Freeways/state highways (M)						
Railroads (M)						
Historic railroad right-of-ways (M)						
Road Right-of-ways (herbicide use areas) (M)						
Roads/ Streets (L)						
PCA Checklist **Table K-4, page 3 of 3**						

OTHER ACTIVITIES						
PCA (Risk Ranking)	No PCA in zones	PCA in Zone A?	PCA in Zone B5?	PCA in Zone B10?	Unknown	Comments
Hospitals (M)						
Storm Drain Discharge Points (M)						
Storm Water Detention Facilities (M)						
Artificial Recharge Projects						
Injection wells (potable water) (L)						
Injection wells (non-potable water) (M)						
Spreading Basins (potable water) (L)						
Spreading Basins (non-potable water) (M)						
Medical/dental offices/clinics (L)						
Veterinary offices/clinics (L)						
Surface water - streams/ lakes/rivers (L)						
Wells – monitoring, test holes (L)						
Other (list)						

page intentionally blank

Appendix L

Possible Contaminating Activities Evaluation– Ground Water Source

(Note: This form is OPTIONAL. It should be completed for each PCA if a modification of the risk ranking of a PCA is desired)

Public water system _____ID No. _____

Name of source _____ID No. _____

Assessment date:_____ Assessment conducted by _____

PCA/Potential Contaminant Information

1. Type of Activity (from the PCA contaminant inventory checklist):

2. Type of potential contaminant associated with this activity (Refer Table 7-2):
   a. Microbiological
   b. Chemical
   c. Both or Other

3. Potential Risk (from PCA contaminant inventory checklist):
   a. Low
   b. Medium
   c. High
   d. Very High

4. Location:
   a. Zone A
   b. Zone B5
   c. Zone B10

5. Spatial Area occupied by activity as percentage of Zone:
   a. Small (<1% of area)
   b. Moderate (1% to 10% of area)
   c. High (>10% of area)
   d. Unknown

6. Volume of potential contaminant *(not applicable for microbiological contaminants)*:
   If the maximum quantity of potential contaminant stored at the facility were discharged into

the quantity of water produced by the drinking water supply in a day would the concentration be:
a. Small (less than one part per billion)
b. Moderate (between one part per thousand and one part per billion)
c. High (more than one part per thousand)
d. Unknown

7. Magnitude of potential acute or chronic health effects associated with the contaminant:
a. Low
b. High
c. Unknown

8. Likelihood of potential contaminant to migrate to drinking water supply:
a. Low
b. High
c. Unknown

9. Has the potential contaminant been detected in the drinking water supply or near-by monitoring wells?
a. Yes
b. No
c. Unknown

10. Compliance of facility (demonstrated performance to keep potential contaminant from being discharged)
a. Good
b. Poor
c. Unknown

Determination of revised risk ranking for PCAs

Microbiological Contamination

NOTE: In fractured rock aquifers, microbiological PCAs are always high risk, regardless of the zone, and cannot be modified.

If the PCA is categorized as **2a or 2c**, the risk ranking would be LOW if the PCA meets all of the parameters in the table below for **Low.** The risk ranking would be HIGH if the PCA meets all of the parameters in the table for **High**. Otherwise the risk ranking is MODERATE.

Microbiological Contamination
PCA Risk Ranking

Parameter	Low	High
3	**a or b**	**c or d**
4	**b or c**	**a**
5	**a**	**c or d**
7	**a**	**b or c**
8	**a**	**b or c**
9	**b**	**a or c**
10	**a**	**b or c**

Chemical Contamination

If the PCA is categorized as **2b or 2c**, the risk ranking would be LOW if the PCA meets all of the parameters in the table below for **Low.** The risk ranking would be HIGH if the PCA meets all of the parameters in the table for **High**. Otherwise the risk ranking is MODERATE.

Chemical Contamination
PCA Risk Ranking

Parameter	Low	High
3	**a or b**	**c or d**
4	**c**	**a or b or c**
5	**a**	**c or d**
6	**a**	**c or d**
7	**a**	**b or c**
8	**a**	**b or c**
9	**b**	**a or c**
10	**a**	**b or c**

page intentionally blank

Appendix M

Vulnerability Analysis Procedures – Ground Water Source

The Vulnerability analysis incorporates the types of Possible Contaminating Activities (PCAs) identified in the inventory, their respective Risk Rankings, the Zone and the Physical Barrier Effectiveness determination. These factors are used to develop a prioritized listing of types of PCAs and to determine the types of PCAs to which the drinking water source is most vulnerable.

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

Vulnerability analysis steps:

1. For each type of PCA identified as existing in the protection zones, or as unknown, determine the number of PCA risk ranking points for that type of PCA. (If the risk ranking for a type of PCA has been modified, Appendix L should be attached). (*For example, Very High (VH) risk activities are 7 points.)*

2. For each type of PCA determine the zone in which it occurs. Add the points associated with that zone to the PCA risk ranking points. If the type of PCA exists within more than one zone, repeat the process for each zone. (*For example, if a type of PCA exists in Zone A add 5 points. For a VH risk PCA in Zone A, the PCA Risk Ranking points + Zone points = 7 + 5 = 12 points*.)

3. Determine the Physical Barrier Effectiveness (PBE) for the drinking water source (from Appendix J). Add the points associated with that PBE to the PCA risk ranking and zone points. The total is the Vulnerability Score. (*For example, if the PBE is Low add 5 points. For a VH risk PCA in Zone A, the Vulnerability Score = PCA Risk Ranking points + Zone points + PBE points = 7 + 5 + 5 = 17 points.)*

4. Prioritize all types of PCAs by the Vulnerability Score, from the most points to the least. A sample form is shown below.

5. The drinking water source is vulnerable to all types of PCAs with a Vulnerability Score of **8** or greater. Refer to the Vulnerability Matrix below. The source is <u>most</u> vulnerable to the types of PCAs with the highest score.

6. **In addition, the Drinking Water Source is <u>most</u> vulnerable to all types of PCAs associated with a contaminant detected in the water source, regardless of Vulnerability Score.**

Vulnerability Matrix for GROUND WATER SOURCES

The cutoff point for vulnerability is **8**. The drinking water source is considered Vulnerable to all PCAs with Vulnerability Score greater than or equal to **8** (shaded boxes).

PCA points	**Zone points**	**PCA + Zone points**	**PBE Points**			**Vulnerability Score PCA + Zone + PBE points**		
Risk Ranking	A, B5, B10		Low	Mod	High	PBE Low	PBE Mod	PBE High
VH (7)	A (5)	12	5	3	1	17	15	13
VH (7)	B5 (3)	10	5	3	1	15	13	11
VH (7)	B10 (1)	8	5	3	1	13	11	9
VH (7)	Unknown (0) *	7	5	3	1	12	10	8
H (5)	A (5)	10	5	3	1	15	13	11
H (5)	B5 (3)	8	5	3	1	13	11	9
H (5)	B10 (1)	6	5	3	1	11	9	7
H (5)	Unknown (0) *	5	5	3	1	10	8	6
M (3)	A (5)	8	5	3	1	13	11	9
M (3)	B5 (3)	6	5	3	1	11	9	7
M (3)	B10 (1)	4	5	3	1	9	7	5
M (3)	Unknown (0) *	3	5	3	1	8	6	4
L (1)	A (5)	6	5	3	1	11	9	7
L (1)	B5 (3)	4	5	3	1	9	7	5
L (1)	B10 (1)	2	5	3	1	7	5	1
L (1)	Unknown (0) *	1	5	3	1	6	4	2

* Source is considered vulnerable to types of PCAs that are Unknown, if the Vulnerability Score is 8 or higher.

Format for Prioritized Listing of PCAs

List types of PCAs in order by Vulnerability Score from highest to lowest.

Zone	Type of PCA	PCA Points VH = 7 H = 5 M = 3 L = 1	Zone Points A = 5 B5 = 3 B10 = 1 Unknown = 0	PBE Points L = 5 M = 3 H = 1	Vulnerability Score PCA points + Zone points + PBE points

page intentionally blank

Appendix N
Checklist for Drinking Water Source Assessment – Ground Water Source

Public water system: _____ ID No.: _____

Name of source: _____ ID No.: _____

Assessment date: _____ Assessment conducted by _____

The following information should be contained in the drinking water source assessment submittal.

If another report that is the functional equivalent to the drinking water assessment (e.g., parts of a Ground Water Management Plan) is included in this assessment, the part of that report that fulfills the components of the source water assessment should be clearly indicated.

_____ Source name, system name, source and system identification numbers, date of assessment, name of person and/or organization conducting the assessment (Appendix N, this form)

_____ Assessment map with source location, source area (if known), and protection zones

_____ Drinking water source location coordinates and accuracy of method used (Appendix H or equivalent)

_____ Delineation of protection zones (Appendix I or equivalent)

_____ Drinking water Physical Barrier Effectiveness Checklist (Appendix J)

_____ Well Data Sheet

_____ Possible contaminating activity (PCA) inventory form (Appendix K)

_____ Possible contaminating activities evaluation (optional) (Appendix L)

_____ Vulnerability ranking (Appendix M)

_____ Additional maps (optional) (e.g., local maps of zones and PCAs, recharge area maps, or maps indicating direction of ground water flow)

_____ Means of Public Availability of Report (indicate those that will be used)

- _____ Notice in the annual consumer confidence report* (minimum)
- _____ Copy in DHS district office (minimum)
- _____ Copy in public water system office (recommended)
- _____ Copy in public library/libraries
- _____ Internet (indicate Internet address: _____)
- _____ Other (describe)

*The annual report should indicate where customers can review the assessments.