Nevada
Integrated SourceWater Protection Program

www.ndep.nv.gov/bwpc/sourcewater.htm

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Table of Contents

List of Figures ii

Acronyms and Definitions iv

Disclaimer v

Preface v

Acknowledgments vi

How to Use This Guidance vi

1.0 Introduction 1-1

2.0 Program Background 2-1
- 2.1 Constraints of Previous Program 2-4
  - 2.1.1 CSWPP Development and Implementation 2-4
  - 2.1.2 Integration of CSWPPs at the State Level 2-5
- 2.2 Modifications to Current Program 2-5
  - 2.2.1 Technical Assistance 2-5
  - 2.2.2 Community Planning Schedule 2-6
  - 2.2.3 Community Planning Approach 2-8
  - 2.2.4 Objective of Current Program 2-11
  - 2.2.5 Plan Elements 2-12
  - 2.2.6 Develop Federal, State, and Local Source Water Protection Partnerships 2-13
  - 2.2.7 Integrate and Implement Source Water Protection at the State Level 2-13

3.0 Community plan Development and Implementation 3-1
- 3.1 Element 1: Formation of the Local Planning Team 3-3
  - 3.1.1 Members of the Planning Team 3-4
  - 3.1.2 Team Roles and Responsibilities 3-5
  - 3.1.3 Team Meetings 3-7
  - 3.1.4 Identification of Jurisdictional Authorities 3-7
  - 3.1.5 Community Planning Goals 3-8
- 3.2 Element 2: Inventory and Delineation of Public Water Supply Sources 3-9
  - 3.2.1 Source Inventory 3-9
  - 3.2.2 Source Water Protection Area Delineations 3-10
- 3.3 Element 3: Contaminant Source Inventory 3-12
- 3.4 Element 4: Development of Contaminant Source Management Strategies 3-15
- 3.5 Element 5: Management and Sharing of Information 3-19
  - 3.5.1 Contingency Planning 3-20
  - 3.5.2 Plans for New Well Siting 3-22
  - 3.5.3 Implementation at the Local Level 3-23
  - 3.5.4 Public Education and Outreach 3-24
- 3.6 Requirements of State Endorsed/State Funded Plan 3-26

4.0 Community Program Guidance (pull-out) 4-1
- 4.1 Purpose 4-1

4.2 Overview 4-2
4.3 Steps to Participate 4-2
4.3.1 Team Identification of Potential Issues or Concerns 4-9
4.4 Parts of a Community Source Water Protection Plan 4-9
4.4.1 Section 1: Introduction 4-11
4.4.2 Section 2: Team formation 4-11
4.4.3 Section 3: Plan development 4-11
4.4.4 Section 4: Action Plan 4-29
4.4.5 Section 5. Public Participation 4-31
4.4.6 Section 6 Executive Summary 4-33
4.5 State Endorsement 4-35

5.0 Ground Water Source Water Protection Areas 5-1
5.1 Nevada Hydrogeology 5-1
5.2 Source Water Protection Area Delineation Methods 5-6
5.2.1 Data Selection and Parameter Estimation 5-7
5.2.2 The Arbitrary Fixed Radius Method 5-8
5.2.3 The Calculated Fixed Radius Method 5-9
5.2.4 The Analytical Method 5-10
5.2.5 The Combined Analytical Model/CFR Method 5-13
5.2.6 Hydrogeologic Mapping 5-15
5.2.7 Numerical Flow and Transport Models 5-19
5.3 Selection of a Source Water Protection Area Delineation Method 5-20
5.4 State Endorsement Requirements for SWPA Delineation 5-23
5.5 References 5-25

Tables

Table 3-1 List of Potential Community Stakeholders and Planning Contributions 3-4
Table 3-2 Regulatory and Non-Regulatory Contaminant Source Management Strategies (U.S. EPA) 3-17
Table 3-3 Possible Public Education and Outreach Strategies 3-25
Table 4-1 Example Plan Team Roster and Team Member Responsibilities 4-8
Table 4-2 Potential Source Water Issues and Affected Areas of Concern 4-9
Table 4-3 Suggested Risk Rankings for Potential Contaminant Sources in Nevada 4-19
Table 4-4 Activities Which May Contaminate Drinking Water 4-21
Table 4-5 Example Windshield Survey Form 4-22
Table 4-6 Possible Regulatory Contaminant Management Options 4-25
Table 4-7 Possible Non-Regulatory Contaminant Management Options 4-26
Table 4-8 Example Public Education and Outreach Projects 4-32
Table 4-9 NDEP CSWP Plan Endorsement Checklist 4-35
Table 5-1 Considerations for Selecting a Delineation Method 5-22

Figures

Figure 2-1 Nevada Wellhead Protection Plans as of May 2009 2-3
Figure 2-2 Example County Planning Schedule 2-7

Figure 2-3 Process Diagram to Initiate Community Source Water Protection Planning Assistance 2-9
Figure 3-1 Elements of a CSWP Plan 3-1
Figure 3-3 CSWP Plan Stakeholder Communication 3-2
Figure 3-4 Element 1: Formation of a CSWP Planning Team 3-3
Figure 3-5 Element 2: Modeling and Mapping SWPAs 3-9
Figure 3-6 Example SWPA Based on Times of Travel 3-11
Figure 3-7 Refined SWPA Boundaries Using Physical Features 3-11
Figure 3-8 Element 3: Contaminant Source Inventory and Risk Evaluations 3-13
Figure 3-9 Element 4: Develop Contaminant Source Management Strategies 3-16
Figure 3-10 Element 5: Management, Sharing and Integration of SWP Information 3-19
Figure 4-1 Example Community Announcement for Public Outreach Events 4-3
Figure 4-2 Team Member Information Sheet 4-5
Figure 4-3 Team Roster and Contact Information Form 4-6
Figure 4-4 Graphical Outline of a Completed CSWP Plan 4-10
Figure 4-5 Illustration of Ground Water System Elements (Modified From Edwards Aquifer Authority, San Antonio, Texas) 4-12
Figure 4-6 Example SWPA Delineations Developed from Ground Water Modeling Based on Time of Travel (Larger areas correspond to increasing time of travel). 4-14
Figure 4-7 SWPA Delineation Using Visual Boundaries 4-15
Figure 4-8 Potential Ground Water Contamination Illustration (Modified from Phillips, USGS) 4-17
Figure 4-9 Developing Management Strategies 4-23
Figure 4-10 Example SWPA Notification Letter 4-30
Figure 4-11 Public Participation in Plan Development 4-31
Figure 4-12 Example SWPA Road Sign 4-33
Figure 4-13 Example CSWP Plan Executive Summary 4-34
Figure 5-1 Nevada Aquifers (USGS, Updated 2009) 5-2
Figure 5-2 Conceptual Hydrogeologic Model for the Basin and Range Physiographic Province (modified from White Pine County Water Resources Plan) 5-3
Figure 5-3 Schematic Cross Section of a Valley Fill Aquifer 5-4
Figure 5-4 Schematic Block Diagram of a Carbonate Aquifer 5-5
Figure 5-5 Schematic Cross Section of a Typical Basalt Aquifer 5-6
Figure 5-6 Sample Aproach Arbitrary Fixed Radius Method 5-9
Figure 5-7 SWPA Delineation for a Well Using the CFR Method 5-10
Figure 5-8 Analytical Method Description (modified from U.S. EPA) 5-12
Figure 5-9 Sample SWPA Delineation Approach Using the Analytical Modeling Method (Silver Peak Water System, 2008). 5-13
Figure 5-10 Combined Two Dimensional Analytical Model/CFR Method 5-14
Figure 5-11 SWPA Delineation Using Hydrogeologic Mapping 5-16
Figure 5-12 Topography for the West Slope of Ward Mountain (McGill Ruth, 2009) 5-17
Figure 5-13 McGill Ruth Springs SWPAs 5-18
Figure 5-14 Example 5-year Time of Travel Capture Zone Model Output Image 5-20

ACRONYMS AND DEFINITIONS

BCA – NDEP Bureau of Corrective Action

BLM – U.S. Bureau of Land Management

BSDW – Bureau of Safe Drinking Water

BWPC – Bureau of Water Pollution Control

CFR – Calculated Fixed Radius

CSWPP – Community Source Water Protection Plan, also referred to as the Plan

DEM – Nevada Division of Emergency Management

DWPA – Drinking Water Protection Area

EPA – U.S. Environmental Protection Agency

GIS – Geographic Information System

GPS – Global Positioning System

GWPTF – Ground Water Protection Task Force

ISWPP – Integrated Source Water Protection Program, also referred to as the Program

NAC – Nevada Administrative Code

NDEP – Nevada Division of Environmental Protection

NDWR – Nevada Division of Water Resources

PSA – Public Service Announcement

PWS – Public Water System

SDWA – Safe Drinking Water Act

SWAP/VAP – Source Water Assessment Program/Vulnerability Assessment Program

SWP – Source Water Protection

SWPA – Source Water Protection Area

TA – Technical Assistance

TOT – Time of Travel

USFS – U.S. Forest Service

USGS – U.S. Geological Survey

WHPA – Wellhead Protection Area

WHPP - Wellhead Protection Program

DISCLAIMER

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the State of Nevada. The Nevada Division of Environmental Protection (NDEP) believes that the models mentioned in this document may be very useful for community source water protection program implementation, and NDEP utilizes several of these models. However, NDEP does not select, endorse, or approve their use over any other equivalent approach. Since various ground water modeling software packages are continually updated, improved, and re-released, there may be many models capable of facilitating wellhead protection area delineations.

PREFACE

This document outlines the State of Nevada Integrated Source Water Protection Program (ISWPP – hereafter referred to as the Program) and provides guidance to, and tools for, local communities in the development and implementation of a Community Source Water Protection Plan (CSWPP – hereafter referred to as the Plan).

This document is the Seventh revision to the "State of Nevada Wellhead Protection Program (WHPP)" guidance document. Historical revisions have been made to reflect program refinements. This revision is the result of a comprehensive program review and update. Major modifications include a program name change to "Integrated Source Water Protection Program" and substantial changes to the community planning approach as well as how the program is managed at the State and local level. It is also termed an interim document to allow for additional minor modifications over the next few years as the new program approach is refined.

The bulk of the Program is based upon the Nevada "Comprehensive State Ground Water Protection Program" (updated March 1998) developed by NDEP and approved by the U.S. Environmental Protection Agency (EPA). Periodic revisions to both documents may be made at the discretion of NDEP.

The Nevada Program is administered by the NDEP Bureau of Water Pollution Control (BWPC). The primary goal of the program is the protection of public drinking water supplies through the implementation of contaminant source control at the community level. Nevada communities must realize that much less effort and money is spent to protect drinking water supplies than to clean them once contamination has occurred.

Source water protection in Nevada is dynamic and integrated into many NDEP programs coordinated at the federal, state and local level. The Nevada ISWPP, historically referred to as the WHPP, has been expanded to include source water protection beyond wellhead/ground water protection. The program includes both elements of the WHPP and the Source Water Assessment Program/Vulnerability Assessment Program (SWAP/VAP) that is currently managed under NDEP's Bureau of Safe Drinking Water (BSDW), and Drinking Water Protection Areas (DWPAs) developed by the BWPC. DWPAs are delineated to include all public water systems who have not had the opportunity to or have chosen not to participate in the WHPP to date and that do not currently have a SWAP/VAP report. These assessments were completed in 2003 and each public water system should have received a copy of their SWAP report. If a public

water system does not have one, they can coordinate with the BSDW to get a copy for their use.

The new focus of the program and its unique approach will maximize State and local data collection efforts and dedicated resources for managing and sharing data; provide for increased technical assistance (provided by NDEP) for community plan development and implementation; and also encourage a broader spectrum of public education and inter/intra agency coordination and planning efforts. Communities will have numerous tools and technical assistance available to them to make source water protection planning easier and more efficient.

ACKNOWLEDGMENTS

This document was prepared by the Nevada Division of Environmental Protection, Bureau of Water Pollution Control, Ground Water Protection Branch. The communal knowledge and experience of the Program realignment team, from both technical and administrative viewpoints, provided the foundation upon which this Guidance is based.

NDEP extends its thanks to the technical consultants on this effort. They have demonstrated that wellhead protection can be carried out while balancing the demands of good science, implementable policy, public health and safety, and economic development.

NDEP would also like to thank the members of the Ground Water Protection Task Force (GWPTF) for their advice and guidance in developing an effective and widely supported wellhead protection program. Thanks is also given for the contributions from numerous representatives from local and state government entities who provided great insight to the perspectives of water protection and conservation issues across Nevada in effectively revising the State-wide wellhead protection program.

Special appreciation is also extended to other state organizations who shared their programs and provided valuable information and viewpoints on state run wellhead protection programs: Ohio Environmental Protection Agency, Louisiana Department of Environmental Quality, Washington State Department of Health, Nebraska Department of Environmental Quality, Mississippi Department of Environmental Quality, and Tennessee Department of Environment and Conservation and Utah Department of Environmental Quality.

Finally, the development and printing of this document were made possible through funding by the U.S. Environmental Protection Agency, Region IX. The U.S. EPA continues to encourage and support Nevada's source water protection efforts statewide.

HOW TO USE THIS GUIDANCE

This guidance was developed to satisfy the needs of numerous audiences such as public officials, technical consultants, water systems personnel, interested community members, educators, and more. Public officials are not likely to be interested in reading the entire document and may just want some general information for decision making purposes. Educators may simply need to understand general source water protection information, while technical consultants will want to understand the detailed technical aspects of the

programs.

Subsequently, the sections in this guidance were developed so that individuals may select the section that will best suit their informational needs. Sections 1 and 2 provide the reasons and background for the development of this guidance document and are intended to explain to communities and agencies the programmatic goals of Nevada's ISWPP.

Section 3 provides a detailed description and rationale for each step in the development and implementation of a community's source water protection plan. It is intended to describe the program for regulatory agencies, and to provide specific information which might be needed by community teams based upon questions or interpretations of Section 4.

Section 4 is intended to be a simplified document which can be used by the Community Source Water Protection Team. It provides specific guidelines and examples for how to implement the programmatic elements presented in Section 3.0 in order for communities to develop and implement a Community Source Water Protection Plan. This section can be removed from the this guidance document and copied so that each Team member can have his/her own section and guidance for the steps needed to complete his/her assigned portion of the Plan. Throughout this process, NDEP and its consultants will be available to assist the Team.

Section 5 is technical in nature, and is intended for those Team members or consultants who are providing assistance in identifying the hydrologic characteristics of a community's drinking water source(s), that will ultimately be incorporated in the Plan. This Section provides guidance in the steps to follow to ensure proper acquisition and evaluation of data needed to properly model the areas of concern around the well or water source. The model is then used to determine boundaries for the areas of concern based upon the time of travel for contaminants to reach the drinking water source.

The intended purpose of the ISWPP is to provide assistance and guidance to communities and for NDEP staff to support a community in these efforts throughout the planning process. This guidance provides the foundation for this effort and therefore will likely be updated numerous times as the program evolves and lessons are learned.

1.0 INTRODUCTION

Many people still live with the misconception that since water quality and quantity did not present a problem in the past; it will not present any problems now or in the future. This is no longer true, due to population growth, more intense land use, and the increased use of chemicals that threaten most water supplies.

The State of Nevada Division of Environmental Protection (NDEP) has numerous programs established under the Safe Drinking Water Act and the Clean Water Act which serve to protect surface and ground waters of the State. Each program is unique and typically regulates specific activities to reduce and/or eliminate incompatible discharges (pollution) from entering the waters of the state. Regulated activities are related to commercial, industrial or municipal sites that discharge directly to a body of water, or may include sites that indirectly discharge polluted storm water run-off, commercial and residential septic systems used for sewage disposal, large animal feed lots, and mining operations. Most of these activities are permitted and managed at the State level or through a local jurisdiction's health department.

In addition to these programs, NDEP also provides assistance for and encourages communities to develop and implement local Community Source Water Protection Plans (CSWPPs or Plans). Community Source Water Protection is voluntary action taken to prevent the pollution of community drinking water sources, including ground water, lakes, rivers, springs and streams. Source water protection involves developing and implementing a plan (or plans) to manage land uses and anthropogenic (human caused) sources of contamination in order to prevent contamination or pollution of the community's water supply.

Source water protection in Nevada is dynamic, is considered in virtually all of NDEP's programs, and is coordinated at the federal, state and local level. The State of Nevada Integrated Source Water Protection Program (ISWPP or Program), historically referred to as the Wellhead Protection Program (WHPP), has been expanded to include source water protection beyond wellhead/ground water protection. It now focuses on maximizing data collection, resource sharing, providing needed technical assistance for community plan development and implementation, and on inter/intra agency coordination and planning efforts.

The Program outlines a multi-faceted, voluntary approach that works at both State and local levels, and considers the historical development of, and recent modifications to the WHPP as outlined in subsequent sections of this document. NDEP will facilitate community involvement in the development of Plans and the provision of technical assistance whenever possible.

It is Nevada's belief that effective Plans must be developed and administered by local government (e.g. county commission, city council, town board) in conjunction with the public water suppliers (public or private entities). A local Plan should be a long-term commitment on the part of the community to protect its drinking water sources. Because the needs, abilities, and jurisdictional authorities vary among rural and populous communities, the State plan allows for flexibility in developing local source water protection activities.

NDEP has identified four (4) main elements that are essential to implementing an effective State ISWPP. These elements set the stage for State and local program development and implementation and provide the basis for the most recent program updates. The main elements (goals) of the Nevada Program are to:

- Encourage, motivate and support local source water protection activity;
- Manage, share, and integrate source water protection information;
- Develop federal, state and local source water protection partnerships; and
- Integrate and implement source water protection at the state level.

This guidance outlines recent modifications made to the former WHPP and provides detailed discussion on each of the elements listed above, particularly how each element is satisfied within the structure of the Program.

2.0 PROGRAM BACKGROUND

The 1986 amendments (Section 1428) to the Federal Safe Drinking Water Act (SDWA) mandated that each state develop wellhead protection programs for the purpose of protecting ground water which serves as a source for public drinking water supplies. Although the law specifies certain elements which must be addressed in state programs, individual states are allowed the flexibility to develop programs that meet their particular needs. In response, Nevada developed the State Wellhead Protection Program (WHPP) which was approved by the EPA in February 1994. The program is voluntary in nature and provides incentives to local communities for their participation.

Local source water protection planning efforts in Nevada have been accomplished through the WHPP, which is currently managed within the Bureau of Water Pollution Control (BWPC) and in some cases under the Source Water Assessment Program/Vulnerability Assessment Program (SWAP/VAP) which is managed by the Bureau of Safe Drinking Water (BSDW).

The elements of these two programs vary, mainly due to the fact that they were developed prior to the consolidation of the two Bureaus under the Nevada Division of Environmental Protection (NDEP). However, the programs are complementary in that each outlines areas where contaminants may enter a community's water supply and subsequently each identifies contaminant sources within the delineated areas. Nevada communities are encouraged by both programs to develop and implement strategies at the local level that best protect their drinking water supply.

The BWPC has also established Drinking Water Protection Areas (DWPAs) for all public water systems to be used in conjunction with the community plans for implementation at the state level. Sensitive DWPAs, wellhead protection areas, and source water assessments are further considered with various NDEP programs including (but not limited to): conducting technical permit and plan reviews; establishing public water system capacity; and, in some cases, having a local community plan is considered for various funding opportunities. The community plan not only provides a blueprint for the community to manage and protect their drinking water resource, but the plan may also influence state and local decision making and demonstrate to various funding programs the communities' capacity and commitment to protecting their resources into the future.

Historically, NDEP has awarded "no match" grants to local communities for the development and implementation of local source water/wellhead protection plans. The WHPP included a competitive application process, in which any community or non-transient non-community public water system could apply for funding in any given funding cycle to develop or implement a local plan.

The application process required public water systems to outline a scope of work and detail associated costs (typically done with the help of a private consultant). The applications were reviewed internally for compliance with state criteria for funding and used to prioritize assistance and work to be completed. NDEP awarded multiple grants to water systems during each funding cycle. In many cases, communities retained a private consultant to spearhead and drive the planning process, and a community team was

established (including a NDEP representative) to provide technical and planning support. NDEP staff reviewed and endorsed the local plans, which was required in order for the community to apply for implementation funding.

This competitive process has been successful for many years. Numerous public water systems have developed and implemented plans. Figure 2-1 shows communities/public water systems in Nevada that have developed plans to protect their ground water supplies.

To date the state has endorsed 60 wellhead protection plans. Individual plans may include one or more public water systems for the area resulting in approximately 117 public water systems in Nevada protected under individual plans.

Although many public water systems have successfully developed ground water (wellhead) protection plans, the age and applicability of the State program, slowed community planning momentum, and increased implementation of source water protection areas at the state level, suggested the need for a major program review and update.

While numerous communities/water systems have participated in the program, many still have not developed plans. In addition, many of the public water systems that have developed plans have not implemented them. This may be attributed to the competitive grant process, limited local resources, limited capacity of water system staff to administer the contract requirements and carry out assigned tasks, or simply lack of public interest or understanding of the program elements and goals.

Ultimately, NDEP's goal is to protect all public water supplies and to encourage all communities to develop and implement plans. NDEP has, therefore, reorganized the program to eliminate the competitive grant process so that every community and/or public water system in Nevada has equal opportunity to participate in the planning process.

In addition, NDEP has integrated elements of the SWAP/VAP and State DWPAs into the program to broaden the scope and goals of the program beyond wellhead/ground water protection and to ensure all sources of drinking water are considered in community planning. This approach incorporates some elements of complementary NDEP programs to provide a more comprehensive and focused planning document and also provides the basis for the program name change to "Integrated Source Water Protection Program." Additional information on each of these programs may be obtained from the NDEP website as more information is added regarding source water protection and education.

The following paragraphs provide an overview of the various considerations for major program modifications.

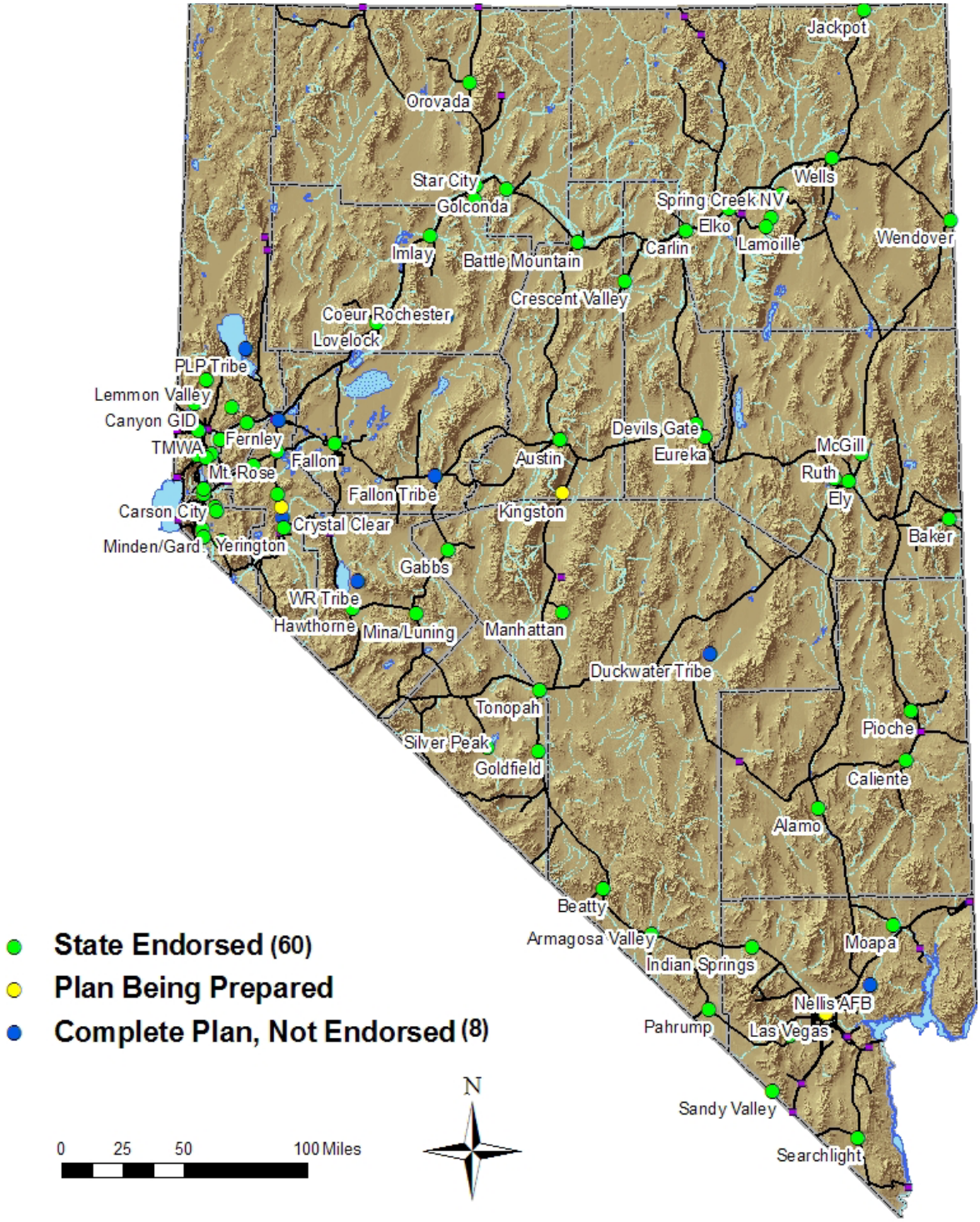


Figure 2-1 Nevada Wellhead Protection Plans as of May 2009

2.1 Constraints of Previous Program

The State has considered numerous program modifications during the program review and update process including identifying constraints on initiating and carrying out the Community Source Water Protection (CSWP) planning process, how local plans are integrated and implemented at the state level, the need for additional incentives for communities to participate in developing and implementing a Plan, and incorporating public education at all stages of program development and implementation.

2.1.1 CSWPP Development and Implementation

Historically, public water systems have hired technical consultants to assist them with the plan development and implementation projects. The consultant has been responsible for developing a planning team, drafting the plan, managing contract administrative duties and developing implementation work plans to include cost estimates (all associated costs were directly reimbursed through the program grant to the community). While many plans have been successfully developed this way, NDEP has recently identified some constraints inherent to this process that are addressed in the new approach.

One situation in particular became apparent as the Program evolved and began to redirect its focus to increase plan implementation. Typically, when a grant contract expired and the private consultants had no further financial commitment to the project, many communities did not have enough involvement in the planning effort or understanding of the plan goals to confidently carry out the program without the consultants. In many cases a plan was developed that literally sat on a shelf until the community was selected for additional funding to implement the plan. Then the consultants picked up where they left off and continued working with the community until the funds again run out. These plans were developed to be completely dependent upon grant funding for implementation into the future, with virtually no local resource dedication.

In some instances a plan was developed with little interaction from the planning team and recommendations for management strategies and action plans may not have been carefully considered by the community. Uninvolved or weak planning teams often resulted in the development of "generic" or "template" style plans which satisfied State endorsement criteria, but might not reflect realistic community goals and management strategies.

In addition, some management strategies recommended were resource intensive and required technical expertise that many small communities simply did not have the resources to support and/or only limited jurisdictional authority to implement. The State guidance suggested a variety of management strategies from a very broad planning perspective. Each community had to carefully consider the applicability of each proposed management strategy, the resource dedication required to implement the strategy, and how to gain community support in these efforts.

Also, the public water system operator is often the person responsible for initiating the planning momentum. Water system operators typically wear many hats in Nevada communities and prioritize their work according to the most pressing issue at hand while

also keeping busy with the daily operations of the water system. Community source water protection planning is voluntary and requires coordination with the local governing body. Water system operators simply do not always have the time to dedicate to coordinating all aspects of source water protection planning. The new Program encourages increased team development to share the tasks and coordinate all activities.

2.1.2 Integration of CSWPPs at the State Level

Another constraint has been quality control and standardization of data presented in the planning documents. This is a direct result of an evolving and dynamic program. Information from the plans is used for a variety of purposes at the state level. Standardized methods for data collection, management and quality control procedures are needed to maximize resources and time dedication in various funding, permitting and plan review efforts.

In order for NDEP to continue to manage and share data effectively internally and with other federal, state and local entities, location and mapping data from local plans need to be provided in a GIS format compatible with State capabilities. Standards for quality control to ensure data accuracy need to be incorporated into local plan development to ensure data that is shared and referenced for various permitting and plan review efforts have been adequately verified.

2.2 Modifications to Current Program

Limited state resources always pose a challenge for the development and implementation of any statewide program. However, the new focus and approach of the Program will maximize the use of available resources and encourage local participation in the program. Nevada is a large state with a mixture of communities ranging from the very rural (i.e., Gerlach and Silver Peak) to large urban areas (i.e., Las Vegas and Reno) and many in between. Each community has unique economical, political and cultural characteristics which play a large role in their source water protection planning goals and approaches. NDEP's new Program takes into account the complexities and differences in each community, enables each community to voluntarily participate in source water protection planning, and empowers each community to create and enforce individual local plans.

The guiding principle is that each community must carefully develop its own flexible, realistic planning perspective which is specific to that community. That perspective means it will be easier to gain local support for implementing a realistic and effective plan into the future.

2.2.1 Technical Assistance

The first and most significant program modification made to motivate and support local source water protection planning is the elimination of the competitive grant process for the development and implementation of local source water protection plans. Historically, public water systems utilized awarded funds to hire technical consultants to assist the community in developing and implementing local community plans. The grant procedure requires a time intensive contract administrative process that may inadvertently exclude

some public water systems that simply do not have the resources to manage a contract. It also requires the state to prioritize which systems receive assistance based upon submitted proposals or work plans. Many water system managers and operators may not have the administrative skills to develop work plans that adequately reflect the importance of the proposed work.

From a geographic view point, the competitive approach distributes funding randomly and can result in the creation of communities with planning momentum which are isolated within a larger area which has no interest in the Program (e.g., a district within a county, a homeowners association within a district, etc.). Additionally, adjacent jurisdictions may be unaware of each others' planning goals and efforts, resulting in plans which may not be mutually complementary.

To resolve these issues, NDEP has contracted directly with a technical consultant (technical assistance provider) who will provide guidance to local communities in virtually every aspect of source water protection planning. The technical assistance provider will, at the direction and discretion of NDEP, provide assistance to communities in virtually all aspects of source water protection planning and implementation – thus eliminating the need for local community contract administration.

The technical assistance provider will guide and assist the community/team through the planning process, through the development of realistic planning goals, and through coordination with adjacent jurisdictions. However, the community/team will actually develop and implement the plan so that the community/team will have the confidence to carry the plan into the future.

2.2.2 Community Planning Schedule

Another significant modification to the Program is in its community approach. Nevada is a geographically large state with 17 counties and nearly 600 public water systems. NDEP plans to maximize its resource dedication and ensure that every public water system has an opportunity to participate in the program. The community approach entails dedicating all resources within a given funding cycle (typically $270,000 a year) in up to three counties.

Ideally, each county may receive as much as $90,000 per year for two years (totaling $180,000) in technical assistance and direct cost reimbursement for the development and implementation of local source water protection plans. The goal is to focus all of the technical assistance efforts into one or two adjacent counties, to provide a means for all public water systems within the county(ies) to participate in the planning process and to coordinate local planning with adjacent jurisdictions.

NDEP has also considered that some of the more populated counties may require more resource and time dedication than many of the lesser populated counties. Therefore, NDEP may use some discretion in prioritizing resources dedicated to each county by considering the number of community and non-transient non-community water systems within the county, populations served by water systems, capacity development surveys, source water and vulnerability assessment rankings, proposed project need, planning momentum and interest in receiving technical assistance for this program. These

considerations allow NDEP adequate flexibility to determine reasonable assistance needs for each county.

Ultimately, NDEP's goal is to include all public water systems in the planning process. In order to successfully implement this goal, NDEP may take a broader county planning approach in which all of Nevada's 17 counties will have an opportunity to participate in the program and benefit from dedicated resources. Ideally, every county will be reached within a 10-12 year program planning horizon.

NDEP can initiate the process by approaching a county once every 10 to 12 years, to solicit interest and support in the development of Plans from communities within the county. NDEP may visit the communities that show interest in Plan development with the support and/or knowledge of the Board of County Commissioners.

Figure 2-2 is an example Program planning horizon in which all 17 Counties in Nevada are provided an opportunity to receive technical assistance over a two year time frame.

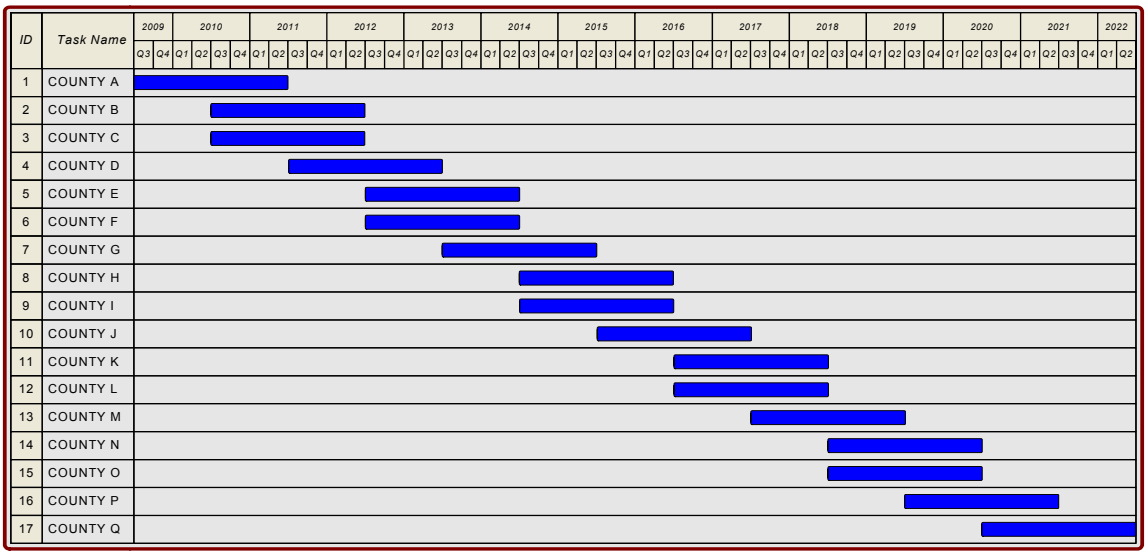


Figure 2-2 Example County Planning Schedule

The order in which NDEP approaches each of the Nevada counties will be based on funding availability and may be influenced by the proximity of bordering counties where overlapping jurisdictions may share a water resource. The goal of the Program planning horizon is to overlap the technical assistance into neighboring counties to allow for maximum coordination and to maximize funds dedicated to travel expenses. NDEP believes more efficient and consistent planning will take place if resource and time dedication are consistent over a period of time, rather than sporadic planning throughout the State which is likely to start and stop planning momentum numerous times depending upon funding cycles.

Once a county has received or has declined the technical assistance offered by NDEP, they may not likely have another opportunity to participate again until their particular county recycles through the schedule. Therefore, it is important for communities to be aware of and to be encouraged to participate in the Program when assistance is offered.

In addition, local plans should include an appropriate planning horizon and include a mechanism for required updates to reflect changes within the community during the waiting period.

Communities which are not part of the initial NDEP contact cycle may also request assistance in the development of their Plan. If they have the desire and support of community members, NDEP may provide assistance for that community, including facilitating interactions with other federal, state, and local stakeholders, based upon available resources and scheduling constraints.

NDEP would like to see counties take the lead in the planning process. As stated previously, NDEP understands that each community is unique and likely will have its own unique political planning approach. However, NDEP recommends that each county develop a comprehensive source water protection map and regional management strategies which outline the source water protection areas identified in that particular county – whether developed independently by the individual public water system or comprehensively at the county level. The source water protection areas may also be included in the county master planning document for consideration in local planning and decision-making efforts.

2.2.3 Community Planning Approach

NDEP envisions a county-wide approach to the CSWPP planning process because the political structure of local government within the State of Nevada promotes local control and management of natural resources through either county or incorporated city entities. These entities generally have the ability and existing mechanisms to provide both regulatory and non-regulatory measures that can directly and indirectly protect and preserve ground water quality. The steps to initiate the community planning approach are summarized in Figure 2-3 and explained in subsequent paragraphs.

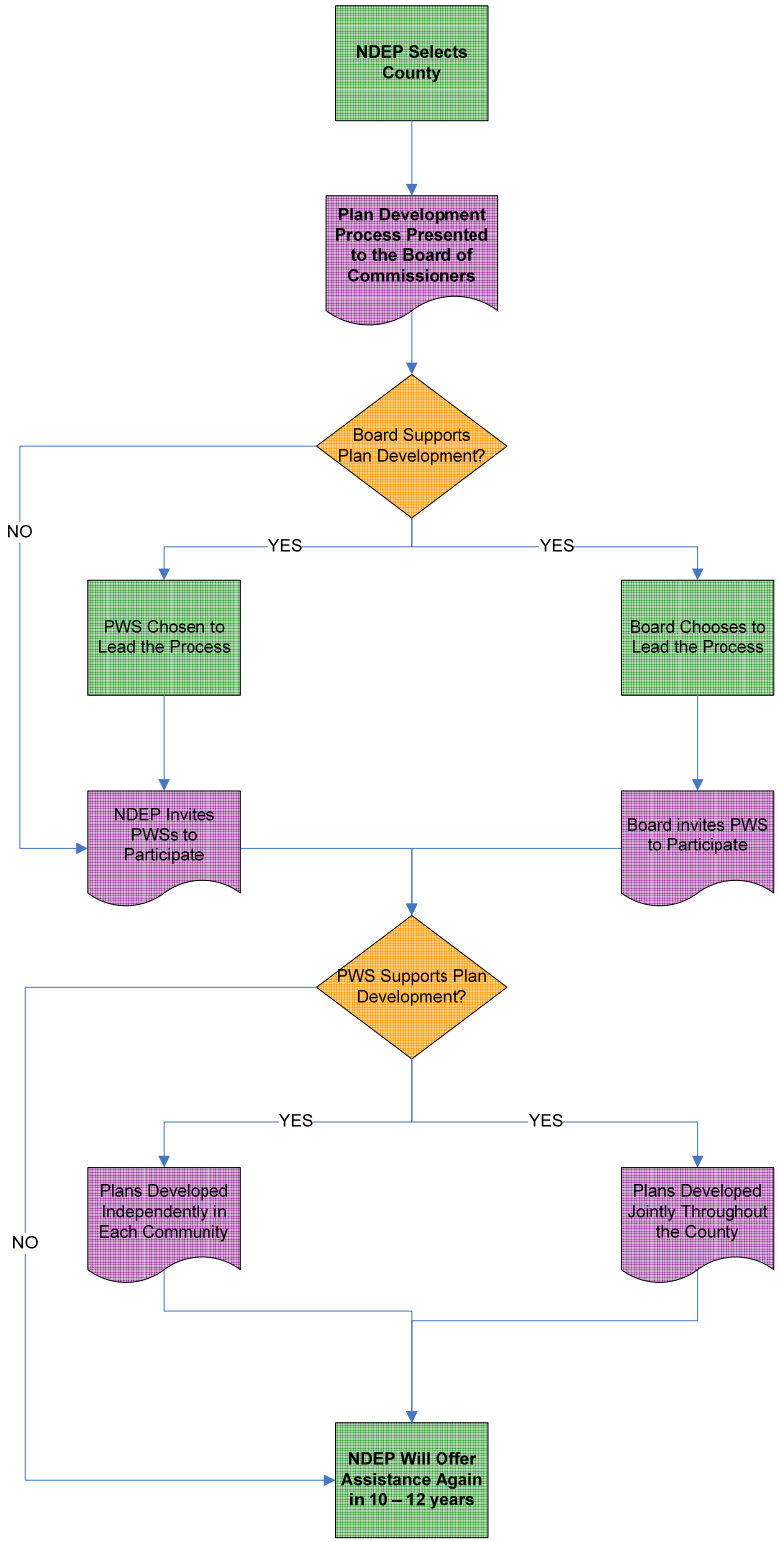


Figure 2-3 Process Diagram to Initiate Community Source Water Protection Planning Assistance

Prior to beginning work within any county, an NDEP representative (staff or technical assistance provider) may arrange to attend a public meeting and provide the local Board of County Commissioners (Board) an overview of the program goals and the new community approach. Development and implementation of a CSWPP is the responsibility of the Plan Development Team and the community. However, community leaders, key staff members, and Public Water Systems (PWS) operators, alike, should be reassured that NDEP can provide support and guidance in the development and implementation of local plans. Additionally, they should be informed that while participation in Nevada's ISWPP is voluntary, NDEP encourages and empowers local communities to participate in CSWPP development and to implement the control strategies identified in their Plan.

NDEP may also gather insights from the Board on their current level of interest and how to most appropriately accomplish source water protection within their particular county. Since each county or municipality generally comprises one or more communities and may have multiple public water systems, NDEP's goal is to maximize community participation in the Program by allowing flexibility in each community's approach to program participation as well as in Plan development. NDEP can use the information provided by the Board to develop a strategy to invite all public water systems located in that particular county to participate in the planning process. By employing a community-wide approach, the direction of the CSWPP within each county and/or municipality will ultimately be directed by the appropriate local government structure, within the confines of the Program guidelines presented in Sections 3 and 4.

Presentations to county boards, city councils, and other municipal governing bodies during open, public meetings, are a formal mechanism for enlisting community support and for providing a brief, concise overview of why that community should participate in the Program.

Community willingness to participate in the Program may be dependent upon several factors, including how Program guidelines relate to that community's overall planning goals. These goals may be identified through a brief review of previously prepared WHPP's, master plan documents, resource plans, websites, and through interviews with local officials (i.e. the County Manager, County Planning Director, Natural Resources Department Manager, Economic Development Coordinator, etc.). When the appropriate staff members are fully briefed and the meeting agenda supporting documents and information is written to demonstrate how the Program can assist the community in meeting one or more of their local planning goals, the governing body and the general public in attendance at the open public meeting will likely be supportive of the Program. If a private organization or group of concerned citizens are initiating the development and implementation of a Plan, they should first contact the appropriate local governing body (e.g. town board, city council, or board of county commissioners), and appropriate land manager if applicable, to generate political support for their planning initiative.

If the county or municipal agency decides to support Plan development, they may choose to lead the process, or have the PWS or an alternative entity lead the process. If the county or municipal agency decides against supporting Plan development, NDEP may directly contact PWS organizations and communities within that jurisdiction to determine

their level of interest in participating in the Plan development process. All public water systems within a particular county will be invited to participate in the local source water protection planning process and efforts will be made to contact and brief each one on the planning process, to promote local participation and the creation of partnerships. While NDEP encourages local cooperation and coordination in the development of a comprehensive regional community planning approach, in some cases, public water systems may prefer to develop and implement an individual plan apart from the county planning process. Each water system will be offered an opportunity to have their water supply sources included and protected under the comprehensive county plan or under an individual water system plan. If neither the county/municipal agency nor the PWS/communities are willing to participate, NDEP will approach another county to determine the level of interest of that county and its communities in participating in the Program. Thus each of Nevada's 17 counties will have the opportunity to participate in the Program within a 10 to 12-year timeframe on a rotating basis.

Whatever the local community approach is, NDEP anticipates that county entities will house all plans and associated maps created either comprehensively or individually within their jurisdiction for continued coordination and consideration in planning efforts. Since the Program goal is to protect all community drinking water supplies, the agency responsible for land management and planning (typically county entities) should have copies of all source water protection plans within their respective communities.

In addition, every public water system within a county should be properly educated on source water protection and community planning issues and goals to protect the local drinking water supplies. Nevada has many small district boards that manage and operate public water systems throughout Nevada. Particularly in very rural communities, the water systems are hard-pressed to find enough individuals to serve on a board and many of the board members in rural areas may lack a fundamental understanding of water system operations and management. In many instances this can be overcome where an experienced water system manager is in place, but when the manager is lacking experience, this situation can be problematic.[1]

Small rural district board members and water system managers may not be fully aware of the benefits of dedicating resources for pro-active source water protection planning versus re-active emergency response. These situations are ideal cases in which the PWS should be strongly encouraged to participate in a more comprehensive regional planning approach and educated on the costs of a contaminated water supply which may include clean up expenses, adverse community health effects, increased monitoring costs, treatment costs, and resource dedication in finding a new source of supply.

2.2.4 Objective of Current Program

The objective of the current ISWPP program is to protect all sources of drinking water through the development of CSWPPs. Benefits from Plan development include the avoidance of water supply contamination and the associated health issues and/or high

[1] Capacity Development Report to the Governor prepared by NDEP Drinking Water State Revolving Fund Program September 2008.

costs of water treatment or new source development. CSWPPs require limited local resource dedication but can result in considerable cost savings for the community by preventing contamination and increasing contingency management capabilities for an unforeseen event.

Many governments are unaware of various activities that can be harmful to, or damage, their water supply. Possible water supply pollutants are widespread and diverse, but are in such common use that they are frequently not viewed as potential problems. A CSWPP provides local perspective on the impact of various land usage and activities that are going on within a community which can affect the water supply. Local officials are expected to be cognizant of these potential threats and adopt appropriate protective measures, partner with the state and business community, and ensure water supply protection. Understanding the issues and developing a CSWPP enables communities and local officials to properly manage existing and potential sources of contamination and ultimately make responsible planning decisions that will protect human health and the financial viability of the community.

In addition, the planning process may provide officials more insights to various funding programs available to assist the community in managing and maintaining a quality water supply. Preparing a Plan will guide the community in researching additional funding opportunities for implementing the Plan into the future. Within the context of the Program, having a state endorsed CSWPP provides eligibility for the community to receive implementation assistance, including technical assistance and direct cost reimbursement for implementation projects.

Source water protection planning momentum is an indicator that the community is proactive and responsible in protecting their assets. A local government can set the tone for source water protection within a community. Communities that have completed a Plan typically have a broader understanding of their source water availability, quality, protection issues and the implications of planning (or lack of planning) on protection of a communities' drinking water supply. Understanding local water supply issues demonstrates to the community and federal and state regulatory and funding agencies that the community takes protecting their drinking water supply seriously and is working to ensure water quality is considered in community development and planning.

2.2.5 Plan Elements

A CSWPP should be used as a guide and tool for a community's awareness of their water resources (quality and quantity) and enable them to make wise land use planning decisions to protect their drinking water supplies. Each Plan should be standardized to the extent they satisfy state endorsement criteria established in accordance with EPA guidelines. Historically, NDEP identified seven (7) elements to be included in a WHPP for state endorsement. This Program guidance document includes modifications to the elements through combining the original seven elements into four (1-4) and by including an additional Fifth element to satisfy the State Program elements and goals. The modified five elements of a Plan are as follows:

1. Formation of a local planning team, including assignments for specific roles and

responsibilities, and local goal development;

2. Inventory of all public water supplies and delineation of protection areas for each;
3. Inventory of all contaminant sources within the identified protection areas;
4. Development of contaminant source management strategies and action plans to meet established local planning goals; and
5. Management and sharing of source water protection information (data).

Each of these elements are discussed in more detail in later portions of this guidance document to provide additional guidance for local communities and insights to the level of detail required for a plan to receive state endorsement, particularly in Section 3 "Community Plan Development and Implementation"; Section 4 "Community Program Guidance"; and Section 5 "Technical Guidance for the Delineation of Source Water Protection Areas".

2.2.6 Develop Federal, State, and Local Source Water Protection Partnerships

Developing and maintaining strong federal, state and local partnerships is a fundamental element of virtually any successful state program or community plan. This will likely include coordinating with various federal and state agency groups like the State of Nevada Ground Water Protection Task Force (GWPTF), local conservations districts, non-profit water associations, university programs, and other local planning teams. These and other groups can provide invaluable insights, mainly because they have already been heavily involved in coordinating source water protection in relation to community planning activities for many years in Nevada. These groups are also typically involved in source water protection education and outreach activities such as educational conferences, community events and water festivals, various workshops and trainings, classroom courses, school presentations and earth day events, technical assistance and training for government officials and planning staff, etc. One would be hard pressed to develop a local source water protection program or plan without first tapping into one or more of these existing resources.

In addition, many of these groups are also typically involved in local planning efforts within their respective communities. Coordinating with these groups provides a venue for source water protection to be incorporated into the local planning process and could enhance existing education and outreach efforts. Developing partnerships will likely result in significant time and resources savings and ensure that all relevant parties are invited to participate and encouraged to share information with one another.

2.2.7 Integrate and Implement Source Water Protection at the State Level

The ISWPP works with other inter and intra state programs to ensure source water protection into the future. NDEP manages source water protection data and information that may be helpful for all federal, state and local agencies to analyze data, prepare reports, and map sensitive areas. NDEP actively coordinates with other state and local agencies in areas where source water protection may overlap in various programs. For example, numerous permitted activities are reviewed by NDEP staff to determine if the activity is located within a designated source water protection area and to evaluate the

vulnerability of the source(s). Also, some of Nevada's federal and state funding programs implement Memorandums of Understanding which solicit comments from virtually all of NDEP programs in relation to projects that are funded through the programs. This process allows NDEP to bring awareness to drinking water sources that could be impacted by a proposed project and allows the funding agencies to impose contractual requirements to protect the source(s). In some cases, outside consultants will also contact NDEP staff with technical inquiries related to source water protection area locations for specific projects.

3.0 COMMUNITY PLAN DEVELOPMENT AND IMPLEMENTATION

The first objective of this section is to provide additional information for each of the elements that comprise a local community's Community Source Water Protection Plan (CSWPP or Plan). A Plan is developed to outline how drinking water sources and ground water systems are protected in the community using strategies tailored to the community's needs and available resources. As presented in Section 2, the process to develop an effective and state endorsable Plan consists of the five (5) elements shown in Figure 3-1.

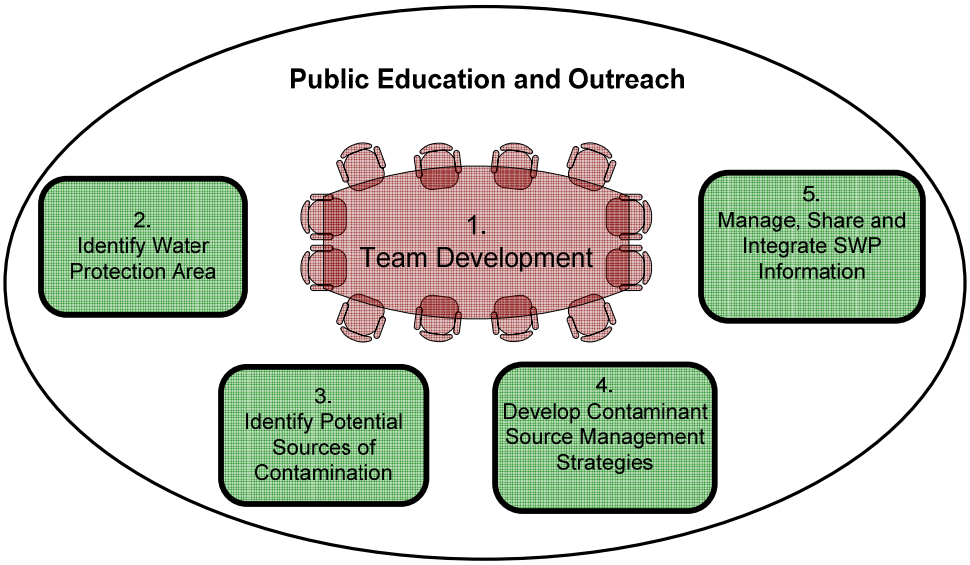


Figure 3-1 Elements of a CSWP Plan

One activity that is universal to the successful development and implementation of a local Plan is the need for on-going public outreach and education. Source water protection programs in Nevada are initiated and implemented at the local level and depend upon the willingness of a community to regulate itself. Therefore, public participation is an effective tool to remind community members of their role as the stewards of the local water resources; to promote voluntary protection efforts and to build public support for the Plan. Public education should be provided up front, during, and after completion of the planning process to encourage both community support for implementing the Plan and individual participation on the local planning Team. A local Plan could easily and quickly be derailed if the public does not understand or has not helped develop the Program. Often, the primary reason that a local Plan fails to be implemented is because the public was not included in the early planning stages. Additional discussion on how to effectively conduct public outreach activities has been provided throughout this section.

Additionally, this section establishes a framework to guide the Nevada Division of Environmental Protection's (NDEP) involvement in working with local communities. Communication between the Team, NDEP, and community stakeholders are essential in

order to successfully develop and implement a Plan as depicted in Figure 3-2.

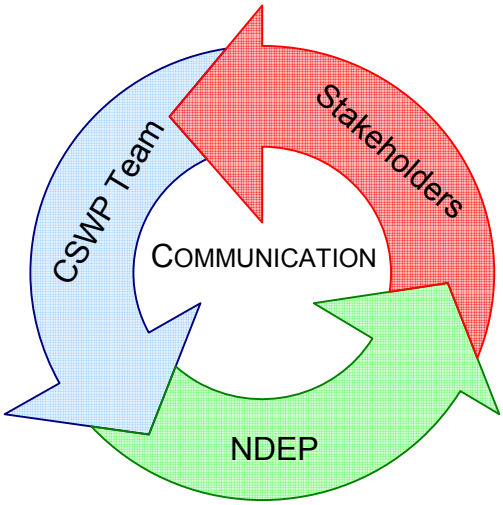


Figure 3-2 CSWP Plan Stakeholder Communication

Interviews with key local officials should help identify the best approach for NDEP-community interactions. This approach may include, but not be limited to:

- Recommendations for Plan development team members;
- Notification requirements and forums for public presentations/workshops;
- Key community contacts (i.e. town board members, school district representatives, planning board/department members, local federal agency representatives, town clerks, etc.);
- Awareness of local events or issues that may effect Program participation;
- Local means of public outreach and education (i.e. local television, radio, newspaper, and newsletter media, etc.);
- Planning mechanisms (departments, districts, boards, etc.); and
- Other relevant information.

The community may enlist NDEP to provide extensive support at the beginning of the Plan development process, but if the Plan is to be sustainable within a community, they must become independent from NDEP as they move through the process. Developing a Plan is a long-term commitment on the part of the community to protect its drinking water sources. The community's role in the Plan process is to:

- ✓ understand the need for the Plan;
- ✓ garner internal support for the state Program and local Plan development;
- ✓ identify and recruit members for the Team from within the community and surrounding land management agencies and organizations;

- ✓ work with NDEP to develop/update and implement the Plan;
- ✓ participate actively in public outreach and educational opportunities throughout the entire development, implementation, and update process;
- ✓ identify local venues for public outreach and education to promote the goals and objectives of the Plan;
- ✓ provide opportunities for community planning and economic development entities to participate in development of goals and objectives for the Plan;
- ✓ work with NDEP to develop a self-sustaining process for the Plan;
- ✓ appoint a Team member to serve as the local contact for stakeholder questions; and
- ✓ educate the community on source water and best management practices.

Additional guidance for each element required to develop a Plan, including the roles and responsibilities of the community and NDEP during the planning process, has been provided in the subsequent sections. These elements are intended to promote active Team participation and continuous public education and outreach in order to produce a Plan that has support from the community and its leaders and results in rapid, visual evidence of successful Plan implementation.

3.1 Element 1: Formation of the Local Planning Team

After building consensus in the community to develop a Plan, the first element to be implemented is formation of the local planning Team. Typically Teams that adequately represent stakeholders in the community develop successful and realistic community plans which are likely to gain local support. Figure 3-3 presents the preliminary activities that should be completed by the Team during the initial planning phases, including developing community goals for the Plan.

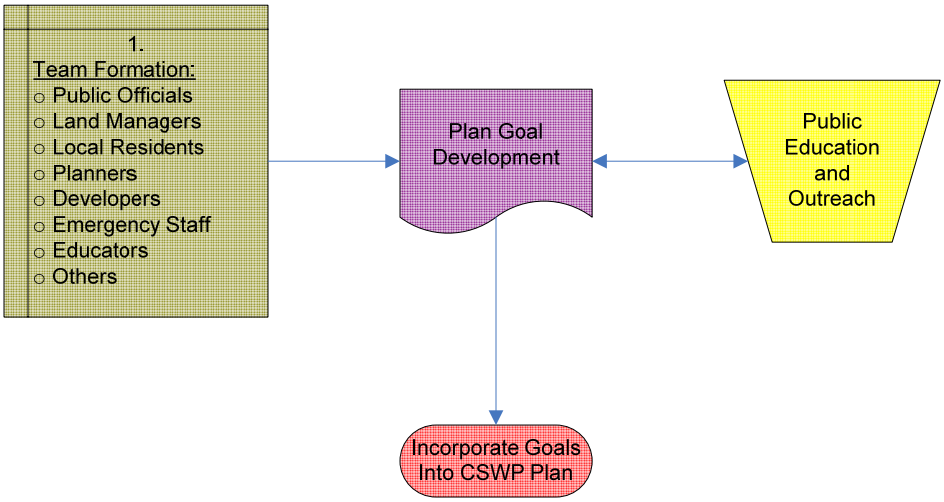


Figure 3-3 Element 1: Formation of a CSWP Planning Team

3.1.1 Members of the Planning Team

Since the planning Team is the driving force behind the development and implementation of a local Plan, careful consideration should be given to the membership of the Team to secure constructive partnerships within the community. Because there are numerous stakeholders in every community that may provide valuable local insight to the planning process, the options for potential Team members are unlimited. However, the most effective members of the Team will possess a cooperative spirit, have a vested interest in protecting their public water supply, and will be able to commit to the process over an extended timeframe. Quite often, the time, talent, interest and commitment necessary to develop and complete a successful Plan can be found within community volunteers.

Planning is a dynamic process requiring a multi-disciplinary Team committed to protecting the community's drinking water sources. Therefore, the Team should consist of members with a variety of backgrounds. Table 3-1 lists potential community stakeholders that may be considered for Team membership and their respective contributions based on their experience in the technical, business, educational, or emergency management fields.

Table 3-1 List of Potential Community Stakeholders and Planning Contributions

Suggested Members	Contribution
Water System Operator	Technical support
Land Management Agency Representative	Regulatory insight
County Commissioner	Community and management strategy support
Area Resident	Local knowledge
Emergency Management Representative	Incident response and contingency planning expertise
Public Relations Specialist	Public education and outreach skills
Fire Chief	Incident response and management
School District Representative	Educational insight
School Board Member	Education and planning expertise
Watershed Planning Group Member	Technical expertise
Representative(s) from Local Industry	Private industry perspective on current and future needs
Environmental Manager/Natural Resource Representative	Environmental compliance expertise
Planning Organization Representative	Planning considerations and impacts
Economic Development Team Member	Growth potential and needs insight
NDEP	Community Support/Technical Assistance
Engineer/Scientist	Technical Assistance

Potential Team members may include, but are not limited to, representatives of local government, utilities, businesses, farming and agricultural communities, schools, residents, and special interest groups. Participation on the Team by a representative of the local governing body with authority over land use zoning is strongly encouraged since controlling the land uses in sensitive Source Water Protection Areas (SWPAs) is one of the most effective management strategies. Teams are encouraged to recruit local scientists, engineers, planners, technicians, attorneys and other experts within the community whenever possible because development and implementation of Plans requires a knowledge and understanding of many varied disciplines and practices. Locally-based professionals may have the best knowledge and understanding of community-specific, technical considerations.

In many of Nevada's communities there may be key community members who have influence on local decision making, employ many of the community residents and provide support for many local activities, or are simply well known and actively involved within the community. These key community members may directly or indirectly influence (support or constrain) the planning process; and they should be invited to join the Team. Ideally, a Team should a least consist of an NDEP ISWPP representative, a public water system manager or lead operator for each water system included in the Plan, a representative from the local land use and planning department, a representative from each local jurisdictional authority, and a technical professional. In the absence of a technical professional that has local expertise, NDEP can provide the necessary technical assistance.

NDEP may provide assistance with Team formation by working with county entities and/or water system personnel to establish a list of potential Team members. Alternatively, NDEP can help the community organize workshops to educate potential Team members on the importance of, and commitment to, the planning process. These workshops can also serve as a forum to exchange information between the local community and NDEP. For example, the communities may express their political, economical, and cultural goals and characteristics and in turn NDEP can solicit ideas, concerns and local insight that can be incorporated into the planning process. However, NDEP anticipates that the local planning Team that evolves from such workshops will assume a leadership role and sustain the momentum of the planning process.

3.1.2 Team Roles and Responsibilities

The activities and decisions of the Team will directly influence the local planning process. Team members will be responsible for implementing the five elements and completing the activities and deliverables associated with each. Part of this responsibility includes setting the schedules for conducting team meetings and completing each of the elements within the first or second organized meeting of the Team. In completing each element, it is the responsibility of the Team to create opportunities for the public to communicate and contribute to the planning process. This will retain the support of the community throughout the planning process and minimize barriers that could otherwise constrain development of the Plan. By having the local Team establish the Plan

development timeline and conduct the public outreach, the community assumes ownership of the process while allowing flexibility in the schedule to account for unforeseen challenges. Documenting Team member responsibilities and creating a formal schedule of milestones as part of the Plan development encourages timely completion of the Plan, delivery of the Plan to NDEP for review, and overall satisfaction of Team members throughout the planning process. Worksheets provided in Section 4 of this guidance document can facilitate the Team and Plan development processes. NDEP can also assist the Team in establishing their schedule for Plan development and implementation as well as conducting educational outreach on the Plan development process.

To maximize the efficiency of the Team, careful consideration needs to be given to its organization and structure. A community should designate specific members of the Team to fill some of these potential roles:

- ✓ Team Lead;
- ✓ Team Secretary;
- ✓ Public Information Specialist;
- ✓ Government Liaison;
- ✓ Document Drafter;
- ✓ Document Reviewer;
- ✓ Regulatory Compliance Specialist;
- ✓ Education and Outreach Coordinator;
- ✓ Historical Records Reviewer; and
- ✓ Technical Support Staff.

During the initial team meetings, the Team Lead is responsible for assigning specific roles and responsibilities to each member or agency represented on the Team. It is anticipated that each Team member will possess unique qualifications and experiences that he or she may contribute to the planning process. Some potential examples include teachers and local media representatives who may want to participate in public education and outreach efforts that are required throughout each of the elements; the public water supplier that may be responsible for the contingency planning and source development planning; a private organization or group of concerned citizens that may have responsibility for contaminant source inventories and public education; and the county and/or city planner who could be responsible for other aspects of Plan development like incorporating the SWPA maps into reviews of compatible land uses. Understanding the abilities and talents of individual Team members facilitates task assignments. However, it is important to understand that information collection, management, quality, and control are critical to the successful development and usability of the Plan.

Teams that generate a large membership may develop sub-groups to cover specific elements of the Plan. Individuals comfortable in dealing with people may want to form a public education and outreach sub-team that can focus on that component. Technical

issues can be discussed in more detail by people with an interest and understanding of ground water, hydrology, modeling or contaminants. The sub-groups may elect to meet more frequently than the overall group to discuss their specific topics.

Individual Team member responsibilities and/or sub-team responsibilities should be formally defined within the Plan. Upon request, NDEP can work with the Team Lead to identify the most appropriate Team member(s) to complete each element of the Plan development process. NDEP can also provide assistance, guidance, and support to Team members in executing their assigned tasks.

3.1.3 Team Meetings

During the Plan development process, it is important for the Team to meet on a regular basis. NDEP recommends monthly meetings be held to monitor progress. Meetings should include an agenda to discuss progress made, tasks accomplished, and meeting minutes to assist Team members in accomplishing specific tasks and for reporting progress.

Some communities may schedule regular Team meetings in conjunction with other local public or planning meetings. Multiple meetings that solicit continuous public involvement should be scheduled to present and discuss source water protection concerns; educate and familiarize community members in the reasons for planning; review needs and goals in ground water protection; and encourage continuous Team development. It is up to the community to determine the most appropriate timeframe and setting for the meeting; however, a definite meeting schedule for Plan development, implementation, and regular Program updates should be established so that the Plan goals may be accomplished.

3.1.4 Identification of Jurisdictional Authorities

Many source waters overlap federal, state, tribal, county, or city land, and in many cases Public Water Systems (PWSs) do not own the land where their wells or springs are located. Having multiple authorities that control land use within the same protection area may make it more difficult to implement certain management strategies. This is of particular concern in Nevada where approximately 85% of the land is federally managed. For Example there are some instances where SWPAs are located in or overlap land that is managed by the BLM.

Therefore, it may be necessary to involve a number of entities during the planning and implementation processes to secure the cooperation of the appropriate land managers. A successful Plan should identify the governmental agencies with jurisdictional authority over land use and development and determine whether protocols exist for generating consensus between each agency. For example, counties that have one or more incorporated municipalities may have established procedures for how these entities address shared issues, such as source water protection.

Since federal, state, and local source water protection methods and messages must complement one another and be clearly and easily understood by community members

during public outreach events, representatives from each pertinent agency should be invited to participate in the planning process and to become part of the Team. Working groups are another means of achieving multi-jurisdictional coordination, both within a county and among adjacent counties. NDEP may assist local communities in coordinating communications between agencies that have jurisdictional authority within the planning areas. NDEP may also be able to help in the review of existing planning documents to coordinate efforts that may be closely related.

3.1.5 Community Planning Goals

It is important to understand the difference between goals and objectives in guiding a community in the development of their Plan. Goals are broad and provide insight to the general intentions of the community. Objectives are focused and quantifiable, and provide a means of supporting goals. Examples of goals and their associated objectives relevant to the ISWPP are as follows:

Goal 1: To ensure the availability of clean drinking water supplies for future generations.

Objective: Prepare and submit a letter requesting technical assistance from NDEP to prepare a CWSP Plan.

Objective: Prepare a CWSP Plan.

Goal 2: To encourage water resource protection measures that will promote sustainable economic growth.

Objective: Send fact sheets on industry-specific best management practices to every commercial or industrial company that applies for a business license in the community.

Objective: Develop and implement an ordinance restricting industrial development around drinking water resources.

Goal 3: To increase community members' awareness of the source of their drinking water supply and how they can help protect that supply.

Objective: Develop and implement a Household Hazardous Waste Management Plan for the community.

Objective: Hold annual workshops in the community to provide an overview of the Plan and the status of updates or revisions to the Plan.

During the Plan development process, the Team will work closely with the county and/or specific communities and their respective team(s) to generate a set of drinking water protection goals. These goals will guide the development and implementation of an appropriate, community-specific Plan. The goals may be unique, based on the community's distinctive needs, available resources, and community inputs. However, some communities may wish to keep their goals consistent with those expressed by others within a political spectrum (i.e. communities within a county may choose to identify similar or identical goals to maintain a consistent approach to that county's Plan).

Interactive public participation can provide feedback that allows the Team to realign the Plan goals so they are consistent with the needs of the community.

Once the overall planning goals are understood, particularly as they relate to potential participation in the ISWPP, one or more key staff members for the municipality should be assigned to act as facilitators during board or council meetings. Educating local decision makers on what source water protection planning is and how their particular positions will be involved in or affected by the local planning effort will prepare them to support the local planning Team. These staff members should be willing to sponsor agenda items (including presentation and action items), be briefed so that they understand the essential elements of the ISWPP, and review proposed agenda items for community-specific considerations. One-on-one interactions between NDEP and key staff members can assist staff in recognizing the importance of the program to their community and in communicating this importance to their community leaders.

3.2 Element 2: Inventory and Delineation of Public Water Supply Sources

After the community has formed their local planning Team and established their source water protection goals, the next element in developing the Plan calls for conducting a source inventory and delineating SWPAs. The Plan must identify all existing and potential new water supply sources for each public water system that will be included in the Plan and then determine SWPAs to protect those sources from potential contamination that could compromise the quality of the community's water supply. The components that comprise Element 2 are summarized in Figure 3-4 and reviewed in the subsequent sections.

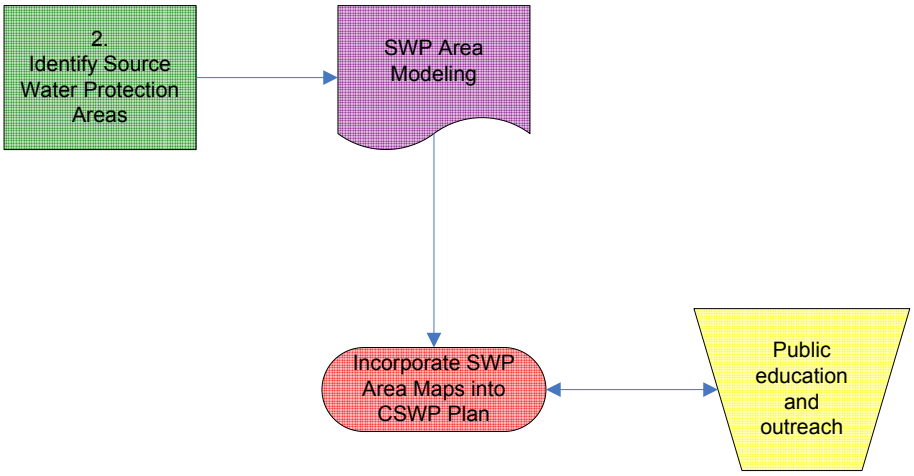


Figure 3-4 Element 2: Modeling and Mapping SWPAs

3.2.1 Source Inventory

Prior to delineating the SWPAs, the community's existing and potential water supply sources need to be inventoried. While conducting the inventory, technical data about each source should be gathered. Such data may include source location and historical

water quality information that can be used to establish a baseline or identify a pattern in the degradation or improvement of source water quality over time.

Local Team members may be helpful in coordinating the gathering of this data and other historical documentation pertaining to the development or construction of each source. For example, much of this information is readily available from the community PWS operator(s), who are required to maintain records that include ground water well locations, water quality information, and contingency plans. To the extent practicable, the technical data should be verified for quality control and mapping capabilities. NDEP can assist the Team in conducting the source water inventory, obtaining the technical data, and reviewing it for quality control (i.e., information that is missing, incomplete, or out-of-date).

3.2.2 Source Water Protection Area Delineations

This section provides a general overview of how SWPAs may be delineated. Technical details are provided in Section 5.0 of this guidance document. NDEP has also provided recommendations for delineating SWPAs in their 1995 guidance document that can be located on the NDEP Source Water Protection general information webpage (http://ndep.nv.gov/bwpc/Sourcewater.htm).

Once all the Plan sources (wells, springs, etc.) have been located and all pertinent technical data has been gathered the data can be used to delineate SWPAs for each water supply source. SWPAs are defined as areas on the ground surface which must be managed in order to protect a public drinking water supply from becoming polluted or contaminated. SWPAs include WHPAs, DWPAs, and Source Water Assessment Capture Zones which have been established through NDEP programs for local communities. If the community has not already established SWPAs through these other programs, then those areas will need to delineated.

SWPAs may be delineated using an EPA-approved scientific model that incorporates local geologic, hydrogeologic, and watershed information to produce areas which contribute water to a given source. The horizontal extents of these areas will be dependant on the selected time frame for water to reach the source. This concept, called time of travel (TOT), is defined as the time required to transport water from a given location to the source location. Typically, SWPAs are delineated using TOTs of two (2), five (5), and ten (10) years or communities can go out as far as they want depending upon their planning goals. The TOT(s) selected to delineate the SWPAs should correspond with the goals established during Element 1.

By evaluating multiple TOTs, corresponding SWPAs may be defined. For example, a community may choose to delineate three areas around a well as shown in Figure 3-5 on the following page, where the boundaries of Area 1 are based upon a TOT of two years, Area 2 is based on a TOT of five years, and Area 3 is based upon a TOT of ten years. Once the SWPAs have been delineated, they should be located on a community planning map or base map, so that the planning Team and the community clearly see the areas.

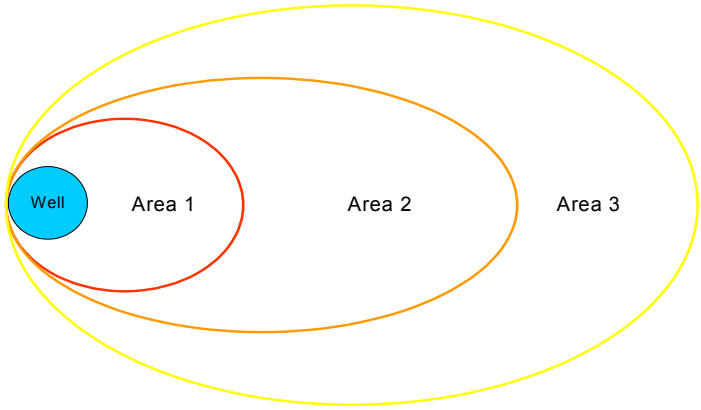


Figure 3-5 Example SWPA Based on Times of Travel

Boundaries for the SWPAs may also be refined using boundary features such as roads, rivers, or property lines. However, to be conservative, the refined boundaries should encompass all of the model-delineated capture zones. Figure 3-6 demonstrates how boundaries of a SWPA delineated by WhAEM 2000 can be modified to correspond with physical characteristics and boundaries within a community.

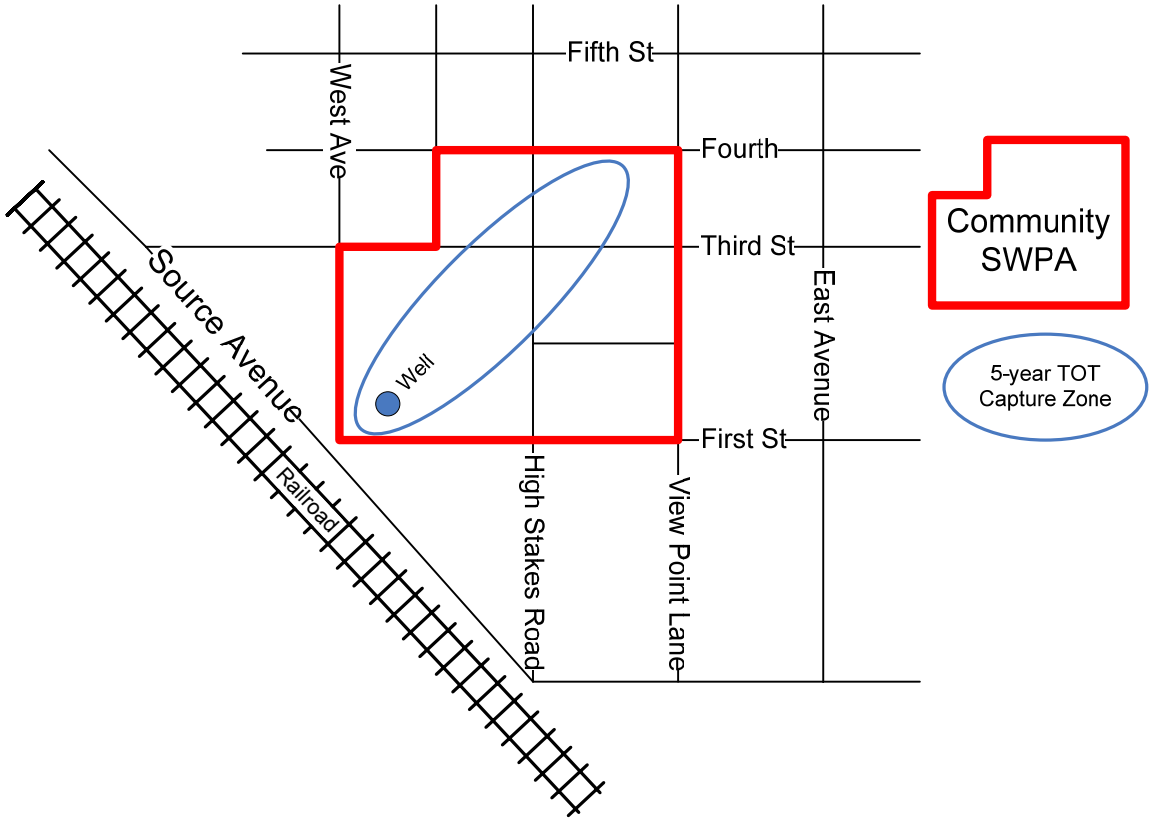


Figure 3-6 Refined SWPA Boundaries Using Physical Features

Work to delineate SWPAs should be conducted by individuals with a technical background who are proficient in scientific modeling. If the local Team requires technical assistance, NDEP can work closely with the Team and its community to help delineate SWPAs. This support may include a review of the availability and quality of existing information to determine if field evaluations are necessary, e.g. pump tests or related activities to quantify aquifer characteristics. It can also include help selecting a TOT to be evaluated, selecting the appropriate scientific model, and interpreting the results from the model.

3.3 Element 3: Contaminant Source Inventory

Once the SWPAs have been delineated, the existing and potential sources of water contamination within those areas must be identified to provide the Team with an understanding of the potential threats to the community's water supply. A variety of industries, businesses, and land uses can introduce pollutants into the source water and degrade its quality. For example, septic systems, underground and above ground storage tanks, leaking drums, cemeteries, or road salting may contribute pollution to a community's water supply. Knowing these potential contamination sources is required in order for the Team to evaluate the risks associated with each and develop appropriate management strategies during Element 4.

The components required to complete the contaminant source inventory are shown in Figure 3-7 (next page), and start with the formation of a Team dedicated to overseeing the inventory. This provides another opportunity to encourage public participation in the planning process. For example, the community may decide to recruit volunteer groups to complete the inventory of actual and potential contaminant sources.

A contaminant source inventory consists of both an administrative and field investigation within a given SWPA to identify existing soil and ground water contamination as well as potential contamination sources. Existing sources include those that either have already been identified and are currently managed under an existing NDEP program or that have become apparent during the planning process and should be dealt with immediately under an existing program. Alternatively, potential sources are those that currently do not impact the water supply, but that may pose a threat if not managed appropriately into the future.

Both types of contamination sources may be identified during an administrative investigation, which includes a review of state and local documents which could indicate the location of current, historical and/or proposed potential sources of contamination. For example, potential contaminant sources are often identified near PWS wells as part of the Source Water Assessment Program/Vulnerability Assessment Program (SWAP/VAP) conducted by the Bureau of Safe Drinking Water (BSDW) and local PWSs. If available, communities may use information from the SWAP/VAP as a starting point for their own inventory. Additional information may be obtained from telephone directories, business records (e.g. fuel oil deliveries), government records (including NDEP BCA case file records); historic records (such as defunct business activities and mine sites), and news articles. Land use data, assessor's parcel maps and records, master plans, zoning maps, engineering studies, and aerial photographs may be useful.

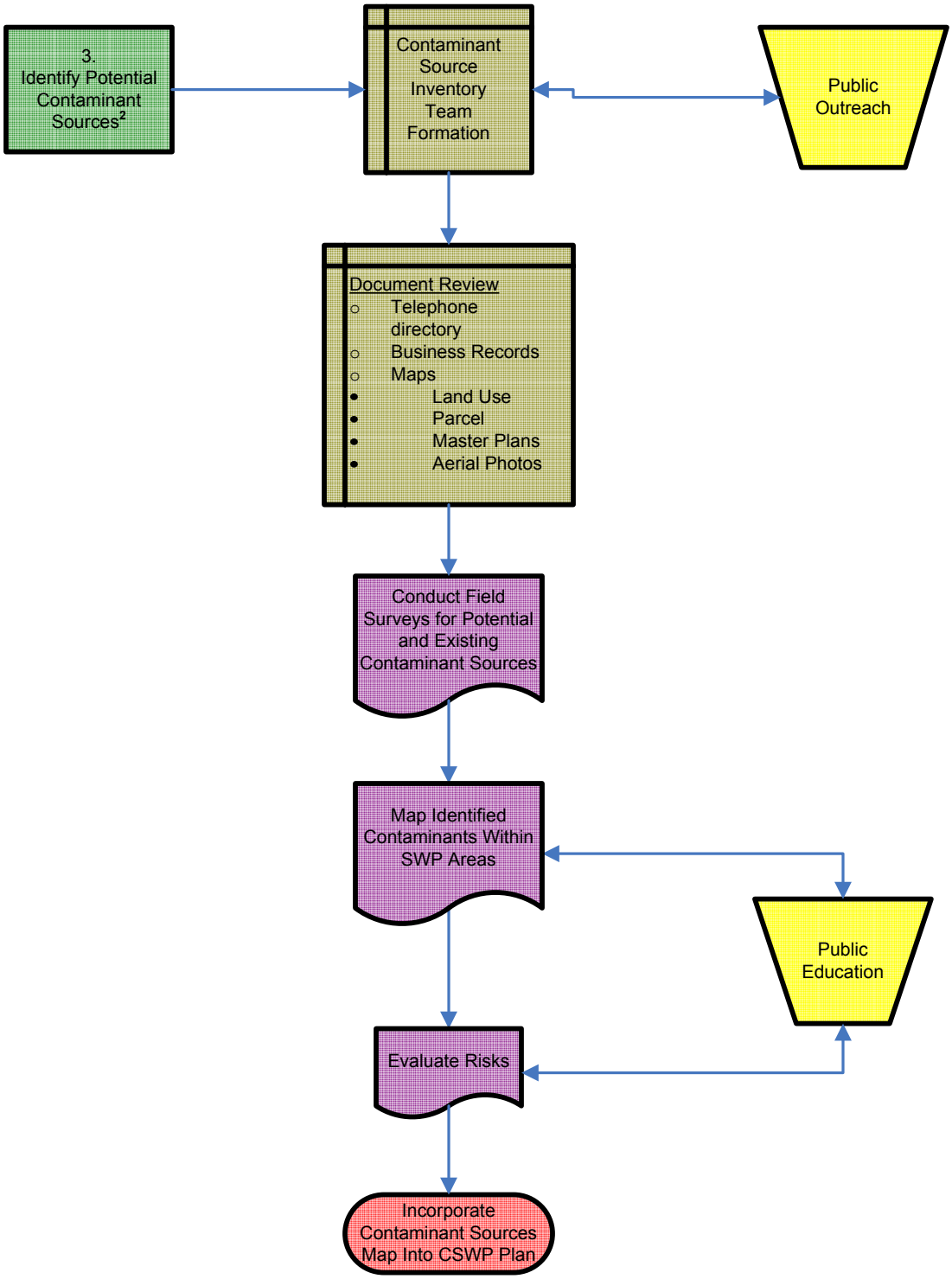


Figure 3-7 Element 3: Contaminant Source Inventory and Risk Evaluations

Field investigations include an actual on-site survey of the area to visually identify what is happening within the SWPAs. Interested community members, equipped with clipboards and lists of activities to look for, can comb the SWPA in teams collecting GPS locations for potential contaminant sources. Information may also be obtained through door-to-door, mail, or "windshield" surveys. During field investigations, improperly abandoned wells, or orphaned (unplugged when abandoned) wells, should also be identified, as they may provide another route for contamination of the aquifer. If the wells are not in use and are unlikely to be used, they should be considered for plugging and abandonment in accordance with Nevada Division of Water Resource (NDWR) requirements per Nevada Administrative Code (NAC) 534.420 -534.427.

In reviewing the potential contamination sources, the goal is to develop an inventory based on the most complete and best possible information available to the community. While some communities may have more resources or documentation than the examples listed above, others may have less. However, NDEP may be able to assist the Team in locating the desired background or historical data. The Bureau of Water Pollution Control (BWPC) has example checklists and associated survey forms that are available for use in conducting the contaminant source inventories. The BWPC can also help a Team develop checklist and survey forms which may be more appropriate to a specific community. NDEP can also assist Team members by training them in the types of facilities and activities to consider and may perform initial field surveys in conjunction with individuals until they feel comfortable with continuing the surveys independently. In training team and community members to recognize potential contaminant sources, NDEP empowers these individuals to conduct future surveys on an independent basis. Additionally, these individuals have an increased awareness of activities within their community that may trigger the need for a Plan update or revision, which is conducted during Element 5.

Any approach or combination of approaches chosen should ensure that the inventories are complete and accurate, and that the information collected is properly located on a map. The map of the inventoried data should be at the same scale as the other maps developed. Maps should be appropriate to the community size and complexity of data, and should be easily overlain with maps of current and historical land use, existing and proposed zoning designations, other related master planning data, and the SWPAs delineated during Element 2. At a minimum, the Team should identify, locate, and map the past, present, and proposed operations that may represent sources of ground water contamination.

The final component in Element 3 is to evaluate the risk, or vulnerability, for each source. Vulnerability is a description of the likelihood that a contaminant from a particular source or activity identified in a SWPA will reach a drinking water supply. Vulnerability is composed of two factors: 1) physical susceptibility to the infiltration of contaminants, and 2) the source's risk of exposure to contaminants. Susceptibility is determined by conditions that affect the movement of contaminants from the land surface into a water supply. This would include the depth of the well, its construction, the geology of the area, the pumping rate, the source(s) of ground water recharge, and the nature of the aquifer. The risk of exposure to contaminants is determined by whether or not contaminants were used in the area near or upstream of a water supply.

A sometimes overlooked vulnerability can be found in the presence of a well within a flood zone. For example, is the wellhead within a 100 year flood zone? If so, is there a protective berm or structure around the wellhead to protect it in the event of a flood? Is the wellhead located above the expected flood level? Flood zone maps may be available from the county planning department, or information on past flood levels may be available within the community.

It is the responsibility of the Team and the implementing agencies to evaluate the risks to the water supply sources, assess the threats posed by various contaminant sources, and prioritize how each supply source will be managed and protected based on the degree of management the community is willing to support. The Team is encouraged to evaluate the risks publicly since community members may provide new information that is not available within the Team's knowledge pool. NDEP can help communities in evaluating the risk to their source water supplies by providing mapping assistance or examples of specific incidents that affected ground water quality. These resources may prove useful to the community during Element 4 when the Team will define the protection strategies that are most appropriate for the community.

3.4 Element 4: Development of Contaminant Source Management Strategies

Following the delineation of SWPAs and the identification of actual and potential sources of contamination within them, an approach to managing those sources must be carefully developed and implemented at the local level. The intent is to provide local communities a clear outline for how they are managing potential risks to their public drinking water supplies. The process for developing the contaminant source management strategies is shown in Figure 3-8 on the following page. Additional considerations for risk factors relevant to subsurface conditions, such as depth to water table, aquifer type (level of confinement), and soil media are discussed in greater detail in Section 5.4.

Since each community must balance the issues of potential threats, acceptable risk, and degree of management the community is willing to support, the local Team should determine which management strategies are appropriate for the community. Management strategies may be regulatory in nature (e.g., adoption of ordinances, land use restrictions or overlay zones) or may be non-regulatory (e.g., promote the use of best management practices, public education, etc.) or could include both regulatory and non-regulatory measures. A list of example management strategies extracted from "Wellhead Protection Plans: Tools for Local Governments" (Office of Groundwater Protection, U.S. EPA, April 1989, EPA 440/6-89002) is provided in Table 3-2 on page 3-18. Additional details and guidance on management strategies that may be considered for a local Plan have been provided in Section 4.

Management strategies that are selected should support the goals and objectives developed during Element 1 of the planning process. However, in selecting the appropriate management strategies, the Team should also evaluate resources such as personnel, equipment, and supplies that will be required for implementing each potential strategy. Without sufficient resources to carry out the management strategies, the strategies become unrealistic and cannot be implemented. Developing management

strategies also needs to be forward looking and involve an action plan for future review and updates as communities change or grow.

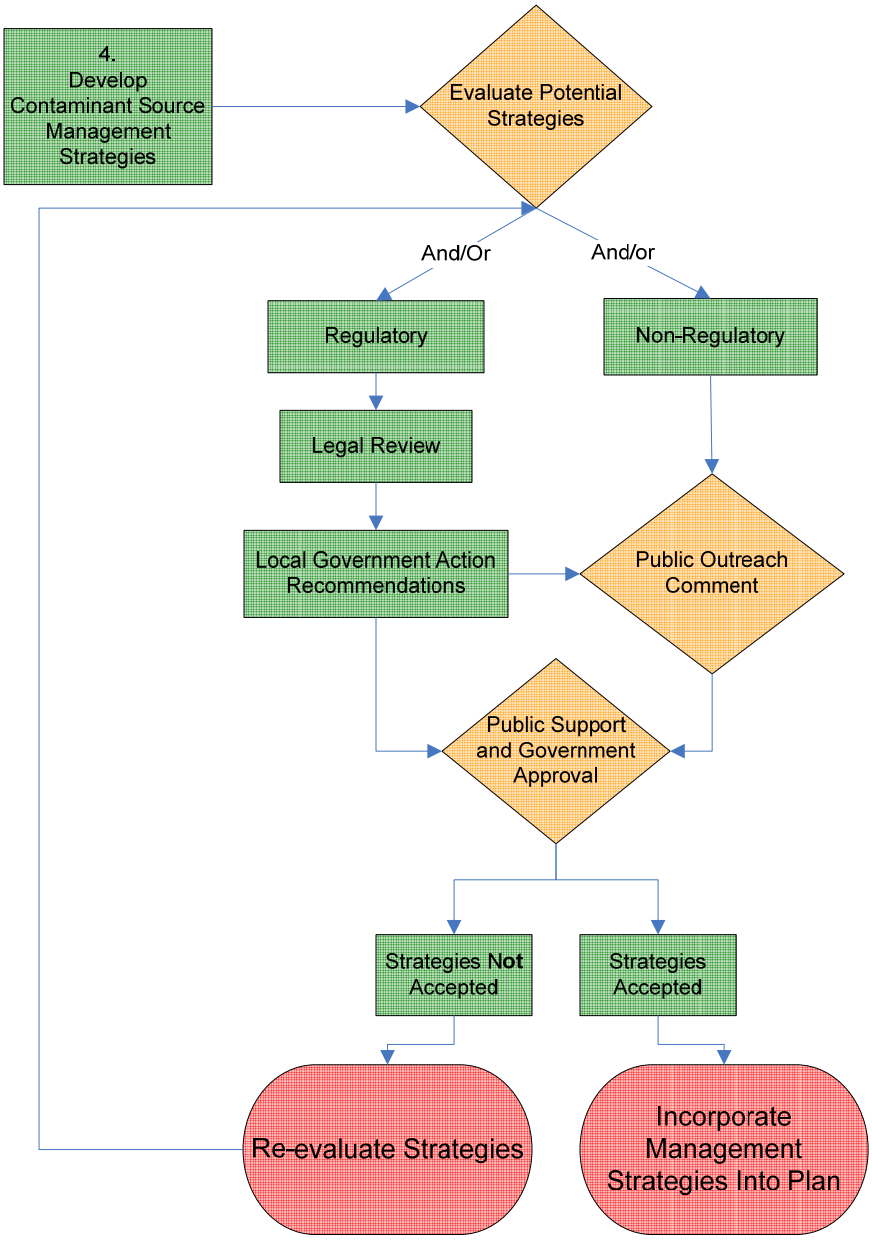


Figure 3-8 Element 4: Develop Contaminant Source Management Strategies

Table 3-2 Example Contaminant Source Management Strategies (U.S. EPA)

Management	Action
Zoning Ordinances	Comprehensive land use requirements designed to direct the development of an area where certain land uses may be restricted or regulated in SWPAs. One of the most powerful tools for managing future contamination events that could impact underground sources of drinking water.
Subdivision Ordinances	Community adopted subdivision rules and regulations to regulate road drainage/runoff in subdivisions within SWPAs. Used to ensure that subdivision road drainage is directed outside of SWPAs.
Site Plan Review	Regulations requiring developers to submit, for approval, plans for development occurring within a given area. This tool ensures compliance with regulations or other requirements applied to a SWPA.
Design Standards	Typically regulations that apply to the design and construction of buildings or structures, used to ensure that new buildings or structures placed within a SWPA are designed to minimize the potential for contaminant releases.
Operating Standards	Regulations that apply to ongoing land use activities to promote safety or environmental protection. Such standards can minimize the threat to the SWPA from ongoing activities such as the application of agricultural pesticides or the storage and use of hazardous substances.
Source Prohibitions	Regulations that prohibit the presence or use of chemicals or hazardous activities within a given area. Local governments have used restrictions on the storage or handling of large quantities of hazardous materials within a SWPA to reduce the threat of contamination.
Purchase/Donation of Property or Development Rights	Land is acquired by a community either by purchase or by donation. This provides a broad protection to the ground water supply and may be used to ensure complete control of land uses in or surrounding a SWPA. *It may be preferred if regulatory restrictions on land use are not politically feasible and the land purchase is affordable.*
Public Education	According to EPA (1990), the public typically is unaware of basic ground water concepts, and this lack of knowledge often frustrates communication efforts. The public should be educated about the drinking water supply system so that they can become familiar with the basic concepts and terminology relating to source water protection.

Table 3 2 Regulatory and Non-Regulatory Contaminant Source Management Strategies (Cont.)

Ground Water Monitoring	Generally consists of drilling a series of monitoring wells and developing an ongoing water quality testing program. This tool allows the Team to monitor the movement of contaminants.
Household Hazardous Waste Collection	Residential hazardous waste management programs can reduce the quantity of household hazardous waste being disposed of improperly. These programs have been used in localities where disposal of household wastes in municipal landfills potentially threaten ground water.

One tool to help achieve balance between a community's source water protection goals and its resources is to adopt a differential management, or phased management, approach by using corresponding SWPAs that are associated with a unique management strategy. For example, the management strategy for the smallest SWPA (Area 1 shown in Figure 3-5) could be to prevent accidents and direct contamination of the spring collection area or the well. Management options used within this area might include Source Prohibitions, or the PWS may decide to purchase the land in Area 1 to control land use activities. The management strategy in Area 2, the next larger SWPA, might be to allow sufficient time or distance from the wellhead for the reduction in concentration of most contaminants to levels safe for drinking. Management options may require that all sources of pathogenic microorganisms, such as septic tanks and drain-fields, be excluded from this area. Area 3 would be the largest protection area delineated around a well or spring. The management strategy for this area is to provide sufficient time for remediation or development of a new source of water if the drinking water aquifer becomes irreparably contaminated. Management options implemented in Area 3 might include design standards, operating standards or ground water monitoring.

Once SWPAs are defined, NDEP can work with the Team to develop a management strategy for those areas. NDEP recommends that a management plan be developed regionally to include all PWSs. The effectiveness of the management strategies to protect the drinking water supply from potential contamination depends upon obtaining support and participation from members of the local community. Restrictive or prohibitive strategies are often difficult for the public to accept. Therefore, the more stakeholders that participate in the public outreach efforts to evaluate the potential contaminant source management strategies, the more likely the local community is to accept the selected strategies or propose effective alternatives.

Because the degrees of need, financial resources, and control over land use activities vary by community, there is no model plan that can be followed uniformly. Therefore, NDEP encourages creativity and flexibility in selecting contaminant source management strategies and can assist the local Team in evaluating potential opportunities to leverage existing resources to implement the selected strategies. For example, if the contaminant source(s) exists on public land, BLM may provide assistance with enforcement of best

management practices, and/or contaminant mitigation. Contaminant sources that constitute a public nuisance or health hazard may be addressed by local law enforcement, emergency management services, or both organizations. Additionally, the Team may contact the NDEP to report non-compliance with regulatory requirements.

3.5 Element 5: Management and Sharing of Information

The final element to the Plan development process combines or integrates information gathered during the previous elements with that of other community planning documents such as pubic water system emergency response plans/contingency plans, new well siting plans, and where feasible other local master planning documents. Integrating complimentary documents and programs related to protecting the communities drinking water supply empowers the local community to actively manage and ensure the long-term sustainability of their water resources. The components that comprise Element 5 are presented in Figure 3-9 and are explained in more detail in subsequent sections.

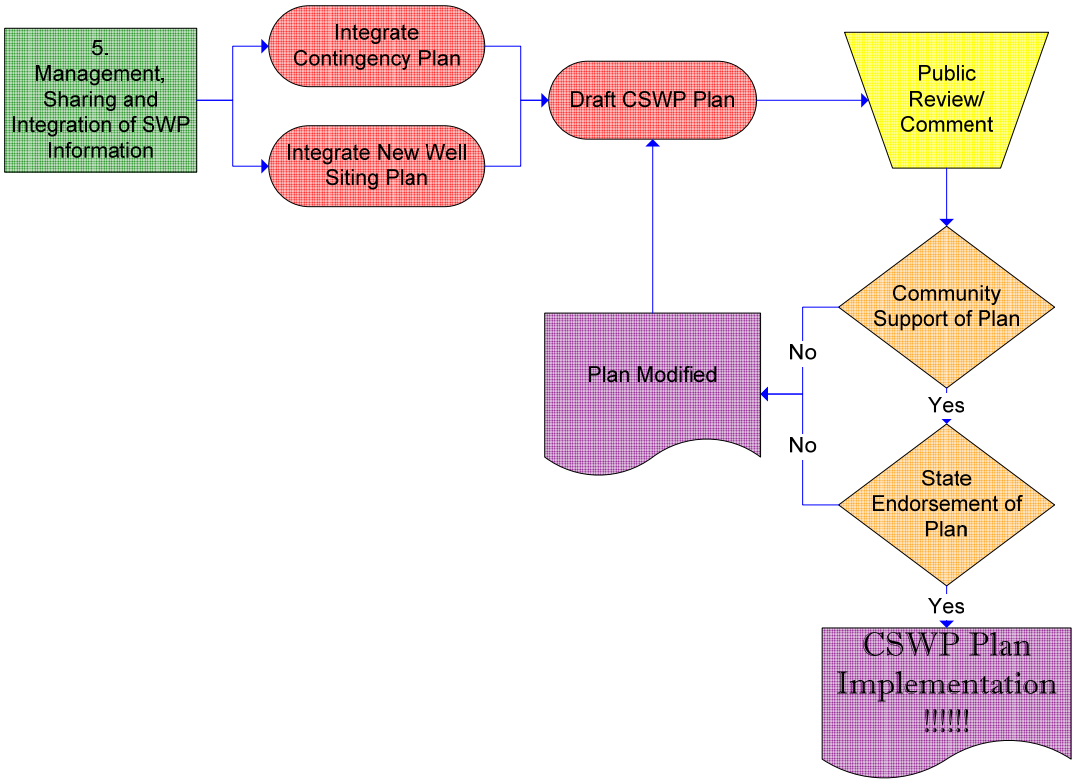


Figure 3-9 Element 5: Management, Sharing and Integration of SWP Information

Due to current constraints and security risks, the processes and procedures for the management and sharing of CSWP Plan data and information are still under development. Additional information will be provided either on the NDEP website or in separate documents when completed for the following subjects:

- Data Housing, Security and Quality Control;
- Data Integration and Coordination; and
- GIS Mapping and production for federal, state and local agencies.

3.5.1 Contingency Planning

The State of Nevada Administrative Code NAC 445A.66665 requires all water suppliers to develop emergency response plans that detail the procedures to be followed in the event of water quality or quantity problems. The NAC requires this Plan be submitted to the BSDW or the county health district office in which the public water system is located. It is expected the emergency response plans developed for the various communities will differ depending on the size of the public water system and the population served, actual and perceived threats to the water supply, financial resources, and other local concerns.

Emergency Response Plans are typically short term solutions in response to an immediate shut-down of a water supply, either related to mechanical issues, water quantity problems, or in response to a contamination threat or natural disaster. Public water suppliers in Nevada work with the Nevada Division of Emergency Management (DEM) through county emergency management representatives if an emergency response is required. The DEM assists with short term problems, such as spill response and coordinating the trucking of water to the afflicted community. However, emergency response plans do not address the longer term problems presented by contaminated aquifers.

Contingency Plans within the context of the ISWPP should build upon the Emergency Response Plan to provide guidance and direction to the local community and public water systems in the event the aquifer or main source of drinking water becomes contaminated. The Contingency Plan should demonstrate the community's planning capacity in an emergency situation. Some considerations include assessing the time frame needed for the community to switch to an alternate source, the capacity and quality of water alternate sources may provide, and what local resources are currently available to implement the use of an alternate source.

All communities and public water suppliers should develop contingency plans that address topics such as:

- The purpose for and relationship of Contingency Plans versus Emergency Response Plans within the context of the local Plan;
- Who is responsible for developing the Contingency Plan and what considerations should be included in the process;
- How the Contingency Plan may satisfy the requirements of or be used in conjunction with other state and local plans;
- Outline who the Plan's responsible parties are, their duties, the chain of command for local authorities, water system personnel, and emergency management teams, and what coordination steps will be required;
- Identify the process for procuring where and how temporary (short and long term) alternate water supplies will be made available and the associated costs or financial commitment;
- Outline the water supply disruption response procedures in the event of aquifer contamination and/or disruption of service (a local contingency plan may include the initiation of specific actions to decrease contaminant concentrations after they have

risen to a specific level but before they exceed Maximum Contaminant Levels for drinking water);
- Identify state, local and PWS responsibilities for the evaluation of monitoring, testing, and inspection results;
- Identify state, local and PWS responsibilities during various types and phases of contamination events such as health threat assessment, short and long term containment and clean up, and public notification;
- Contacts and telephone numbers for notifications;
- Include background and/or historical context for the water system development, specific operating characteristics, and the potential of contamination or disruption based upon the Plan analysis; and
- Include a process and schedule for reviewing and updating the Plan.

Each PWS and Team should decide what they will consider a threat or contingency that needs to be addressed in the Contingency Plan. The Team may utilize a tiered screening process where they first identify a variety of contingencies and then assess the relative importance of each. Screening the large set of potential contingencies should yield a smaller set of "primary" contingencies. These threats can then receive the most urgent attention in the planning process. Once the Team has identified the "primary" set of supply disruption contingencies, these threats should be summarized in a way that is useful in designing appropriate response actions.

The potential resource dedication associated with addressing each contingency and remediation effort should be evaluated. These considerations should be compared with actual resources available within the community. A cost benefit analysis may assist the Team in determining the community's financial ability to respond to a given contingency or potential emergency. For example, should a contaminant release threaten a community's primary water source, the cost benefit analysis can be used to determine if the community should continue providing service by treating the current water source or by developing a new source.

One component of the Contingency Plan is a Water Supply Decontamination Plan, which reviews the technologies currently available to remediate potential contamination within the SWPAs and can be used to significantly expedite remedial actions should a contaminant release occur. Under this scenario, water system managers that have a general understanding of various remediation options and expenses can develop funding in advance of an event.

Another component of the Contingency Plan should be a long term Rationing Plan. These are developed to ensure an adequate water supply is available to the community in the event of water shortages resulting from drought, overuse, or contamination. A public water supplier or community may wish to define an "action level" in terms of water supply that would activate the Rationing Plan. The Plan should identify all resources available to the water supplier, and may evaluate the following: alternate water supplies; emergency water supply equipment; communications systems; and technical and financial assistance. Conservation measures, public education initiatives and compliance

actions should be developed and implemented in response to action levels identified in the Plan.

3.5.2 Plans for New Well Siting

In addition to the Contingency Plan, PWSs may already have a Source Development Plan, which evaluates whether existing water supplies will sustain the community's future growth and development as well as potential water shortages and the economic impacts associated with each scenario. The following information will likely be considered and included in a common Source Development Plan:

- Estimate projected supply needs to determine when a new source will be needed;
- Identify undeveloped water sources that have potential for production and long-term water supply;
- Examine steps required to obtain water rights, permitting for use, and land acquisition to develop the source;
- Define protection areas and management levels around the proposed new well sites;
- Identify actual and potential sources of contamination in each proposed protection area;
- Consider existing or proposed management options and degree of protection afforded for each new well site;
- Perform water quality studies to ensure that the source water meets federal and state drinking water standards; and
- Evaluate financial needs and procure funding for water development projects.

PWS operators often work with planning officials to project water supply needs that, in turn, may be used to evaluate the need for a new water source. Even if a PWS has not anticipated the need for a new water source prior to Plan development, the Team may work proactively with the PWS operator to quantify future demands. If the community anticipates the need for new resources in the future, hydrogeologic, topographic, planning, and related data assembled during Element 2 may be used to locate future sources in suitable areas.

The suitability of potential sources for development by the community may be evaluated by examining the water quality and quantity of the source. Water quality can be assessed by conducting water quality sampling and testing. Evaluating the available quantity of water is accomplished by reviewing flow rate or reservoir storage information for surface water sources and by drilling a test well and conducting pump tests for underground sources. Results from these tests can be used to identify potential sources that are qualified to supply the community. It should be noted that new water wells and related drilling are regulated by both NDEP's BSDW and the NDWR as specified in NAC 445A.66855 t- NAC 445A.6693 and NAC 534.010 - 534.450, inclusive. Before drilling a potable drinking water well commences, BSDW must review and approve, at a minimum, the following items: flood zone information per NAC 445A.66865(1)(a), potential contaminant sources per NAC 445A.66865, casing thickness per NAC 445A.6689 and depth of the sanitary seal per NAC 445A.66905. The NDWR requirements also include constructing a seal around the well from the ground surface to

a depth of 50 feet (NAC 534.380). An "Intent to Drill" must be registered with NDWR prior to drilling and a permit must be obtained to drill or replace a water well within a water basin designated by the State Engineer.

The identified sources should then be protected in the same manner as existing sources, i.e., they should be incorporated into the local Plan by delineating SWPAs that are protective of the source. For example, if a local government or PWS owns and/or controls land where future wells might be located to develop an underground source, then SWPA delineations and potential contaminant source inventories should be completed prior to construction of the wells to ensure the long-term protection the ground water. Management practices already being implemented at existing wells may be utilized for the potentially new wells and/or modified where appropriate. One potential strategy is to avoid using a single well to draw water from more than one aquifer. Since a well may serve as a conduit for contamination to reach an aquifer, using a well to access multiple aquifers increases the vulnerability of cross-contamination. If it is absolutely necessary to draw water from multiple aquifers, it is recommended that the unconfined, or water table, aquifers not be utilized. This will take advantage of the natural protection provided by a confined system. The community should also incorporate provisions for protecting the new source in the local Contingency Plan.

NDEP can assist with the Team to evaluate and incorporate new source water information into the Plan. Additionally, NDEP may provide guidance to Team members on advanced planning measures (i.e. zoning overlays highlighting the location of future sources, drafting local ordinances, or similar measures) that can be used preemptively to protect and preserve the quality of the new source.

3.5.3 Implementation at the Local Level

After incorporating the information produced during each element of the planning process, the Plan should be formally endorsed by the local community. This may involve conducting a public outreach meeting to providing a brief, concise overview of the Plan to the community and discuss how the Plan is coordinated with that of other Plans in surrounding communities. Understanding this coordination may help communities realize their role in the larger effort to preserve and protect Nevada's drinking water supply. Alternatively, presentations to county boards, city councils, and other municipal governing bodies during open, public meetings, are a formal mechanism for obtaining endorsement by the local community. NDEP can participate in the public outreach or government meetings to help the Team obtain formal endorsement of the Plan from the local government. After receiving support from the local community, the Plan should be submitted for State endorsement. The requirements to achieve State endorsement are summarized at the end of this Section and a checklist has been provided in Section 4.0.

Once a Plan has been endorsed by the local community and the State, the provisions of the Plan should be implemented according to the schedule established during Element 1. Because this schedule is based on community goals and resources, immediate and obvious implementation measures are most conducive to receiving broad-based community support. A community can measure success in accomplishing its goals and

objectives based on improvements to water quality or by comparing when measures were actually implemented relative to when they were scheduled to be implemented.

Conditions in the SWPAs can change over time as new wells may be added to meet projected demand, replace dried up wells, old businesses close and are replaced by new businesses, and existing businesses change their operations, etc. Since these changes may result in the elimination of some potential contaminant sources or introduce new ones, the contaminant source management strategies for a given SWPA will also need to be updated. Timeframes for completing updates to the Plan may be established in terms of months or years or may be triggered by local community characteristics and events (local population and development rates, new well development, well abandonment, consolidation of public water systems, changes in community goals, modifications to management strategies, etc.) or other measures identified by the Team in the local Plan. Updates may apply to the entire Plan document or certain sections, such as the contaminant source inventory. NDEP recommends no more than five years between Plan updates and the responsibility to conduct the updates be delegated to specific member(s) of the Team (e.g. planning department staff, city or county engineering staff, PWS staff, fire department, etc.).

The local Team should continue to meet at least annually in order to review the Plan for necessary updates. Regularly scheduled meetings will provide a venue to review the institutional knowledge of the local Plan amongst Team members. Since Team members lost through attrition will need to be replaced with new members, the regularly scheduled Plan review meetings will provide an opportunity to concisely reiterate prior discussions pertaining to the development of the Plan. This will serve to refresh the memories of Team members who previously participated in the planning process while simultaneously transferring the institutional knowledge to the new Team members. By continuing to provide opportunities for public outreach during updates to the Plan, the local Team may solicit interest from new stakeholders and can also recruit new members to the local planning Team.

3.5.4 Public Education and Outreach

Public education and outreach activities are an important part of a community's source water protection program. There are numerous formats and educational tools that can be customized to inform a variety of audiences about water supply and water protection issues. These venues may be used year after year to help raise community awareness about their water supply, promote voluntary protection efforts, or build public support for the local protection program.

Public education often consists of brochures, pamphlets, or seminars designed to present issues of concern and potential solutions in an understandable fashion. Potential audiences may include community groups, youth groups (Boy Scouts, Girl Scouts, etc.), professional organizations, individuals interested in the development of the Plan, a citizen advisory committee, agencies with jurisdictional authority in the local community, or representatives of the local government (planning departments, etc.). Public outreach activities targeted to these stakeholders may consist of presentations and workshops that

help community members understand the local source water protection issues. During these venues, the public should also be encouraged to provide local and historical insights that are pertinent to development of the Plan.

The educational materials and forums that best promote personal ownership of local source water protection will be those that are tailored to the specific issues within a community. NDEP has significant information relevant to State-endorsed public outreach and education programs that is available at NDEP's education website (http://ndep.nv.gov/edu/). NDEP can help with modifying these materials so they address the individual needs of each community or a target audience.

Table 3-3 summarizes some of the methods that can potentially be used in the Team's public outreach efforts. Since some are more costly than others, the method(s) chosen by the community may depend upon community's available resources.

Table 3-3 Possible Public Education and Outreach Strategies

Education Venue	Description
Ground Water model demonstrations	One of the most effective educational approaches toward understanding ground water movement and contaminant migration is through the use of physical ground water models. These provide a visual representation of ground water flow and avenues of contamination to the audience.
Informational brochures to customers	This could be a separate mailing to water customers, or could be included with their monthly billing statement. Particularly useful is summarizing the Plan including: what is Source Water Protection and why is it necessary; areas comprising the SWPAs; objectives of the plan; what is being done to protect local drinking water supplies from contamination; what citizens can do to help.
Newspaper articles	Newspaper articles and editorials are an inexpensive and efficient way to communicate the basic elements of the water supply system and threats to water quality. In larger communities, system staff should approach the science editors, if they have one, of local and regional papers. The contact may be less formal in smaller communities, where local and regional papers may rely upon general reporters and donated features.
Television and radio media	Television and radio can also be used to educate the public in an inexpensive and efficient way. Contacts made with television and radio personnel may also be useful during a contamination incident. If funding permits, Public Service Announcements (PSA) could be prepared. NDEP can reference a variety of scripts that may be used for these Public Service Announcements (PSAs).

Table 3-4 Possible Public Education and Outreach Strategies (cont.)

Education Venue	Description
Movie theatre slides/ads	Pictures are worth a thousand words. Movie going is a popular leisure activity in the U.S., providing a distraction-free environment for getting the word out.
Grade school plays	Schools provide a venue for water education as well as public service announcement.
Airplane banners	More popular in urban areas, these can be expensive but they are eye-catching.
Vehicle wraps	Turning a Team member's vehicle into a public service announcement is an effective way to target the local audience.

3.6 Requirements of State Endorsed/State Funded Plan

In order to be eligible for endorsement by the State, a local Plan must contain the following information, which is a summary of the elements presented in this section. These requirements have also been summarized on a checklist presented in Section 4 that may be used by local communities in developing their Plan to ensure it is suitable for State endorsement.

Element 1: Formation of the Planning Team

1. Form the CSWPP Team. Every effort should be made to include representatives of the public water system, city, county, state, and federal land managers, and a representative from the Nevada Division of Environmental Protection (NDEP). Representation from the local governing body with land use zoning and planning authority (city and/or county) is strongly recommended.
2. Conduct meetings to outline the community's source water protection goals, establish how those goals are to be accomplished and the responsibilities and/or involvement of individual Team members.
3. Prepare a Team member list with contact information.
4. Present the planning process and community source water protection goals to the Board of County Commissioners and/or other appropriate jurisdictional authority.

Element 2: Develop Source Water Protection Areas (SWPAs) and Recharge Areas

1. A review and assessment of the Source Water Assessment Program (SWAP) report for each public water system (if available) must be conducted as part of this task. The SWAP report may be obtained from NDEP Bureau of Safe Drinking Water.
2. Review of references, well logs, pump test data, and available files (City, State, U.S.G.S.) and compilation of pertinent information and data for the wells, aquifers and springs.
3. A conceptual hydrologic model must be submitted to NDEP for approval prior to

ground water modeling and delineation of source water protection areas.

4. The modular semi-analytical model (WhAEM 2000), or other equivalent NDEP approved model must be used to delineate the source water capture zones and protection area(s).
5. The community may consider performing an aquifer pumping test to derive parameters to be used as model inputs, or an equivalent approved by NDEP. A pump test is required for each general type of subsurface material screened by the water system wells (i.e., basin-fill aquifer, carbonate rock aquifer, volcanic rock aquifer).
6. Outline the method, criteria, and threshold selected for the SWPAs and presents the rationale for the selection. In the appendix of the Plan, include raw pump test data and field data sheets, and model assumptions and input data.
7. In the text of the CSWPP, identify the ground water recharge area(s) for the aquifer(s). The final CSWPP must include maps delineating the SWPAs. Maps must clearly and accurately depict these features at a scale that is consistent with the community's base maps.
8. Discuss geologic and hydrogeologic susceptibility to contaminant infiltration in the SWPAs and the recharge areas
9. Prepare poster-sized print(s) of SWPA maps. Display the poster in water system and community planning and development offices. Distribute posters to community planning agencies for display and education.

Element 3: Identify Potential Sources of Contamination

1. Perform an inventory of existing and potential contaminant sources within the SWPAs using available databases, such as records at the City, County, and State, and those observed during field activities. Listed sources should be ranked by estimated risk to ground water. Begin by reviewing results from the SWAP report.
2. Perform an on-site "windshield" survey to visually determine the locations of all potential contaminant sources and gather location data where needed.
3. Prepare a summary of data sources used to conduct contaminant source inventory.
4. Prepare a map or maps that depict existing or potential contaminant sources as well as land uses that may pose a potential threat. The scale of this map should be consistent with existing base maps and other maps being developed.
5. Prepare a map of current and proposed master plan and land use zoning designations.
6. Develop a schedule for updating contaminant source inventories, with the name, address and telephone number of the responsible Team member.

Element 4: Develop Contaminant Source Management Strategies

1. Conduct a Team meeting(s) to discuss and evaluate appropriate management strategies (both regulatory and non-regulatory). Develop and document selected management strategies that are to be implemented for protecting SWPAs from potential contaminant sources including implementation schedule/Action Plan and

rationale for the selection. Non-industrial zoning for SWPAs is strongly encouraged.

2. Compile documentation related to the management options, such as copies of proposed or enacted zoning changes, ordinances, design or operating standards, public education materials, etc.
3. Provide name, address and telephone number of the Team member(s) responsible for coordinating and overseeing implementation of source management, regular updates and necessary strategy revision, and a tentative revision schedule.
4. Prioritize and develop a schedule for implementing management strategies.

Element 5: Management, Sharing, and Integration of SWP Information

Contingency Planning

The Plan must identify and prioritize short- and long-term threats to the system, develop response tailored to the specific situations, review resources available and/or needed, define response procedures and assign responsibilities. The short-term response procedures must:

1. Identify all public water systems which are included in this plan that satisfy NAC 445A.66665 requirements for an Emergency Response Plan or provide required information in the CSWPP contingency planning sections.
2. Identify safe alternative sources of water and include plans for short term and long term water rationing, water supply decontamination, and emergency response. This section must fulfill the contingency plan requirements of Nevada Administrative Code 445A.66665.
3. Demonstrate the community's preparedness to deal with a contamination event by outlining production source redundancy or sustainability should the main production source be taken out of service for an extended period of time and outline relative costs versus available local resources.
4. Outline activities for the restoration of services in the contingency that an emergency, including power failure, mechanical or electrical failure, natural or man-induced disaster, or water main breaks, reduces or threatens water supply.
5. List state and local response agencies and personnel, including contact information.
6. Include the chain-of-command for personnel responsible for plan implementation. Identify staff responsible for implementing specific tasks, if available.

Plans for New Well Siting

As part of the long-term Contingency Plan mentioned above, the following information, where applicable, should be included:

1. Prepare a map or maps depicting sites of future wells and their SWPAs.
2. Document rationale for site selection.
3. Identify resources needed to secure new site (if required).

4. Develop tentative schedules for putting wells in use.
5. Discuss plan for protection of the new site through various management strategies (CSWPP development/implementation).

Public Education and Outreach

1. Prepare a public education and outreach plan that establishes all source water protection pubic education activities (presentations, handouts and factsheets, local workshops, events, etc.) which the community has considered or plans to coordinate during program development and for plan implementation.
2. Propose public participation and education activities with implementation schedules. Development of a perennial ground water presentation program for the community public schools is strongly encouraged.

Other Optional/Suggested Activities

1. Prepare mailings, advertisements and/or flyers for water users and businesses to encourage public participation and education.
2. Develop source water protection messages to be included in water billings.
3. Set appropriate protection signs at strategic locations.
4. Present the CSWPP at City Council, Town Board, and/or County Commission meetings for assistance with land use zoning and planning for SWPAs.
5. Use State ground water protection logo and slogan: "Ground Water – protect it today, you may drink it tomorrow". Logo and slogan available in electronic form from NDEP.

4.0 COMMUNITY PROGRAM GUIDANCE (PULL-OUT)

4.1 Purpose

Drinking water is critical for any community's survival, and how that community manages its water supply will determine its future. Communities throughout Nevada can protect and preserve their water supply by taking the time to understand where their drinking water comes from and what factors affect the quality and quantity of that supply.

Nevada's drinking water comes from many sources, including ground water wells, springs, and surface water (such as Lake Tahoe or Lake Mead). All of these sources of drinking water need protection to preserve water supplies for future generations. The Nevada Division of Environmental Protection (NDEP) created the Integrated Source Water Protection Program (ISWPP or Program) to assist communities in understanding where their water comes from and what they can do to protect their drinking water supply now and for future generations. One means of gaining this understanding is by actively participating in the development of a Community Source Water Protection Plan (CSWPP or Plan).

NDEP developed this step-by-step guide to provide the basic information and tools necessary to create a Plan. However, the information in the Plan can and should be tailored to incorporate local goals, priorities, and approaches that will meet the needs of a specific community.

A Plan can be prepared by a public water system (PWS), community, collection of communities, or a county to ensure that public drinking water supplies are kept safe from potential sources of pollution. Some of the reasons a community may want to protect their drinking water supply include:

Water is the most neglected nutrient in your diet but the most vital.

- ✓ Preserving drinking water quality;
- ✓ Promoting sustainable economic development; and
- ✓ Avoiding the costs of cleaning up contamination.

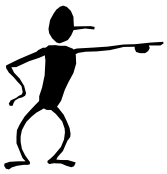
Communities that choose to develop Plans, will become part of Nevada's ISWPP. Participation in the Program is voluntary. However, when they participate in the Program, NDEP provides communities with the technical assistance and tools needed to create a community-specific Plan that promotes local control over drinking water protection and preservation.

This document is directed toward the preparer(s) of a Plan. It is intended to provide guidance, suggestions, and ideas on how to prepare a Plan, but the true architects of the Plan will be the people who actively participate in its development and implementation. Only the members of, and stakeholders in, a community can truly understand its unique needs.

4.2 Overview

Overall, the Plan documents the community's evaluation of its drinking water resources and the measures that the community intends to take to protect those resources. The information in a Plan generally includes:

- Names and affiliations of the individuals that helped prepare the Plan (also known as the CSWPP Team members or Team);
- Location(s) and source(s) of drinking water for the community;
- A map of the areas around the drinking water source(s) that may be susceptible to contamination;
- Inventory of activities and conditions that may adversely affect drinking water quality;
- Strategies the community intends to use to protect its drinking water source(s);
- Contingency Plan describing what the community would do to replace its drinking water supply if the source became contaminated; and
- Action Plan that provides a schedule for Plan **implementation**.



Implementation: process of moving an idea from concept to reality.

Because public water system staff and community leadership change over time, preparing a written Plan will help provide continuity. Additionally, a Plan completed in accordance with the guidelines provided in this document will be eligible for State endorsement, which in turn provides future benefits and incentives.

4.3 Steps to Participate

Step 1: Public Education and Outreach

The most important initial step in developing a Plan is public interest and support. Public participation and education are vital aspects of Plan development. Planning could easily and quickly be derailed if the public does not understand or does not support the Plan. Voluntary community participation in directing the development of a Plan is essential, so the community must be allowed frequent opportunities to provide input to and comment on the Plan throughout the Plan development.

One of the easiest means of accomplishing this step is to use an existing public forum (such as a Town Board, General Improvement District, or local planning committee meeting) to introduce the concept of the Plan development process. Here, NDEP can provide assistance in giving an overview of the process. Figure 4-1 presents an example community announcement for encouraging participation in outreach events.

Your opinion is important.

The safety of your drinking water is too.

We want to hear from you!

On this date, come and share your thoughts during a Drinking Water Awareness Meeting. This gathering, designed to bring the community together, will be held at the special meeting place, at this address, from this time to this time.

Water is a precious resource that we all depend upon. It's vitally important that we all do what we can to manage this resource – for ourselves, for our children, and for generations to come.

Attend this meeting to learn about the source of our community's drinking water supply – plus share your thoughts about how this resource should be managed for future use.

No charge to attend.

RSVP Requested (000) 555- 1111

Questions? Contact:

Insert Name	Insert Name	NDEP
Insert Title	Insert Title	Bureau of Water Pollution Control
(000) 555-2222	(000) 555-3333	(775) 687-4670

Figure 4-1 Example Community Announcement for Public Outreach Events

Step 2: CSWP Team Formation

Public outreach activities also provide an opportunity to recruit members for your Plan Team. The greater the diversity of your Plan Team members, the more likely your Plan will address the goals and needs of your community. Everyone in the community relies on safe water in some way; therefore, everyone has a stake in protecting their water supply.

Potential Team members may include:

- ✓ Water System Operator
- ✓ Public Official
- ✓ Land Management Agency Representative
- ✓ County Commissioner
- ✓ Area Resident
- ✓ Emergency Management Representative
- ✓ Public Relations Specialist
- ✓ Fire Chief
- ✓ School District Representative
- ✓ School Board Member
- ✓ Watershed Plan Group Member
- ✓ Representative(s) from Local Industry
- ✓ Environmental Manager/Natural Resource Representative
- ✓ Plan Organization Representative
- ✓ Economic Development Team Member
- ✓ Engineers/Scientists
- ✓ NDEP
- ✓ Others

As new Team members join the planning effort, it is beneficial to understand their skill sets, affiliations, and reasons for participating. This information can later be used to assign tasks to each member to distribute the workload for Plan development. A sample data collection form is provided on the next page (Figure 4-2) for use in this process.

In addition, Figure 4-3 on page 4-6 is an example of a Team member roster and contact information form that your Team may want to use, or which can be modified to fit your specific needs.

Community Water Resource Protection Team Member Information

Name:

Organization: _____

Relevant Skills: _____

_____

_____

_____

Email: _____

Phone Contacts: _____

_____

Desired Goals: _____

(overall outcome) _____

_____

_____

_____

_____

_____

Desired Objectives: _____

(measurable criteria) _____

_____

_____

_____

_____

Other Suggestions: _____

_____

_____

_____

_____

Figure 4-2 Team Member Information Sheet

Team Membership

Contact Information

Name: _____ Phone: _____

Interest / Affiliation: _____ E-mail: _____

Mailing Address: _____

_____

Name: _____ Phone: _____

Interest / Affiliation: _____ E-mail: _____

Mailing Address: _____

_____

Name: _____ Phone: _____

Interest / Affiliation: _____ E-mail: _____

Mailing Address: _____

_____

Name: _____ Phone: _____

Interest / Affiliation: _____ E-mail: _____

Mailing Address: _____

_____

Name: _____ Phone: _____

Interest / Affiliation: _____ E-mail: _____

Mailing Address: _____

_____

Figure 4-3 Team Roster and Contact Information Form

Step 3: Goal Setting

It is important to understand the difference between goals and objectives as you develop each in the context of creating a Plan. Goals are broad and provide insight to your community's intentions relevant to drinking water resource protection. Objectives are focused and measurable, and provide a means of supporting goals.

Outline Plan goals so that they are clearly defined and easily understood by others.

Goals may be pulled from existing planning documents, community resolutions, and other information previously developed by the community, or they may be shaped by the Team members and their community. The goals you develop should reflect your reason for wanting to implement a Plan. Examples of goals include:

- ✓ To ensure the availability of clean drinking water supplies for future generations;
- ✓ To encourage water resource protection measures that will promote sustainable economic growth; and
- ✓ To increase community members' awareness of the source of their drinking water supply and how they can help protect that supply.

The Plan is a living document that will need to be modified over time. Like any other planning document, it will need occasional updates as new information becomes available, as conditions change, and as recommendations within the Plan are implemented. As your Plan is updated, goals may also require updating, modification, or replacement to stay applicable to current situations within the community.

As you develop your Plan, you will identify measurable objectives that should support one or more of the goals that you have established. You should be able to use the objectives in your Plan as milestones to gauge the effectiveness of your Plan and to determine its stage of implementation.

Step 4: Team Organization and Schedule Development

At this point, you may want to review the skills and qualifications of your Team members and assign responsibilities to each member that are consistent with their abilities. The roles of each Team member may be dependent on the number of individuals available to do the work. Teams may range in size from a few key personnel to more than a dozen people, and the number of Team members is not necessarily dependent upon the size of the community.

Team member positions can include:

- ✓ Team Lead;
- ✓ Team Secretary;
- ✓ Public Information Specialist;
- ✓ Government Liaison;
- ✓ Document Drafter;

A Team's success is entirely dependent upon the commitment it's members.

- ✓ Document Reviewer;
- ✓ Regulatory Compliance Specialist;
- ✓ Education and Outreach Coordinator;
- ✓ Historical Records Reviewer; and
- ✓ Technical Support Staff.

Once a Team is developed, you may want to detail each member's jurisdiction and assigned responsibilities or tasks to assist in coordinating subgroups and creating effective contact lists, as shown in the example in Table 4-1.

Table 4-1 Example Plan Team Roster and Team Member Responsibilities

***Silver Sage* Community Source Water Protection Team**			
Name	Jurisdiction/Title	Team Position	Responsibilities
Ian M. Lead	Town Manager	Team Lead	▪ Facilitates Team meetings ▪ Assigns Tasks ▪ Monitors task completion and timeline
Zuke Éper	High School Principal	Assistant Team Lead	▪ Assists in Team Lead duties
Ira Cord	Public Water System Operator	Secretary	▪ Records notes and minutes from each meeting ▪ Prepares public notices for outreach meetings and workshops
Freda Flame	Fire Chief	Technical Support	▪ Provides technical support ▪ Reviews draft documents
Ed Ucater	School Superintendent	Outreach Coordinator	▪ Facilitates outreach meetings and workshops
Al Busnus	Chamber of Commerce President	Document Drafter	▪ Prepares draft documents
Ima Helper	NDEP Representative	Technical Support	▪ Provides technical support and assistance

The Team may also benefit from a timeline used to schedule and track progress throughout Plan development. A timeline can expedite the process, and can be as generic or detailed as suits the needs of the Team.

Step 5: Plan Development

With your Team in place, and a list of goals established, you are ready to begin development of the Plan. Some of the information you will need to develop the Plan will be fairly complex, but NDEP can provide you with technical assistance to accommodate those needs throughout the document development process.

The next few sections will assist your Team in breaking the Plan into manageable portions. As you review each section, you may decide to assign specific tasks to Team

members or may request that NDEP assist Team members with performing some of these tasks.

4.3.1 Team Identification of Potential Issues or Concerns

A main task of the Team is to brainstorm any current, potential, or historical threats to their drinking water sources. You do not need to discuss solutions or prioritize issues in the beginning of the process. Simply write down issues and concerns you've identified; you can develop a chart similar to the example shown in Table 4-2 to help guide the flow of ideas. It will help identify goals and actions you can take to help develop and implement your Plan.

Table 4-2 Potential Source Water Issues and Affected Areas of Concern

Issue or Concern	Category of Need			
	Quality	Quantity	Security	Education
High Nitrates	X			X
Lack of consumer knowledge of CSWP				X
No meters		X		X
No fencing around wells or water tower			X	X
Use of fertilizers in town	X			X
Excessive lawn watering in town		X		X
Septic systems	X			X
Outdated contaminant source inventory	X			X
Declining water levels		X		X
Household hazardous wastes	X			X
Leaks in the distribution system	X	X		

4.4 Parts of a Community Source Water Protection Plan

Now that you have assembled your Team, established your community's goals, and organized your approach to Plan development, you are ready to begin writing the Plan. If you have documented your progress to date, the first two sections of your Plan are almost

complete. The diagram below (Figure 4-4) demonstrates the basic outline for a state endorsable Plan, and encompasses the four sections that will be included in your Plan.

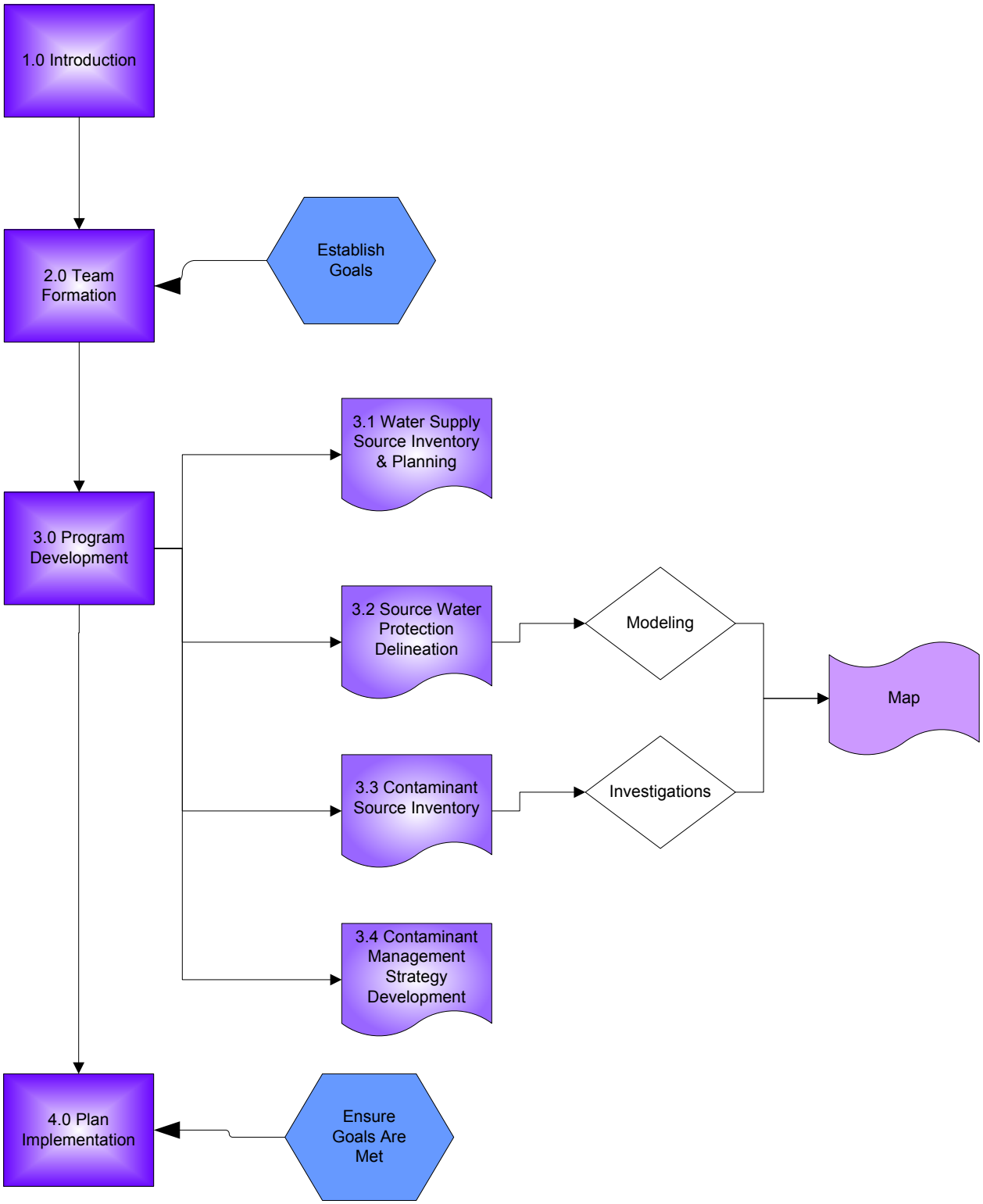


Figure 4-4 Graphical Outline of a Completed CSWP Plan

4.4.1 Section 1: Introduction

The following information should be considered for inclusion in Section 1:

- ☐ The purpose and desired outcome of the Plan;
- ☐ A description of the community and a map of that community's location within the county; and
- ☐ A summary of past investigations relevant to or used in the development of the CSWP.

4.4.2 Section 2: Team formation

Section 2 should include the following information:

- ☐ Detailed Team formation summary;
    - o Methods used (workshops, presentations) to solicit members;
    - o Perceived effectiveness of Team development method(s); and
    - o Adequate community representation in Team membership.
- ☐ Team member names and jurisdictions/titles;
- ☐ Team member expertise or background;
- ☐ Team member responsibilities/Team titles; and
- ☐ Community specific goals for your Plan.

4.4.3 Section 3: Plan development

Source Inventory and Planning

Source inventory and planning involves gathering information about your community's drinking water supply. Most of this information is readily available through local public water system (PWS) operators, such as the local water utility company. Key questions to ask for this section are:

- ✓ Where does my community's drinking water come from?
- ✓ What is the quality of that drinking water supply?
- ✓ Is there enough water to meet my community's current and projected demands on that supply?
- ✓ What is my community currently doing to protect its water supply?

The three common sources of drinking water for Nevadan's are ground water wells, springs, and surface water. Figure 4-5 demonstrates how each of these drinking water sources is related. In fact, two or more ground water wells that tap into the same **aquifer** are likely to have similar water quality results. From a water quality standpoint, the concept of taking water out of one aquifer through two different ground water wells is similar to that of taking water out of a lake from two different locations.

Aquifer: a naturally-occurring, underground "pocket" of water-soaked sand or gravel.

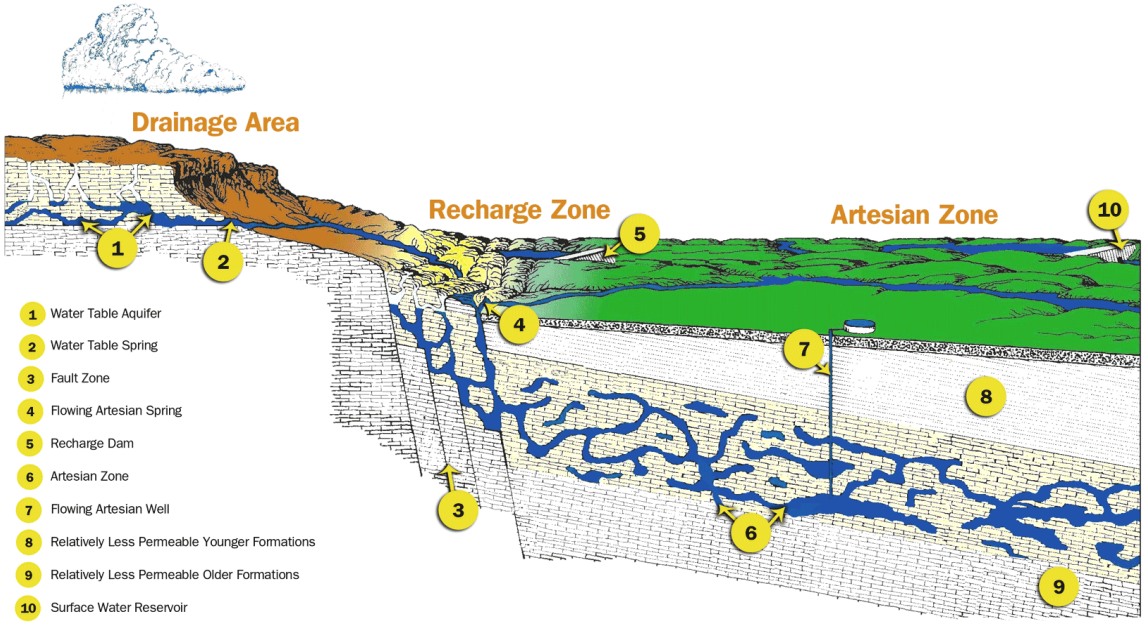


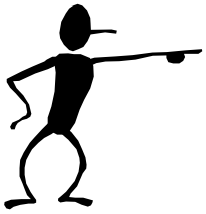
Figure 4-5 Illustration of Ground Water System Elements (Modified From Edwards Aquifer Authority, San Antonio, Texas)

Many unseen dissolved mineral and organic constituents are present in drinking water sources in various concentrations. The quality of these sources is generally assessed by taking water samples to a laboratory for analysis, and comparing the results against State Safe Drinking Water standards, which are based on EPA guidelines. Water with test results below the standards is assumed to be safe to drink. Water with results above the standards may have either naturally occurring challenges (such as high arsenic concentrations associated with the rocks and minerals in the area), or may have signs of **contamination** from external activities.

Contamination: introduction of an undesirable chemical or biological substance that is not normally present in source water.

In addition to the quality of your community's water supply, an assessment of the quantity of that supply is necessary to determine if the existing water supply sources meet your community's current and future needs. While surface water sources are readily measured, the assessment of ground water sources that feed wells and springs can prove more challenging.

A summary of the general **hydrology** and **hydrogeologic** conditions for your area will provide a reference and the necessary background information to assist in understanding both ground water and surface water conditions. This section does not need to be overly technical, and often includes figures, diagrams, and/or maps. Individual topics within this section can include climate, ground water occurrence and movement, aquifer types, information reviewed, etc. If the gathering of this information is beyond the technical expertise of members of the Team, NDEP can offer technical assistance with the analysis.



Hydrology: the distribution, use and movement of water in all of its forms

Hydrogeologic: the distribution and movement of ground water.

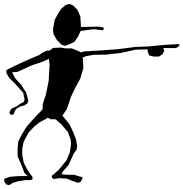
In addition to identifying drinking water sources and the quality and quantity of those sources, the Plan Team will want to review current measures your community is taking to protect its water resources. These protection measures may include:

- ✓ Ordinances or planning requirements to prevent incompatible development close to drinking water sources;
- ✓ Physical barriers, such as well houses or fencing that prevent unauthorized access to drinking water sources;
- ✓ Educational campaigns that provide businesses with lists of best management practices for dealing with their waste products; and/or
- ✓ Household hazardous waste management plans to prevent accidental contamination to a community's drinking water supply.

This subsection of Section 3 should include the following information:

- ☐ Historical ground water conditions (quality and quantity);
- ☐ Current ground water conditions;
- ☐ Projected future ground water conditions;
- ☐ Current measures for protecting ground water from contaminant sources; and
- ☐ Additional measures that may be utilized to protect ground water in the future

Source Water Protection Areas



Source Water Protection Areas: area that surrounds a water supply source through which pollutants can or may flow into the drinking water within a defined time frame (e.g. 2 years, 5 years, 10 years, etc.) if not protected or managed appropriately.

This section can also be kept relatively broad and non-technical, as the technical evaluation can be detailed in an appendix of your Plan. It should, however, include a

brief summary of the description of the area geology from the *Source Inventory and Planning* section, since this information is necessary for **delineating** Source Water Protection Areas (SWPAs), and for developing a description of the SWPAs. Each area that is delineated around a wellhead needs to have a name (e.g. Area 1 as shown in Figure 4-6) and a description detailing how that area was determined, be it a fixed distance from the wellhead or a certain **time of travel** determination, and what protection measures and management strategies should be implemented in that protection area. Including practices and activities that are restricted or monitored in each of the zones is also necessary for understanding the protection levels.

Delineation: physical means used to mark a boundary; a way of indicating the edges of an area where pollutants may reach a drinking water source within a certain amount of time (A SWPA).

Time of travel: length of time it takes a particle of water to travel from a fixed distance location to a well or surface water intake.

NDEP can assist the Team in working with the community to develop SWPA delineations based on the most accurate and applicable information available, or will locate the information needed for an accurate analysis (see Section 5.0). EPA approved models will be utilized to determine the appropriate SWPAs for the geology of the area, while also taking into account community goals and management plans.

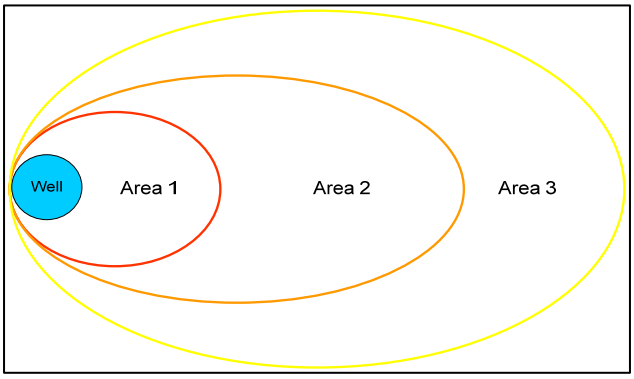


Figure 4-6 Example SWPA Delineations Developed from Ground Water Modeling Based on Time of Travel (Larger areas correspond to increasing time of travel).

Once the Team and NDEP have defined a SWPA, the next step is to locate it on a map so that the planning team and the community can clearly identify the area to be placed under special management.

It will be up to the Team to decide how the SWPAs will be defined; the areas can be delineated as modeled or natural boundaries may be used (roads, rivers, property lines as shown Figure 4-7 on the following page.

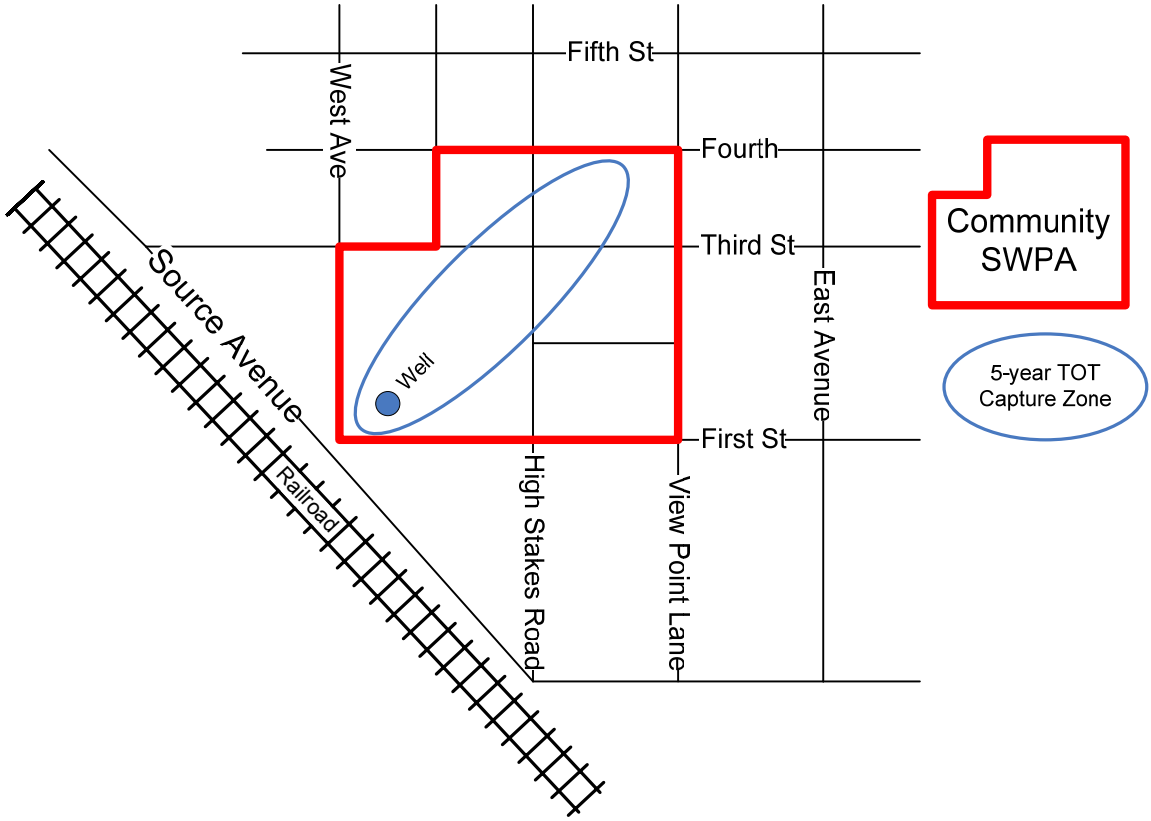


Figure 4-7 SWPA Delineation Using Visual Boundaries

Visual boundaries make the SWPAs more easily understood by a community and may provide a more conservative and manageable protection area. Care needs to be taken in using natural boundaries for the protection area delineation (Note Figure 4-7). The 'road defined' boundaries for the protection make it more conservative only if it includes the entire capture zone and protects more area (than the computer modeled protection area).

This is an acceptable outcome when using topographic features for delineating protection areas. Reducing the protection area to less than the modeled version is not recommended for a State-endorsed plan. Issues such as this need to be discussed with the Team and NDEP before finalizing a defined SWPA.

This subsection of Section 3 should include the following information:

- ☐ Geologic/Hydrogeologic summary of the area;
- ☐ SWPAs named (area, zone, region, sector, etc.);
- ☐ SWPAs described/determined;
- ☐ SWPA map(s); and
- ☐ Jurisdictional boundaries.

Contaminant Source Inventory

An inventory of local contaminant sources will provide the Team with an understanding of the level of potential threat to ground water as well as basic information that can be used in designing management tools to prevent future contamination.

Once the SWPA has been delineated, the actual and potential sources of ground water contamination within the areas must be identified and managed to minimize the risk of contaminating the ground water. It is important to address known release or spill incidents differently than potential sources, particularly in considering future management approaches.

Potential contaminant sources are often identified near public water supply wells as part of the Source Water Assessment Program/**Vulnerability** Assessments (SWAP/VA) conducted by NDEP's Bureau of Safe Drinking Water for the public water systems in the State. Communities should use the SWAP/VA data as a starting point for conducting their own inventory.

Vulnerability: susceptibility to contamination if substances that can be harmful to people or the environment are released.

Potential Contaminant Sources

Many types of industry, businesses, land uses and activities may have an impact on ground water quality. A list of potential sources is provided below and an illustration of how these sources may impact source waters is shown in Figure 4-8.

- ✓ Septic tank fields;
- ✓ Floor drains not connected to sewer system;
- ✓ Landfills;
- ✓ Storage tanks (above and below ground);
- ✓ Cemeteries;
- ✓ Pipelines;
- ✓ Irrigated farm land;
- ✓ Flooding;
- ✓ Mining operations;
- ✓ Orphaned or improperly abandoned wells;
- ✓ Filled or abandoned septic systems; and
- ✓ Household hazardous wastes.

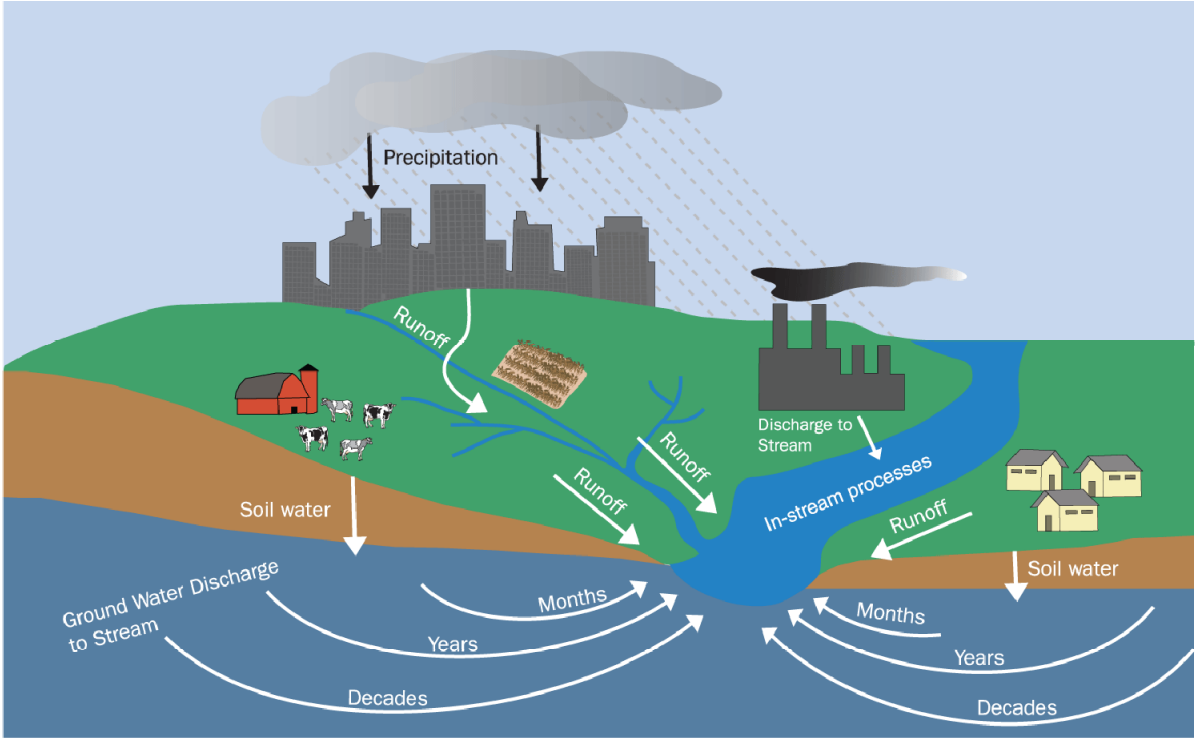


Figure 4-8 Potential Ground Water Contamination Illustration (Modified from Phillips, USGS)

Orphan Wells: An orphan well is an unplugged abandoned well. These are of concern because an abandoned well is a direct conduit from the surface to the aquifer below. Contaminants that enter the well are introduced directly into the aquifer with no opportunity for natural filtration by soils. If a contamination incident occurs, the potential for health-threatening contamination levels in the surrounding aquifer is high. This puts other wells in the aquifer at risk, particularly those wells located close to the abandoned well.

Initial steps in conducting an inventory include a review of any documents that may indicate the location of current, historical, or proposed potential sources of contamination, as well as historical contamination events. Such documents may be:

- ✓ Telephone directories;
- ✓ Business records (e.g. fuel oil deliveries);
- ✓ Government records;
- ✓ Historic records (e.g. defunct businesses, mine sites);
- ✓ News articles;
- ✓ Land use data;
- ✓ Assessors' maps and records;
- ✓ Master plans;
- ✓ Zoning maps; and
- ✓ Aerial photographs.

A risk ranking should also be added to each potential contaminant source identified. The assignment of Very High, High, Moderate, or Low risk value for a potential contaminant is based on the likelihood of a release of the contaminant(s). Risk ranking will help prioritize management efforts. An example of initial risk rankings for Nevada's potential contaminant sources is located on Table 4-3 on the following page and can also be accessed electronically at the NDEP source water website. Final Risk ranking may depend on the proximity to the source and other factors.

Best Management Practices should be put in place to protect sources from contaminant releases. Monitoring procedures should be put in place to identify potential contaminants, and to monitor the ability of the contaminant to reach the ground water. An example list of activities which have the potential to contaminate drinking water has also been provided in Table 4-4 on page 4-20.

Best Management Practices: also referred to as BMPs are barriers, methods, measures, or practices designed to prevent or reduce water pollution.

Information obtained through door-to-door, mail, or **windshield surveys** may also be useful, especially with respect to historical contamination. Table 4-5 on page 4-21 is an example of information that may be collected during a windshield survey.

Windshield Survey: collecting information by making observations, either by walking or driving, instead of directing questions to individuals or conducting literature research. The windshield survey got its name because many of these projects are done while the observers sit in a car.

Inventories should be updated regularly. The timing of each update will depend on the growth rate of the community and can be scheduled by the Team. The responsibility for updating the inventories should be directed to a specific Team member.

Table 4-3 Suggested Risk Rankings for Potential Contaminant Sources in Nevada

CLASS	SOURCE	CATEGORY					RISK
		A	B	C	D	E	RANKING
Agricultural	Animal burial areas			X	X		High
	Animal feedlots		X	X	X		Mod to High
	Chemical application (e/g/ pesticides, fungicides, & fertilizers)		X	X			High
	Chemical mixing & storage areas (including rural airports)	X	X	X			High
	Irrigated fields		X				Moderate
	Irrigation ditches			X			High
	Manure spreading & pits	X		X			Moderate
	Unsealed irrigation wells	X		X			High
Industrial	Chemical manufactures, warehousing/distribution activities	X	X	X			High
	Electroplaters & fabricators			X			High
	Electrical products & manufacturing			X			High
	Machine & metalworking shops	X					High
	Manufacturing sites	X	X	X			High
	Petroleum products production, storage, & distribution centers	X					High
Commercial	Dry cleaning establishments	X					High
	Furniture & wood stripper & refinishers	X					High
	Jewelry & metal plating			X			High
	Laundromats						Low
	Paint shops	X					High
	Photography establishments & printers			X			High
Automotive	Auto repair shops	X					High
	Car washes	X		X	X		Moderate
	Gas stations	X					High
	Road deicing operations: storage & application			X			Moderate
	Road maintenance depots	X		X			High
Residential	Household hazardous products	X	X	X			Moderate
	Private wells	X	X		X		Moderate
	Septic systems, cesspools		X	X	X		Mod to High
Medical/ Educational	Educational institutions (labs, lawns, & chemical storage		X	X			Moderate
	Medical institutions (medical, dental, vet)				X		Low
	Research Laboratories	X	X		X		High
Storage	Underground and above ground storage tanks	X					High
	Public storage	X					Low
	Radioactive materials storage					X	High

Table 4-3 Suggested Risk Rankings for Potential Contaminant Sources in Nevada (Cont.)

CLASS	SOURCE	CATEGORY					RISK RANKING
Municipal Waste	Dumps and landfills (historical & active)	X	X	X	X	X	High
	Municipal incinerators		X	X	X		Moderate
	Recycling & reduction facilities			X			High
	Scrap & junk yards	X		X			High
	Septage lagoons, wastewater treatment plants		X	X	X		High
	Sewer transfer stations	X					High
Miscellaneous	Airports	X					High
	Asphalt plants	X					High
	Boat yards				X		High
	Cemeteries	X					Moderate
	Construction areas	X			X		Moderate
	Dry wells	X					High
	Fuel storage systems		X	X			High
	Golf courses, parks & nurseries (chemical applications)	X		X			High
	Mining (surface & underground)	X					High
	Pipelines (oil, gas, coal slurry)	X	X	X	X		High
	Railroad tracks, yards & maintenance				X		High
	Surface water impoundments, streams, ditches	X	X	X	X		High
	Storm water drains & retention basins	X	X		X		High
	Unplugged abandoned well	X	X	X	X		High
	Well – operating						Low to High

Contaminant Categories:

A = Volatile Organic Compounds

B = Synthetic Organic Chemical

C = Inorganic Compound

D = Microbiological

E = Radionuclides

Table 4-4 Activities Which May Contaminate Drinking Water

Residential Uses: • Failing septic systems, chemical septic system cleaners • Improper storage and application of fertilizers, pesticides and lawn care chemicals • Disposal of household cleaners, automotive products, poisons, waste oil, paint thinners, gasoline, and pet waste into septic systems, backyard pits and storm drains • Driveway runoff of oils, gasoline, heavy metals, deicing chemicals • Leaking underground heating oil tanks
Schools and Institutions • Disposal of oil, paints, chemicals into floor drains, sinks or directly to the ground • Contaminated runoff from parking areas • Improper fertilization of recreation fields • Equipment wash waste water
Municipal Uses: • Improper storage and application of deicing chemicals • Street sweeping • Public works garages – auto maintenance, equipment wash waste water • Uncapped/Unlined landfills and open dumps • Leaking sewer lines/oil lines • Improper storage/application of pesticides and fertilizers • Contaminated runoff from roads, parking lots
Commercial, Industrial Uses: • Improper storage , disposal and management of hazardous materials/waste • Abandoned or leaking underground storage tanks • Spills and releases that go unattended • Floor drains which discharge directly to the ground • Exposed bodies of water from mining and sand and gravel operations • Waste storage lagoons • Transportation spills and releases
Agriculture Uses: • Improper use/storage of pesticides, herbicides, animal manure, fertilizers • Improper irrigation methods • Animal burial • Storage lagoons • Concentrated animal feedlot operations • Contaminated runoff and equipment wash waste water

Table 4-5 Example Windshield Survey Form

Contaminant Source Inventory Data Sheet

Windshield Survey

Name of Water System: _____

Well Site ID: _____

Facility/Tenant/Land Use: _____

Address: _____

Facility Location Information (TRS, Lat/Long, or other descriptive): _____

Spoke with: _____

Time the facility has been in operation: _____

Previous uses of the location: _____

How long ago? _____

Additional Observations/Comments (Materials on site, Quantities, Number of Units - i.e. gallons, pounds, cubic yards, head of livestock, etc.):

_____

_____

_____

_____

_____

_____

_____

Collector(s)
Name:_____ Date:_____

Conducting a Contaminant Source Inventory

- ☐ Review any previous work conducted;
- ☐ Develop a team that may include non-Plan Team members, such as community organizations, scouting troops, or students, who can serve as local historians and conduct the inventory;
- ☐ Walk or drive through delineated SWPAs to further determine the locations of potential contaminant sources that may have been overlooked by previous surveys or assessments;
- ☐ Consider including detailed surveys to provide further information on potential contaminant source in industrial areas, farmsteads, or other high-risk areas;
- ☐ Establish an up-to-date database of the information gathered including well information and potential contaminant sources;
- ☐ Establish a map that will provide an accurate visual assessment of all potential contaminant sources within the SWPAs; and
- ☐ Establish a monitoring plan that will continue to update the inventory on a time schedule agreed upon by the Plan Team.

Contaminant Management Strategies

Once the contaminant source inventory is completed, the information collected should be included on a community planning map. The planning Team will use the map and other pertinent information gathered during the survey to assess the level of risk to the drinking water supply, as well as the level of threat posed by various contaminant sources. Based on this evaluation, each community must balance the issues of potential threats, acceptable risk, and the degree of management the community is willing to support. It is the responsibility of the Team to define the levels of management that are deemed appropriate for the community's SWPAs as represented in Figure 4-9 and to ensure the Plan's established goals are met.

Management strategies need to be forward looking and involve a plan for future review and updates as communities change or grow. In conjunction with goal development, the adoption of realistic and useable management strategies is necessary. Because the degrees of need, financial resources and control over land use activities vary by community, there is no model or recommended strategy that can be followed uniformly.

Strategies for managing SWPAs should be appropriate to the specific needs of the community.

Figure 4-9 Developing Management Strategies

Many SWPA management programs can be implemented easily and at low cost. Enforcement of your existing regulatory controls may be adequate to ensure protection. In other cases, additional protection measures may be needed.

Over time conditions in the SWPA(s) may change. New wells may be added to meet demand or wells could be abandoned and no longer used. This could require enlarging existing SWPAs, creating new ones or require proper abandonment of an abandoned well. Old businesses may close and new businesses will replace them, eliminating some potential contaminant sources and introducing new ones. Existing businesses can change their operations, eliminating their potential contaminants from the protection area. As these changes occur, changes will also need to be made to your Plan.

Communities are encouraged to first brainstorm and develop a list of all management strategies that may be effective in protecting a source. Then the Team should evaluate how strategies could be implemented, associated resource dedication needs, and the anticipated level of community support for each. Without resources or local support to carry out the management strategies, the strategies become unrealistic and cannot be implemented.

Don't plan in more detail than you can manage.

However, do not be quick to discount strategies simply because there may not currently be resources available to implement them. Community planning is dynamic and implementing strategies may become feasible in the future. Documenting all strategies considered with some context for how they were prioritized and why they were, or were not, implemented in an Action Plan, sets the stage for the next Plan review and update process. Various strategies may be included at a later date when the community is better prepared to implement them.

Creativity and flexibility are important in developing management strategies that will fit your community needs. Tables 4-6 and 4-7 on the next pages provide a few examples of regulatory and non-regulatory management strategies, respectively, that the Team and the community may consider when determining which management strategies will best suit their community goals.

Regulatory Management Options
ordinances, zoning, source prohibitions, design and operating standards

Table 4-6 Possible Regulatory Contaminant Management Options [2]

Management Options	Description
Zoning Ordinances	Zoning ordinances typically are comprehensive land-use requirements designed to direct the development of an area where certain land uses may be restricted or regulated. Zoning ordinances are one of the most powerful tools for managing future contamination events that could impact ground water. Team participation from a representative of the local zoning authority is important
Subdivision Ordinances	Subdivision ordinances are applied to land that is divided into four or more subunits for sale or development. The tool may be used to protect SWPAs in which ongoing development may introduce potential or current sources of contamination.
Site Plan Reviews	Site plan reviews are regulations requiring developers to submit, for approval, plans for development occurring within a given area. This tool ensures compliance with regulations or requirements made within SWPAs.
Design Standards	Design standards typically are regulations that apply to the design and construction of buildings or structures. This tool can be used to ensure that new buildings or structures placed within a SWPA are designed to minimize the potential for contaminant releases.
Operating Standards	Operating standards are regulations that apply to ongoing activities to promote safety or environmental protection. Such standards can minimize the threat to ground water from ongoing activities such as the application of agricultural pesticides or the storage and use of hazardous substances.
Source Prohibitions	Source prohibitions are regulations that prohibit the presence or use of chemicals or hazardous activities within a given area. Local governments have used restrictions on the storage or handling of large quantities of hazardous materials within SWPAs to reduce the threat of contamination.

2 Extracted from "Wellhead Protection Programs: Tools for Local Governments" (Office of Groundwater Protection, U.S. EPA, April 1989, EPA 440/6-89002).

Non-regulatory Management Options
public education, water supply monitoring, waste management

Table 4-7 Possible Non-Regulatory Contaminant Management Options[3]

Purchase of Property or Development Rights	This tool may be used to ensure complete control of land uses in or surrounding a SWPA. It may be preferred if regulatory restrictions on land use are not politically feasible and the land purchase is affordable.
Public Education & Outreach	Education opportunities enhance source water protection efforts at the local level. Involving community groups, youth groups, or interested individuals in the development and implementation of a Plan can help bring drinking water issues to the public's attention.
Ground Water Monitoring	Ground water monitoring generally consists of drilling a series of monitoring wells and developing an ongoing water quality testing program. This tool allows the Team to monitor the quality of the ground water supply or the movement and threat of a **contaminant plume**.
Flooding Protection	Floods present a potential for contaminants to enter ground water through the well when flood waters are allowed to reach levels higher than the wellhead. Protection from floods can be as simple as ensuring the well is properly sealed as required by regulators and building a berm around the wellhead or wellhouse to keep the waters away.
Household Hazardous Waste Collection	Residential hazardous waste management programs can reduce the quantity of household hazardous waste being disposed of improperly. These programs have also been used where disposal of household wastes in municipal landfills could potentially threaten ground water.

Contaminant Plume: An area of polluted ground water moving with the ground water flow direction.

Differential management, also termed tiered management, may be implemented by using multiple corresponding SWPAs and management zones. For example, a community may choose to delineate three areas around a well (see Figure 4-6). Area 1 would be the smallest area (tens to hundreds of feet). The idea for Area 1 is that if a contaminant event/accidental release occurred in Area 1, the wellhead will likely be affected very quickly (if not immediately). Therefore, protection activities in this smallest area would focus mainly on preventing accidents and direct contamination of the ground water.

3 Extracted from "Wellhead Protection Programs: Tools for Local Governments" (Office of Groundwater Protection, U.S. EPA, April 1989, EPA 440/6-89002).

Management options utilized within this area would like include prohibitions of specific if not most potentially contaminating activities.

Area 2 would be the next larger SWPA. Its purpose would be to allow sufficient time or distance from the wellhead to act as a buffer zone and possibly allow for the reduction of concentration of most contaminants to manageable levels before the impacted ground water reaches a well or spring. Sources such as septic tanks and drain-fields would be excluded from this area.

Area 3 would be the largest protection area delineated around a well. The purpose of this area is to provide sufficient time for **remediation** activity to take place or for the development of a new source of water if the drinking water becomes contaminated beyond remediation. Management options implemented in Area 3 might include design standards, operating standards and/or ground water monitoring.

Remediation: the process by which pollution is removed or filtered from the ground water.

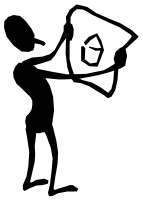
Land management strategies may be difficult to implement because of the potential for overlap among authorities that control land use within a SWPA. This is of particular concern in Nevada, since approximately 85% of the land in Nevada is federally managed. This is most likely to affect management of SWPAs in rural communities where many capture zones are located on land managed by the Bureau of Land Management or U. S. Forest Service. For this reason, representatives from each of the potentially impacted land management agencies need to be part of the CSWP Team.

This subsection of Section 3 should include the following information:

- ☐ Management strategies applied to each SWPA;
- ☐ Reasoning behind management strategies application; and
- ☐ Expected issues with current and future management strategies.

Contingency Plan

Another important aspect of a Plan is the development of a **Contingency Plan.** The Contingency Plan differs from the BSDW required Emergency Response Plan (ERP) in that it is a long term plan of action, which may be necessary if a drinking water source is inadequate or becomes permanently impaired. The Contingency Plan is similar to the ERP required by the state for Public Water Systems (PWS); however, the Contingency Plan focuses on preparing the community for long-term contamination or loss of quality or quantity drinking water. For example the Contingency Plan may address alternatives such as siting new wells or water treatment options.



Contingency Plan: provides resources for problem solving in the event of a loss of supply or impairment to the quality of the drinking water.

Each Plan Team should decide for itself what it will consider a threat or contingency that needs to be addressed in the Contingency Plan. Regardless of how the priorities are set, it is useful to think of determining the appropriate contingencies as a screening process. The Team might first identify a variety of contingencies and then screen the contingencies to assess their importance. The screening of a large set of potential contingencies should yield a smaller set of "primary" contingencies. These threats can then receive the most urgent attention in the planning process. Once the Team has identified the "primary" set of supply disruption contingencies, these threats should be summarized in a way that is useful in designing appropriate response actions.

This subsection of Section 3 should include the following information:

- ☐ Emergency contact list;
- ☐ List of individuals and their responsibilities;
- ☐ Description of possible primary contingencies and emergencies;
- ☐ Short and long term water treatment options;
- ☐ Emergency drinking water replacement sources;
- ☐ Long term drinking water source replacement, augmentation or remediation; and
- ☐ Cost/Benefit analysis for possible actions.

New Well Siting

Planning for the siting of new wells or well-fields is difficult. Predicting the location of ground water is not an exact science without first drilling test wells to verify the existence of sufficient quantity and quality of water. For this reason, planning for the protection of lands expected to be used for future wells is limited. A PWS may already have a Source Development Plan, which evaluates whether existing water supplies will sustain the community's future growth and development as well as potential water shortages and the economic impacts associated with each scenario.

Communities in high growth areas may examine land-use patterns and elect to direct industrial development or other potential sources of contamination to areas that are least likely to provide adequate ground water sources. Public water system (PWS) operators often work with planning officials to project water supply needs that, in turn, may be used to evaluate the need for a new water source. Even if a PWS has not anticipated the need for a new water source prior to Plan development, the Team may work proactively with the PWS operator to quantify future demands.

NDEP can assist the Team to evaluate and incorporate new source water information into the Plan. Additionally, NDEP may provide guidance to Team members on advanced

planning measures (i.e. zoning overlays highlighting the location of future sources, drafting local ordinances, or similar measures) that can be used preemptively to protect and preserve the quality of the new source.

Information in a PWS's existing Development Plan may also assist in the development of a community's SWP Plan. Examples of information which may be included in the existing Development Plan and that are pertinent to the SWP Plan Include:

- ☐ Projected supply needs to determine when a new source will be needed;
- ☐ Undeveloped water sources that have potential for production and long-term water supply;
- ☐ Steps required to obtain water rights, permitting for use, and land acquisition to develop the source;
- ☐ Protection areas and management levels around the proposed new well sites;
- ☐ Actual and potential sources of contamination in each proposed protection area;
- ☐ Existing or proposed management options and degree of protection afforded for each new well site;
- ☐ Water quality assessment to ensure that the source water meets federal and state drinking water standards; and
- ☐ Financial needs and procure funding for water development projects.

4.4.4 Section 4: Action Plan

The Action Plan is the implementation of the initial goals set forth by the Team and identifies the steps and objectives needed to guide the Team in achieving your Plan goals. It highlights the actions that the Team anticipates or will consider taking in order to implement these objectives. The Action Plan should provide a clear outline of priorities and the direction to be taken in accomplishing the end goals of your Plan. The initiation of the Action Plan is a beginning. As your Plan moves forward, all of the stakeholders who participated in the Team need to continue to be involved in the implementation process.

Section 4 should include the following information:

- ☐ Goals listed and described;
- ☐ Detail of the steps necessary (objectives) to reach the stated goals;
- ☐ Resources required to accomplish each objective;
- ☐ Participation from organizations and individuals required to reach goals;
- ☐ Timeline for implementation of each step; and
- ☐ Team member(s) responsible for monitoring progress toward each goal.

Figure 4-10 below is an example letter template that may be used to inform residents and businesses that they are located within a SWPA and where to obtain, or who to contact

for more information and assistance in complying with a SWPA management strategies.

Re: _____DRINKING WATER PROTECTION PLAN

Dear Property Owner/Operator:

The community(ies) of _____has(have) taken a proactive approach to protecting our valuable drinking water supply by establishing a Community Source Water Protection Plan. The Plan was developed by delineating the geographic area where the water supplies originate and protecting that area through our own selected methods. Our local drinking water protection Team worked to develop this Plan with involvement from as many local citizens and stakeholders as possible. The purpose of this letter is to tell you that your property is within the Source Water Protection Area which contributes ground water to our drinking water supply. One element of our local Community Source Water Protection Plan involves creating more awareness of the need to take precautions to prevent ground water contamination in this area. We are asking for your commitment to join us in this effort.

OPTIONAL: An ordinance has been adopted for this Protection Area which requires all property owners to employ best management practices.

Or...

OPTIONAL: We will be relying on voluntary implementation of pollution prevention activities, including the incorporation of best management practices.

We are committed to helping you obtain free information on what can be incorporated into your day-to-day operations to reduce the risk of release of any potential ground water contaminant. Businesses within our Source Water Protection Area can begin by reviewing the attached handout which summarizes best management practices that are applicable to most operations. These are basically common sense approaches that are already employed by many businesses in order to reduce their liabilities.

The second attachment to this letter contains some resources available to help you with your pollution prevention efforts. We have also enclosed some information on other Nevada pollution reduction programs. We encourage all property owners within our Source Water Protection Area to contact one or more of these resources to get more information on best management practices specific to your type of operation.

If you have any questions about drinking water protection, please feel free to call _____. Thank you in advance for your participation in this important community effort. It is critical to the protection of our drinking water supply.

Sincerely,

_____(list of Team members)

Figure 4-10 Example SWPA Notification Letter

4.4.5 Section 5. Public Participation

The importance of involving all sectors of the public as well as local government or administrative entities during the planning, development and implementation of Plan cannot be over emphasized. Not involving the public in the early stages of planning is often the primary reason that local Plans are not implemented.

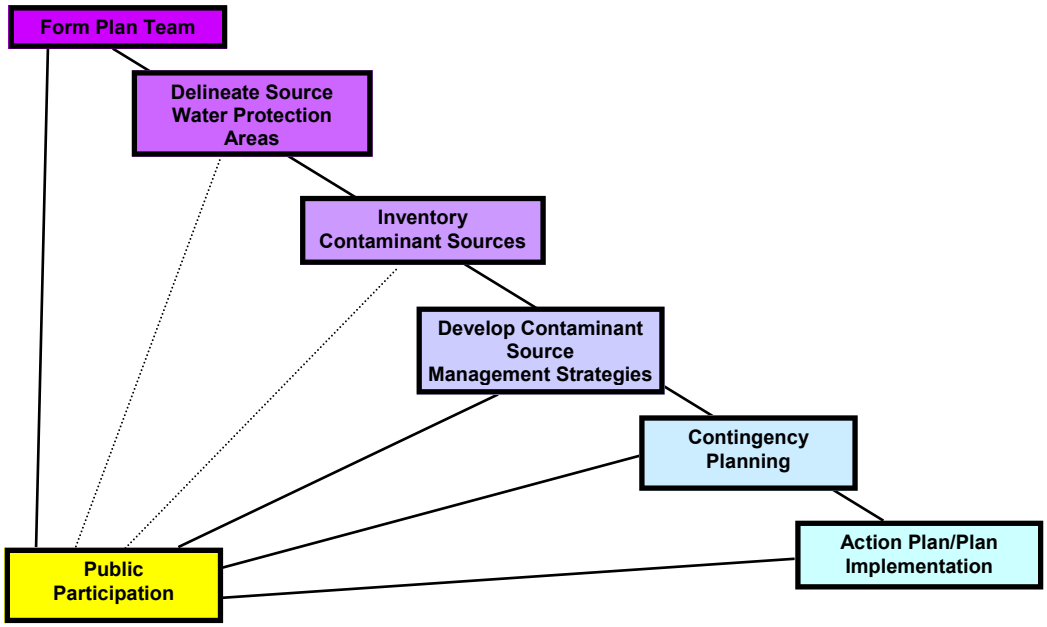


Figure 4-11 Public Participation in Plan Development

Public education is an effective tool to promote voluntary protection efforts and build public support for Plan development and implementation. It is also crucial to Plan efforts since programs are initiated and implemented at the local level. A Plan could easily and quickly be derailed if the public does not understand the planning goals or if they missed an opportunity to assist in the development of the program.

Involving community groups, youth groups, or interested individuals in the development and implementation of a Plan helps bring drinking water issues to the public's attention. In the long run, preventing contamination of ground water, and expanding or improving the Public Water System will be easier if the public understands the issues and 'buys into' your Plan.

There are a number of ways to educate and inform the public concerning ground water supply and ground water protection. Some are more costly than others and some depend upon the extent of the community's communication resources. A common education/outreach method is to develop a ground water presentation for local public schools and professional organizations that can be used year after year to raise the level of ground water awareness.

Table 4-8 presents examples of common approaches to educating and informing the public of issues relating to ground water management and protection.

Table 4-8 Example Public Education and Outreach Projects

Education Venue	Description
Ground water model demonstrations	One of the most effective educational approaches toward understanding ground water movement and contaminant migration is through the use of physical ground water models. These provide a visual representation of ground water flow and avenues of contamination to the audience. NDEP may assist in performing ground water demonstrations.
Informational brochures to customers	This could be a separate mailing to water customers, or could be included with their monthly billing statement. Particularly useful is summarizing your Plan including: what is Source Water Protection and why is it necessary (very simply!); areas comprising the SWPAs; objectives of the plan; what is being done to protect local drinking water supplies from contamination; what citizens can do to help.
Newspaper articles	Newspaper articles and editorials are an inexpensive and efficient way to communicate the basic elements of the water supply system and threats to water quality. In larger communities, system staff should approach the science editors, if they have one, of local and regional papers. The contact may be less formal in smaller communities, where local and regional papers may rely upon general reporters and donated features.
Television and radio media	Television and radio can also be used to educate the public in an inexpensive and efficient way. Contacts made with television and radio personnel may also be useful during a contamination incident. If funding permits, Public Service Announcements (PSA) could be prepared. NDEP can reference a variety of scripts that may be used for these PSA.
Installation of road signs	Again, awareness can go a long way in promoting public participation in ground water protection. Each community needs to decide independently if the installation of signs indicating the location of the Source Water Protection Areas is a security risk.
Movie theatre slides/ads	Pictures are worth a thousand words. Movie going is a popular leisure activity in the U.S., providing a distraction-free environment for getting the word out.
Grade school activities	Schools provide a venue for water education as well as public service announcement.
Vehicle wraps	Turning a Team member's vehicle into a public service announcement is an effective way to target the local audience.

There are many ways to keep the community informed of the Team and planning activities. In this technological age, a variety of electronic media, including e-mail and

website postings, should be considered as a way to encourage participation in the process. Traditional venues, such as newspaper articles, posters in the library, a phone call or face-to-face invitation, or a personal letter, can also motivate individuals to get involved. The most successful promotional efforts combine general promotion techniques with personal invitations.

Regardless of the venue chosen for public education and outreach, NDEP will be on hand to assist the Team in any aspect of the outreach effort. Teach the members of the community where their drinking water comes from and how the water system works, and they will want to protect it.

Section 5 should include the following information:

- ☐ List of public education efforts and materials to be used;
- ☐ Dates for community events in which the Team can participate; and
- ☐ List of Team members responsible for public education and outreach events, materials, etc.

Figure 4-12 Example SWPA Road Sign

4.4.6 Section 6 Executive Summary

Now that your Plan is complete, you will need to provide an overview of what you have done so that people who have not been involved in the planning can understand what you did, why you did it, and what you intend to do next. Your Plan should begin with an executive summary describing the purpose and desired outcome of the Plan. It is recommended that the executive summary be up to two pages so that it allows the reader to gain an understanding of your Plan without having to read the entire Plan. An example Executive Summary is provided in Figure 4-13, on the following page.

Silver Sage County's Community Source Water Protection Plan (Plan) has been prepared to provide a framework for the long-term protection of our public drinking water supply sources. The Plan Team (Team) that created this document was composed of representatives from the community, and from local, state, and federal agencies. The Team's mission was to review existing conditions around each of the communities' drinking water supply sources to determine if they were adequately protected from potential sources of contamination, or if additional measures to manage these critical water supplies were necessary.

The goal of this Plan is to ensure a clean drinking water supply for future generations, to reduce the risk to human health by ensuring that the communities of *Silver Sage County* have an uninterrupted supply of uncontaminated drinking water, and to minimize operating costs of the *water supplier*. The Team intends to accomplish these goals through implementation of its proposed contaminant source management strategies as outlined in this Plan.

The community obtains its drinking water supply from multiple wells located at the northeast end of Silver Sage Valley. Source Water Protection Areas (SWPAs) were established around each of the identified drinking water sources by using available site-specific ground water data. A SWPA is the area on the ground surface which must be managed in order to protect the Community's drinking water supply. This outlined or delineated area is the result of complex ground water modeling and demonstrates the above ground land surface where various human activities can contribute to pollution or contamination of an underground well or spring fed water supply. The SWPAs are illustrated on maps to provide a physical representation of the areas to be compared with surrounding land uses.

A local survey of the types of activities that can result in ground water contamination was conducted. Over 35 potential contaminant sources were identified within the community; however, only one was identified within the SWPA.

Based upon the results of the contaminant source survey, the Team developed a strategy to manage potential contaminant sources in the community and a schedule for implementing this strategy. This strategy includes *(briefly detail strategies developed)*.

The *water supplier* also maintains a Contingency Plan that details emergency response and planning measures to safeguard the drinking water supply, or if necessary, remediate or replace the water supply. Actions include *(briefly detail contingency plan actions)*. In addition, a source development plan has been investigated that includes consideration of possible resource dedication (associated costs and man hours) to develop a new well or source of drinking water.

The Team also recommended encouraging the use of Best Management Practices by local businesses and residents to further promote the program and local awareness. The children of the community should be educated on the importance of protecting their drinking water supply. Presentation and educational materials developed by different organizations will be provided to or made available for the community to use throughout the year.

Finally, the Plan should be revisited on a regular basis to ensure continued success and evaluation of program activities. The community may later identify sources of contamination not originally considered in the plan or experience an event that changes the characteristics of the community's water supply. Regular updates will ensure the plan incorporates any significant changes within the community into the future.

Figure 4-13 Example CSWP Plan Executive Summary

4.5 State Endorsement

Congratulations! You have now completed your Plan, and have the opportunity to become part of Nevada's Integrated Source Water Protection Program. Now that you have completed your Plan, you should submit it to NDEP for review and possible State endorsement. State endorsement provides future benefits and incentives, and is a means of incorporating all of the work you have done, into a broader, county-wide, and eventually, state-wide perspective of Nevada's water supply issues. Table 4-9 provides an example of the checklist of subjects used by NDEP to review your Plan for endorsement, and should be periodically reviewed while you are preparing your Plan as a check that all necessary elements have been entered in the Plan.

Table 4-9 NDEP CSWP Plan Endorsement Checklist

Formation of the Planning Team			
Minimum Requirements	**Yes**	**No**	**Comments**
The Team includes representatives from public water systems, local public officials, NDEP representative, local community planners, and other pertinent parties.	☐	☐	
The Team conducted meetings to develop and establish the community's source water protection goals and to outline how those goals are to be accomplished.	☐	☐	
The Plan includes a list of Team members and their respective contact information and outlines their individual involvement or responsibility in the planning effort.	☐	☐	
Where applicable, the Team presented the Plan development and implementation schedule and Community Source Water Protection Goals to the Board of County Commissioners.	☐	☐	
Delineation of Source Water Protection Areas and Recharge Areas			
Minimum Requirements	**Yes**	**No**	**Comments**
A review and assessment of available and applicable Source Water Assessment Program/Vulnerability Assessment Program (SWAP/VAP) reports was conducted.	☐	☐	

Table 4-9 NDEP CSWP Plan Endorsement Checklist (Cont.)

Delineation of Source Water Protection Areas and Recharge Areas Cont.			
Minimum Requirements	**Yes**	**No**	**Comments**
A complete review was conducted to include available well logs, pump test data, other relevant engineering studies or planning documents, and information was compiled and presented in the plan.	☐	☐	
A conceptual hydrologic model was submitted to NDEP for approval prior to delineating source water protection areas.	☐	☐	
The modular semi-analytical model (WhAEM2000, US EPA, 1991), or other equivalent state approved model was used to delineate the source water protection capture zones and protection areas.	☐	☐	
All information related to the model input data was derived from pump test data, or an equivalent approved by NDEP.	☐	☐	
The method, criteria, and threshold selected for the SWPAs were presented and a rationale and supporting documentation for the selection was provided to the satisfaction of NDEP.	☐	☐	
Maps were prepared to include the modeled capture zones and delineated source water protection areas and maps are clearly depicted on a scale that is consistent with the community's land use and zoning maps or master planning maps.	☐	☐	
A discussion of the ground water recharge area(s) was provided and included sufficient details to provide context for ground water flow to the community.	☐	☐	
A discussion of the geologic and hydrogeologic susceptibility to contaminant infiltration in the source water protection areas and recharge areas was included.	☐	☐	

Table 4-9 NDEP CSWP Plan Endorsement Checklist (Cont.)

Contaminant Source Inventory			
Minimum Requirements	**Yes**	**No**	**Comments**
Obtained and reviewed available source water assessments completed by NDEP.	☐	☐	
Performed a review and inventory using available local, state and federal databases and documents (maps and other relevant engineering or planning studies and documents)	☐	☐	
Walked or drove through the delineated source water protection areas to visually determine the locations of all potential contaminant sources that may have been overlooked.	☐	☐	
Established risk associated with identified PCSs based upon criteria and identified with context for whether PCSs are "adequately controlled" or "inadequately controlled."	☐	☐	
Prepared a map of contaminant source locations in relation to the source water protection areas and local land use planning maps.	☐	☐	
Established a schedule to update the contaminant source inventory with the name and contact information for the responsible Team member.	☐	☐	
Selection and Implementation of Contaminant Source Management Strategies			
Minimum Requirements	**Yes**	**No**	**Comments**
The Plan Team conducted a meeting(s) to discuss and evaluate appropriate management strategies to be implemented for protecting the source water from existing or potential contaminant sources.	☐	☐	
The Plan outlines selected management strategies including a prioritization and implementation schedule and an action plan.	☐	☐	

Table 4-9 NDEP CSWP Plan Endorsement Checklist (Cont.)

Selection and Implementation of Contaminant Source Management Strategies Cont.			
Minimum Requirements	**Yes**	**No**	**Comments**
Documentation related to management options, such as copies of proposed or enacted zoning changes, ordinances, design or operating standards, public education materials, etc. were provided.	☐	☐	
A Team member was identified with contact information that is responsible for coordinating and overseeing implementation of the source management and who is also responsible for regular updates or necessary revisions.	☐	☐	
Contingency Planning			
Minimum Requirements	**Yes**	**No**	**Comments**
The Plan identifies all public water systems which are included in this plan that have already satisfied (or not) the Bureau of Safe Drinking Water requirements for an Emergency Response Plan in accordance with NAC 445A.66665.	☐	☐	
The Plan demonstrates the community's preparedness to deal with a contamination event; outlines chain of command and contact information; identifies current production redundancy or sustainability should the main production source be taken out of service (short term and long term) and outlines relative costs versus available local resources.	☐	☐	
The Plan lists applicable state and local response agencies and personnel, including contact information and chain of command.	☐	☐	

Table 4-9 NDEP CSWP Plan Endorsement Checklist (Cont.)

Plans for New Well Siting			
Minimum Requirements	**Yes**	**No**	**Comments**
The Plan includes a map(s) depicting sites of planned future well sites.	☐	☐	
The Plan outlines historical water quality monitoring and geologic information and rationale for selecting the site(s) as a future source(s).	☐	☐	
The Plan identifies resource dedication to acquire and develop the source(s) and a tentative schedule for putting the new source(s) into production.	☐	☐	
Where feasible and where data is available, the Plan models and delineates all future planned source water protection areas and outlines management strategies to protect them.	☐	☐	
Public Education			
Minimum Requirements	**Yes**	**No**	**Comments**
The Plan identifies all source water protection public education activities (presentations, handouts, flyers, workshops, events, etc.) which the community has or plans to coordinate during program development and implementation planning phases.	☐	☐	

5.0 GROUND WATER SOURCE WATER PROTECTION AREAS

In 1995 NDEP published the "Wellhead Protection Area (WHPA) Delineation Recommendations," which serves as a guide for delineating protection areas for underground drinking water sources in Nevada. The 1995 document lays out the importance of selecting a technically sound method for delineating WHPAs, important parameters to consider - including the unique hydrogeologic setting of the State, recommended approach in choosing a methodology based on available parameters and aquifer characteristics, and procedures for using each recommended method. The reader is advised to consult the 1995 document, review available information and data for the site specific conditions, and consider the local resources and protection needs prior to choosing the appropriate delineation method.

The purpose of this section is to provide updated and complimentary guidance related to delineating Source Water Protection Areas (SWPAs) for wells and springs. This document is not intended to replace the 1995 recommendations; but rather enhances the information provided within it through incorporating experience and insight gained over the years into this updated guidance.

For wells and springs, a SWPA is the area on the ground surface which encompasses and contributes water to the public water supply well or spring. This area, previously referred to as a Wellhead Protection Area (WHPA), must be managed in order to protect the ground water below from contamination. Identifying and mapping these areas provides a tool for communities to educate the public and to incorporate drinking water protection activities into local planning and management programs (See Sections 3 and 4 for more detailed information on local management strategies). These areas will be an integral part of the Community's Source Water Protection Plan (referred to as Plan from this point forward).

5.1 Nevada Hydrogeology

Nevada lies primarily within the Basin and Range physiographic province, which is characterized by isolated, long, narrow, roughly parallel mountain ranges and broad, intervening, nearly flat valleys and basins. Nevada has been divided into 14 major hydrographic regions that contain 256 hydrographic areas and sub-areas. Hydrogeologic conditions in Nevada vary according to the statewide distribution of three basic aquifer types: basin-fill, carbonate rock, and volcanic rock as shown in Figure 5-1 on the following page.

Figure 5-2 on page 5-3 is a conceptual ground water cycle typical throughout the Basin and Range physiographic province. Understanding this cycle and how source water systems function in each aspect of the cycle, facilitates understanding of how springs and aquifers form, and how other processes serve to affect ground water movement and characteristics.

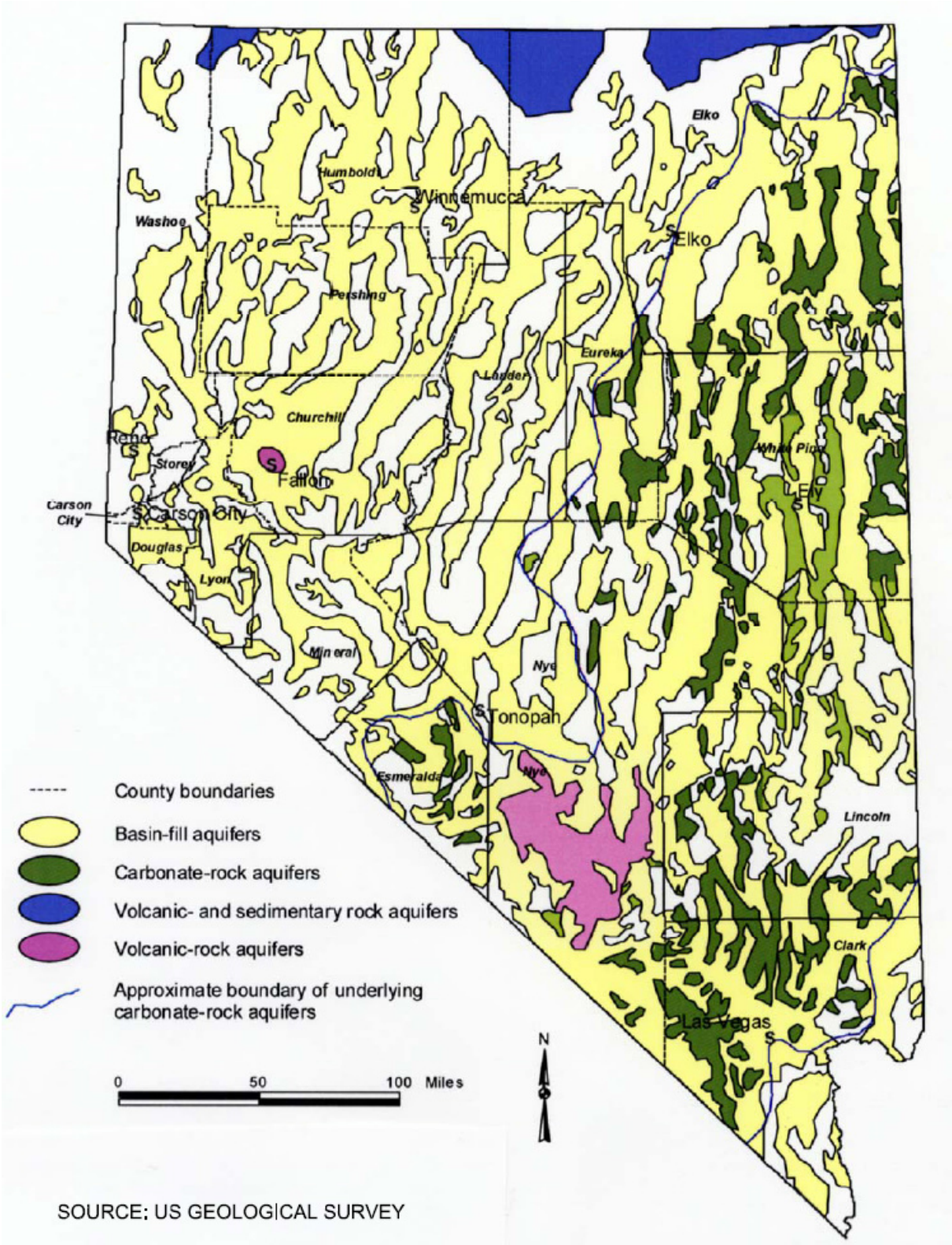


Figure 5-1 Nevada Aquifers (USGS, Updated 2009)

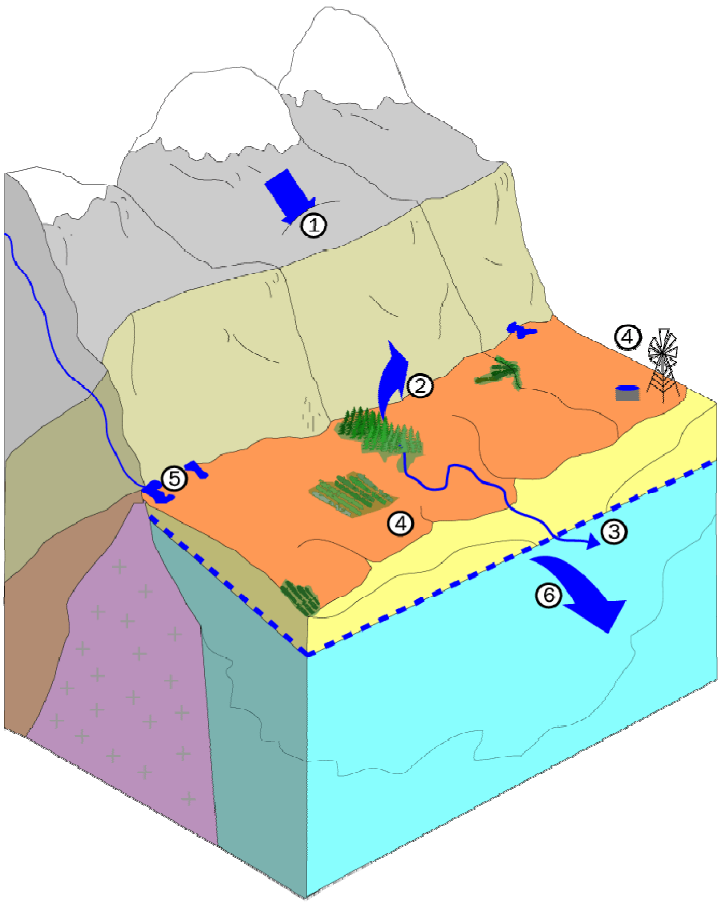


Figure 5-2 Conceptual Hydrogeologic Model for the Basin and Range Physiographic Province (modified from White Pine County Water Resources Plan)

1. The water resources of many Nevada communities originate as the rain and snow that fall over the upland areas. Rain and snow melt run off into rock channels and fractures of the ranges that comprise much of the consolidated aquifer systems (i.e. volcanic and carbonate rocks). Some of this water is consumed by plants and some infiltrates downward to the water table, a process known as *recharge*. Most of the recharge occurs at elevations above 7,000 feet.

2. Streams are important water resources. The streams are fed by runoff from the mountains and by springs that discharge in upland areas. These streams often support lush riparian areas and wildlife. Along the mountain front, additional recharge occurs through the channels that drain the upland areas. The vegetation that is supported by the streams and springs consume a considerable amount of water through *evapotranspiration*.

3. Surface water may flow year round in some springs and streams, but the amount of flow is often quite variable. Following the snowmelt in the late spring, there is usually a surge of discharge in the streams and springs that drains the mountain areas. This surge of flow is also referred to as *rejected recharge* as it represents the excess water that the rocks are not able to intake. Streams that are fed by springs with seasonal flow may dry up completely in the dry months. Streams and springs that flow year round are called *perennial* and seasonal flows are referred to as *ephemeral*.

4. The water that is used by man for irrigation, stockwater, and quasimunicipal purposes is not completely consumed. Water stored in ponds and irrigation canals leaks back into the ground water system. Some portion of the irrigation water (about 25 percent) infiltrates back into the ground. Even domestic septic systems may return a small quantity of water back into the ground. Collectively, the infiltration of water from these sources is called *secondary recharge*. Secondary recharge can be a large component of the water budget in basins where irrigation is widespread.

5. Spring lines often occur where geologic controls such as faults or contacts are present. These controls cause ground water to rise to the surface and discharge.

6. The water that recharges the aquifers of one hydrographic basin, particularly within the unconsolidated basin-fill depositional environment, may remain within that single basin (i.e. a closed basin). Alternatively, this recharge water may ultimately flow from one valley to the next. Basins that are hydraulically linked in this manner are referred to as *flow systems*

A basic understanding of the local hydrogeology of a water supply system is necessary to adequately identify and/or predict potential impacts to an aquifer caused by land development. Each of the three aquifer types described below should be considered separately when delineating a SWPA.

Basin-fill aquifers supply most of the ground water currently withdrawn in Nevada. These unconsolidated aquifers consist of alluvial, colluvial, and lacustrine deposits, and are generally contained within closed basins. The level of confinement of a basin-fill aquifer can range from fully confined to fully unconfined. The relative level of confinement of an aquifer can affect the vulnerability of the aquifer to surface contaminants (U.S. EPA, 1991a). An aquifer's level of confinement should be ascertained and factored into planning and zoning strategies as part of the CSWPP.

Many of the state's alluvial ground water basins are used to the point of estimated perennial yield. Thus the limited availability of water and the excessive cost and time required to clean up contaminated aquifers make source water protection a critical component of community planning. Figure 5-3 on the following page presents a schematic cross-section of a valley-fill aquifer.

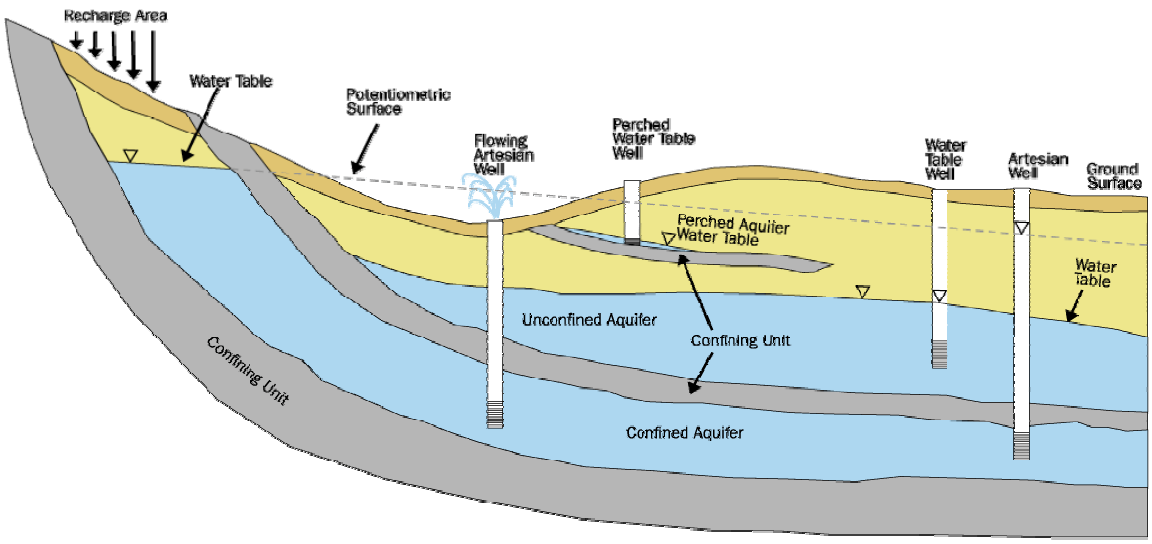


Figure 5-3 Schematic Cross Section of a Valley Fill Aquifer

Carbonate rock aquifers are among the most extensive and productive in the world. A regional carbonate rock aquifer underlies much of the eastern and southern portion of Nevada and carbonate rocks comprise much of the stratigraphy of the mountain ranges. Some carbonate aquifers may have a hydraulic connection to aquifers in adjacent basins via inter-basin flow. Hydraulic connections between basins have been documented in some parts of the state; flow is believed to be through the carbonate rock units that topographically separate the basins.

Recharge to the carbonate-rock aquifer system occurs principally in mountain ranges (typically greater than 7,000 feet in elevation) that receive snow and rainfall. Regionally, ground water moves in fractures and enhanced pore spaces, principally in a northeast to southwest direction, from the area of principal recharge. Discharge occurs principally via large-volume springs, evapotranspiration, base-flow to streams, into overlying basin-fill aquifers, and to the regional sinks at Death Valley and Lake Mead. Figure 5-4 presents a

schematic block diagram of a carbonate aquifer showing three types of ground water permeability elements.

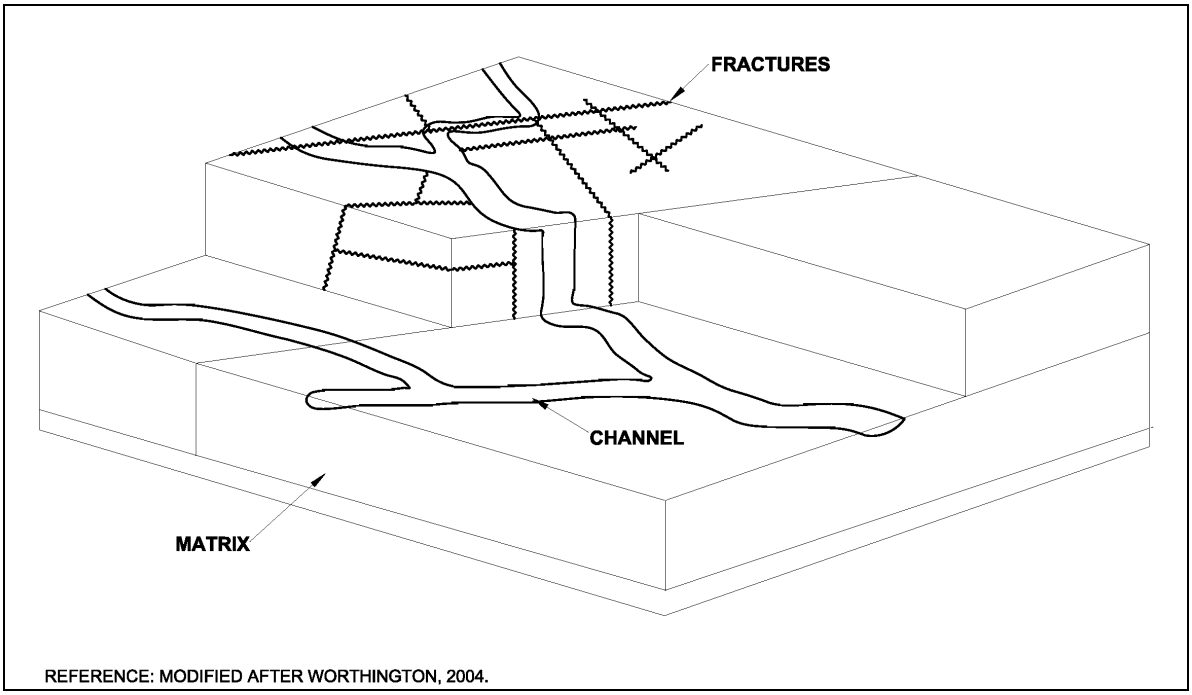


Figure 5-4 Schematic Block Diagram of a Carbonate Aquifer

Looking at Figure 5-4, the matrix is the rock element between the fractures and accounts for most of the aquifer's storage capacity. Water within the matrix moves very slowly compare to the other elements (i.e., very high resident time); Fractures are created by mechanical forces such as plate tectonic or melting of ice at the end of glaciation; most factures have apertures of < 1mm, low storage capacity, and moderate water resident time; Channels are enlarged fractures as the result of dissolution of the bedrock; channels accounts for most of the aquifer flow, little storage, and have very short resident time.

Volcanic rock aquifers are located in several isolated sections of the State (refer to Figure 5-1), but only a relatively small amount of ground water is withdrawn from them for potable consumption. The southern volcanic-rock aquifers, located in Nye and Churchill Counties, consist of ash-flow tuffs, welded tuffs, and minor flows of basalt and rhyolite. Along the northern Nevada border, there are a number of basalt aquifers, which may be an extension of the Pacific Northwest basaltic rock aquifers.

Volcanic rocks have a wide range of chemical, mineralogic, structural, and hydraulic properties, due mostly to variations in rock type, the method and rate of deposition, and the thermal gradient during cooling. Unaltered pyroclastic rocks, for example, might have porosity and permeability similar to poorly sorted sediments. Hot pyroclastic material, however, might become welded as it settles, and, thus, be almost impermeable except where fractures occur. Silicic lavas tend to be extruded as thick, dense flows, and they have low permeability except where they are fractured. Basaltic lavas tend to form thin deposits that have considerable pore space at the tops and bottoms of the flows. It is common for multiple basalt flows to overlap, with interstitial permeable zones comprised of soil or alluvium. Columnar joints that develop in the central parts of basalt flows create

passages that allow water to move vertically through the basalt. Basaltic rocks are the most productive volcanic aquifers, but they tend to be highly variable with regard to permeability. Therefore, development of a conceptual hydrogeologic map is recommended as part of the modeling process. Figure 5-5 presents a schematic cross-section of a typical basalt aquifer.

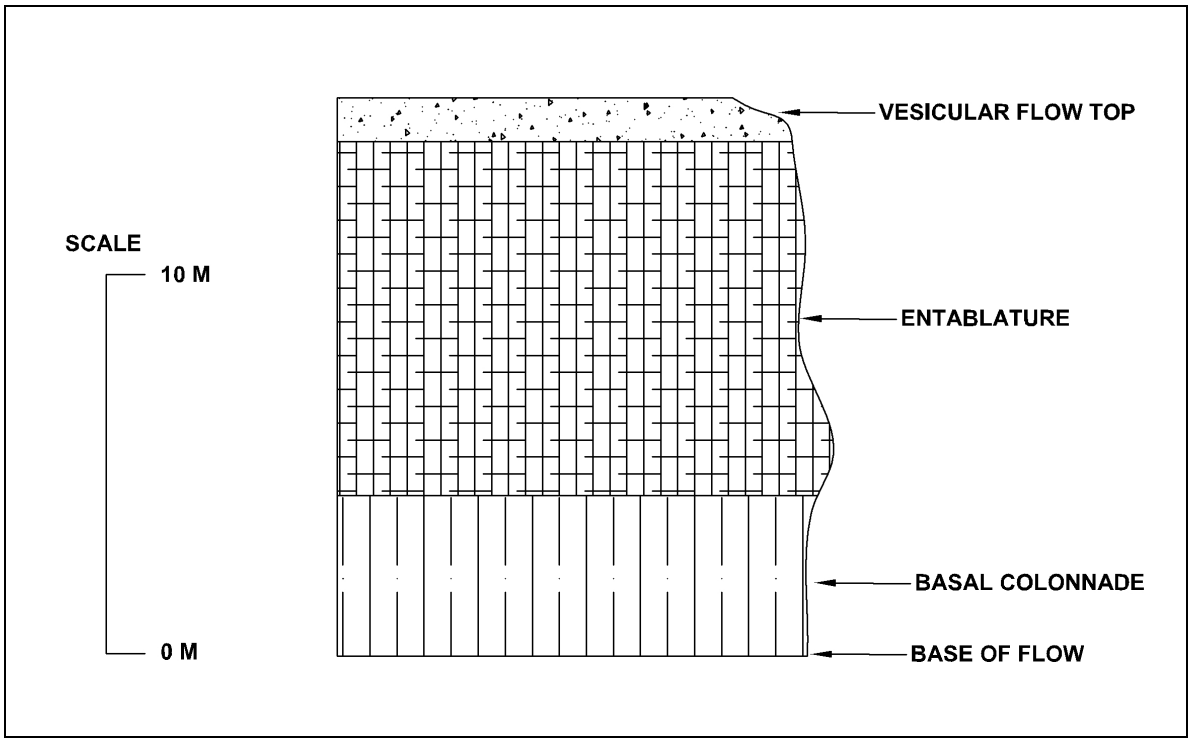


Figure 5-5 Schematic Cross Section of a Typical Basalt Aquifer

Tthe USGS defines a typical basalt aquifer as containing zones of varying permeability:

1. The flow top is vesicular, scoriaceous and broken which has substantial permeability.
2. The flow center: includes the entablature section which is dense with few vesicles; most fractures are vertical. This section has minimal permeability.
3. The flow bottom includes the basal colonnade which is vesicular and broken and has substantial permeability.

5.2 Source Water Protection Area Delineation Methods

A SWPA should be conservative. It should include the surface and associated subsurface areas contributing water to the well. The goal is to provide protection from unexpected contaminant releases so that drinking water standards can be maintained at the well.

There are several criteria that may be used in the delineation of a SWPA. These criteria are physical features or conditions that need to be mapped, measured or calculated. Examples of criteria include time-of-travel (TOT) for ground water from multiple points in the aquifer to reach the well, distance from the well, and ground water flow boundaries. The values selected for these criteria are the thresholds. The selected criteria

and thresholds will dictate the extent of the SWPA. It is recommended that 2-, 5-, and 10-year TOT criteria or equivalent be used to establish SWPAs (although many communities may extend the TOT to 20- or 30- years to coincide with master planning horizons).

The SWPA delineation methods recommended by NDEP include the following:

1. The Arbitrary Fixed Radius Method;
2. The Calculated Fixed Radius Method;
3. The Analytical Method;
4. Hydrogeologic Mapping; and
5. Numerical Flow and Transport Models.

Depending on aquifer type and the availability of aquifer data, Methods 3, 4, 5, or a combination of Methods 2 and 3, may be used for a State endorsed plan. Other methods or combinations of method may be considered, at the discretion of NDEP, where justification is provided to satisfy local hydrogeologic conditions and the needs of the community. It is also required that a conceptual model be submitted to NDEP prior to performing the modeling for a SWPA for state endorsement of the plan. This expedites the State endorsement review process and minimizes comments and inquiries by NDEP when reviewing the draft CSWPP.

5.2.1 Data Selection and Parameter Estimation

For each method, various factors and input parameters may include, but are not limited to:

- Hydraulic Gradient
- Aquifer transmissivity and/or hydraulic conductivity
- Effective porosity
- Aquifer saturated thickness
- Well radius and pumping rate
- Particle time of travel
- Hydrologic boundaries
- Aquifer recharge and leakage
- Aquifer heterogeneity and isotropy

Data selection and parameter estimations for each method should be based upon the best available information. Consultants and professionals who are qualified to perform the various delineation methods in this guidance should already be very familiar with the terms listed above and have a working knowledge of their applications. For reference, the parameters listed above are also included in the glossary at the end of this document.

In addition, documentation of work is standard scientific/professional practice and the delineation work must be documented to ensure that inquiries concerning the delineation can be addressed. Input parameters should all be qualified and explained in the Plan.

For example, the Plan should provide references and sources of hydrogeologic information used, copies of geologic logs for wells, geologic cross sections, or other data that is used to determine the aquifer thickness, pumping rates, effective porosity, hydraulic gradient, ground water flow direction, and hydraulic conductivity. Each of the input parameters should be supported with context for how they were derived and what assumptions were made.

5.2.2 The Arbitrary Fixed Radius Method

The Arbitrary Fixed Radius (AFR) Method uses the criterion of distance to define a circle of a specified radius around a well. The threshold distance, for the radius, should be selected based on typical aquifer and pumping conditions, which would result in a distance corresponding to a reasonable time-of-travel based on practical experience.

The AFR method does not account for variability in hydrologic conditions; therefore, it may under or over predict the SWPA around the well. This method is applied at the State in order to satisfy regulatory requirements, which normally applied a fixed setback distance from a facility or public water supply source. It is implied that the set back distance would allow initial protection from a specific potential source or type of contamination, if an event occurs, until appropriate response measure may take place through technical or other means.

While the use of the AFR Method is not preferred, it may be necessary in some cases and may be applied to satisfy specific setback distance requirements in State regulations.

Sample Approach: Regulations provided in the Nevada Revised Statutes (NRS) offer existing requirements for distancing specific contaminant sources from ground water wells. For example:

- **NAC 445A.66865.2(b) (and NAC 444.792.2)** prohibits locating a public water supply well within 150 feet of a "wastewater force main, wastewater lift station, septic tank or absorption field, or any other source of pollution or contamination".
- **NAC 278.460.2** requires that "a system for absorption of sewage [be] at least 200 feet from any public well.
- **NAC 444.8456.1(a)(8)** prohibits constructing a stationary new or expanding facility for the management of hazardous waste within one mile of an existing well which supplies public drinking water.
- The Bureau of Corrective Action's Secondary Containment Regulations guidance allows exemptions to owners and operators of underground storage tanks located outside 1,000-feet of a public water system or well containing potable water (LCB File No. R005-08).

Additionally, NDEP uses a 3,000-foot fixed radius as a minimum for all SWPAs at the State level in performing vulnerability surveys around existing public water supply wells, consideration in various permitting activities, and contaminant survey requirements for the development of new public drinking water wells funded through NDEP grant and loan programs. These distances can be used to prepare initial source water protection areas on a preliminary basis. Figure 5-6 on the following page is an example AFR method used to delineate SWPAs based upon NRS requirements.

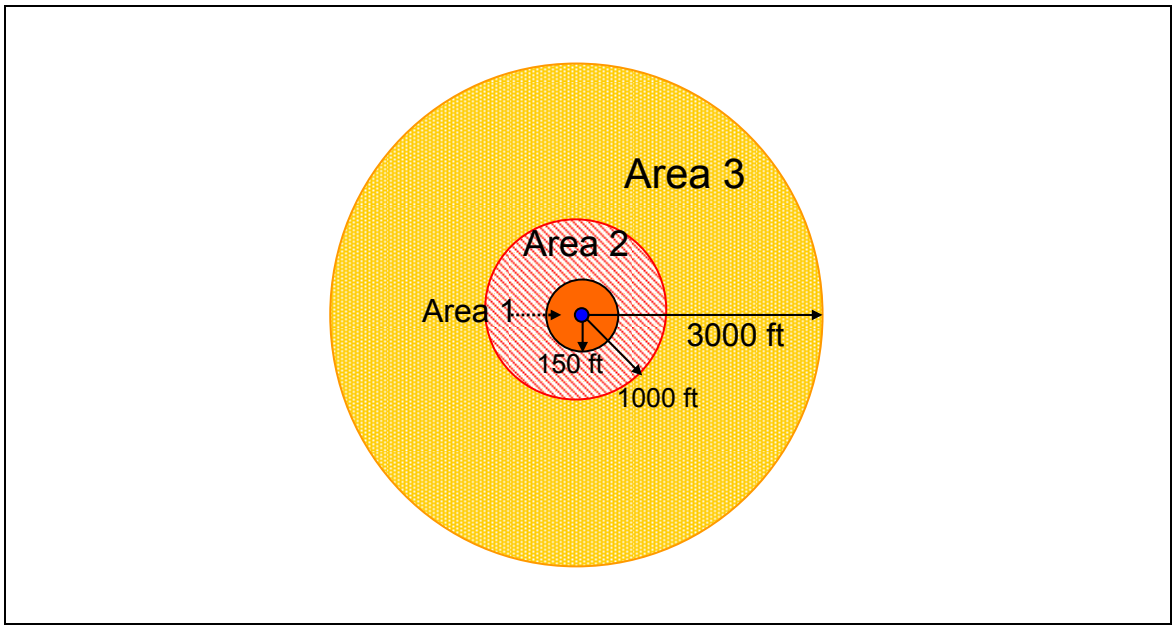


Figure 5-6 Sample Aproach Arbitrary Fixed Radius Method

5.2.3 The Calculated Fixed Radius Method

The Calculated Fixed Radius (CFR) Method uses a specified time of travel threshold to define a radius around a well. A volumetric flow equation is used to calculate the radius of the circle on the ground surface representing the ground water contributing to the well over a period of time.

This mass balance approach calculates a cylindrical volume representing the extent of water flowing to the well within the specified time period. The resulting time related capture zone is represented as a two-dimensional circle plotted on a map with the subject well as its focus.

The following equation is the most commonly used method for a CFR (Refer to Figure 5-7 on the following page):

$$r = \sqrt{\frac{Qt}{\pi nb}}$$

Reference: USEPA, 1987

Where:
r = calculated fixed radius (capture zone in ft) for the specified travel time;
Q = pumping rate of the subject well (ft3/day);
t = travel time to well (days)
π = pi 3.1416
n = aquifer porosity (expressed as a fraction by volume)
b = length of well screen (ft)

The CFR Method is an improvement over the AFR method through taking into account pumping data, some aquifer/well characteristics, and time of travel. It is not recommended for endorsement by the State or as a stand alone method for estimating a SWPA. Under certain conditions however, the CFR Method may be utilized in

conjunction with the Analytical Method described in subsequent sections. Consistent units of measure must be utilized for the CFR equation to generate useful results. The CFR can be calculated either manually or by utilizing WhAEM 2000 (U.S. EPA, 2007). To assist during the review process, the input data, associated sources, and rationale for all assumptions should be presented within the CSWPP.

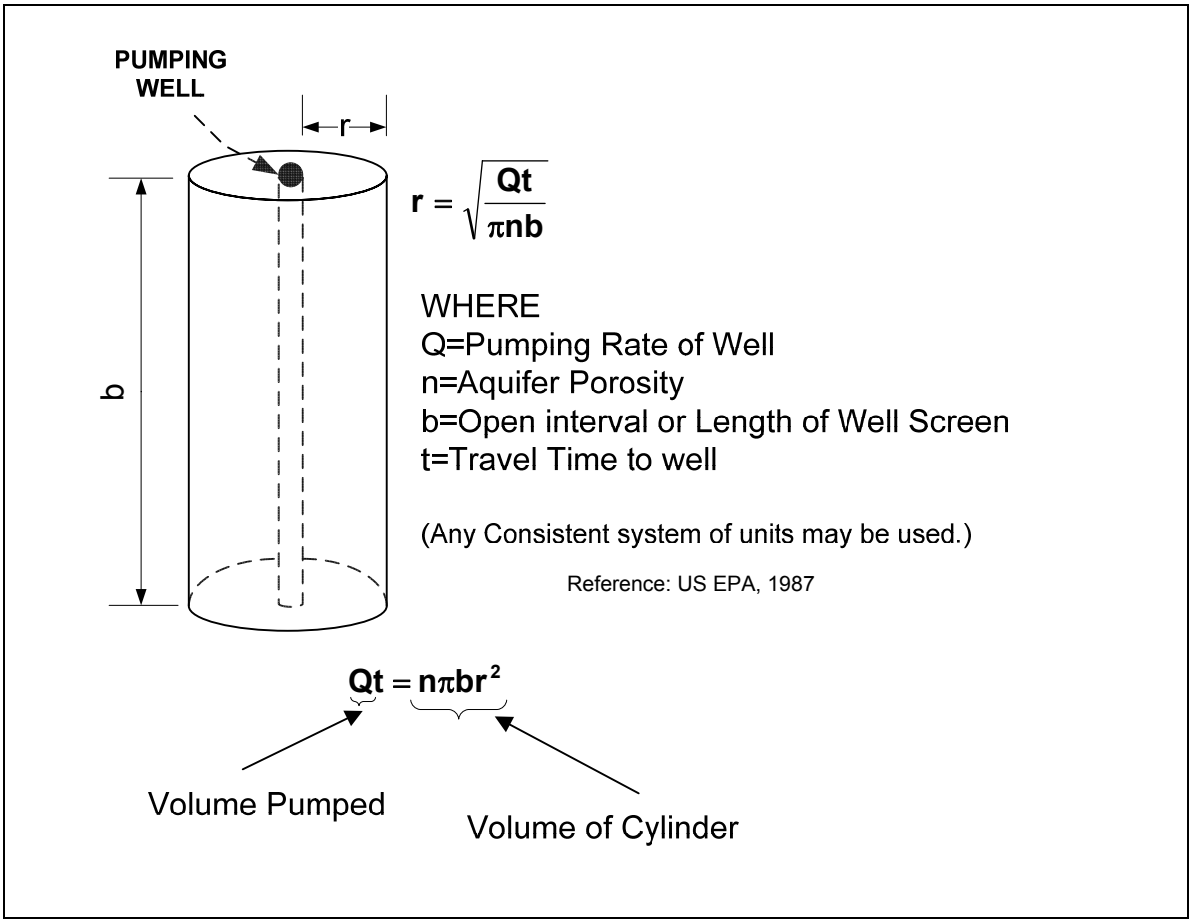


Figure 5-7 SWPA Delineation for a Well Using the CFR Method

5.2.4 The Analytical Method

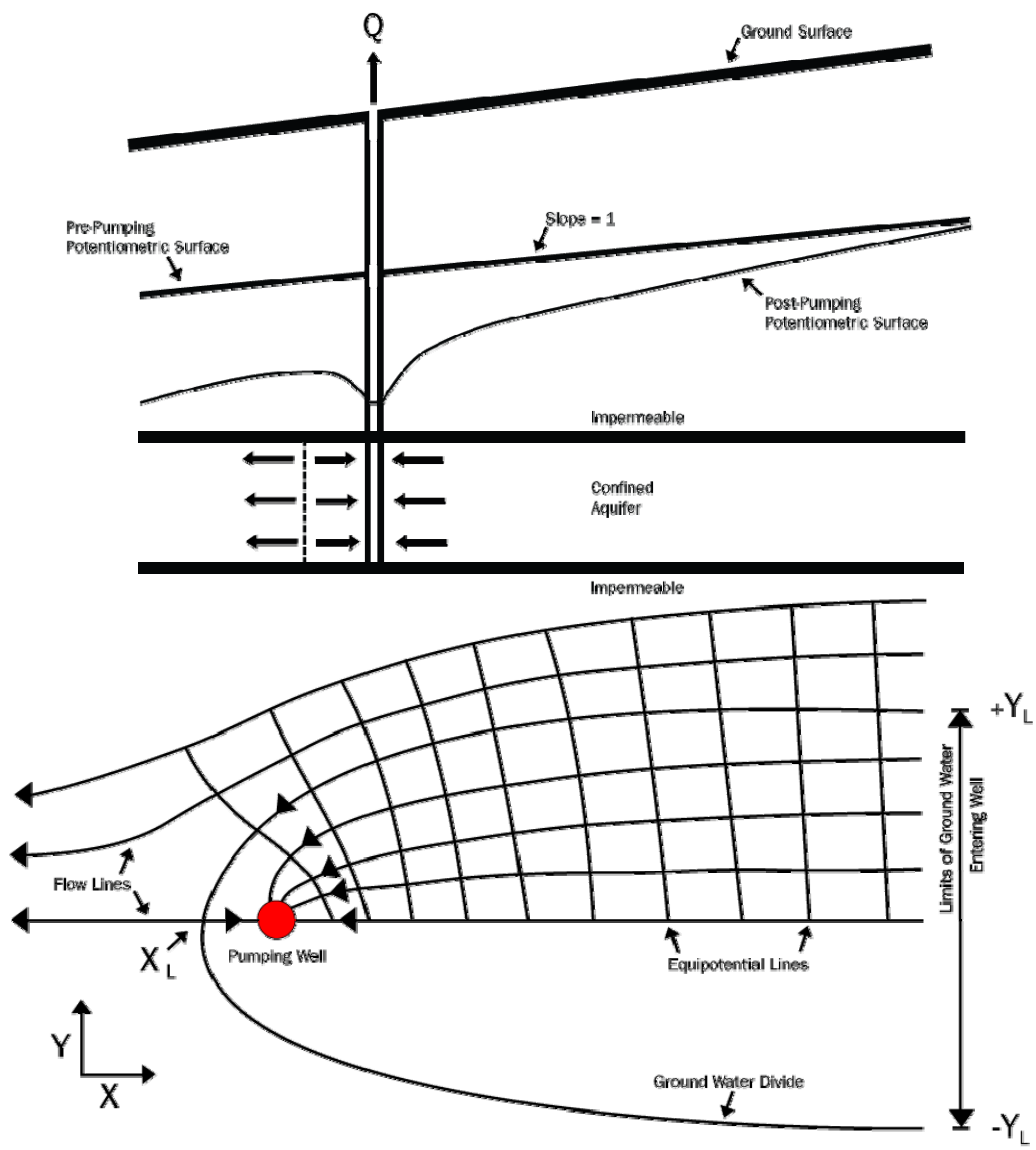
The Analytical Method uses a set of equations to define a steady state capture zone of an infinite time period in unconsolidated and non-fracture flow aquifers where ground water is under a gradient. The equations consider hydrologic conditions for the area around the well, specifically hydraulic conductivity, porosity, hydraulic gradient, saturated thickness and pumping rate. The analytical method calculates the width and down gradient extent of a pumping well's capture zone by utilizing two equations derived from the Uniform Flow Equation. The distance to the up-gradient divide is established as the distance to the up-gradient regional ground water divide.

Basic hydrogeologic analytical equations, such as these, often must be combined with other equations to account for the interactions between ground water, surface water, soil moisture and climate, all of which are necessary components for understanding the full hydrologic cycle. Therefore, the use of this delineation method should be limited to basin-fill systems located in areas free of structural anomalies and surface water bodies.

A graphical representation of the Analytical Method is presented as Figure 5-8 on the following page. Manually calculating ground water flow conditions is no longer common, as the U.S. EPA's computerized ground water modeling platform, WhAEM 2000 (U.S. EPA, 2007), has the uniform flow equation encoded in its RESSQC module. By utilizing WhAEM 2000, a hydrologist can save time and effort, and reduce the potential for calculation and plotting errors, when defining the TOT capture zones.

Sample Approach: Delineated areas can be derived using two- or three-dimensional, ground water/geohydrologic modeling programs. One such program, WhAEM2000 (Wellhead Analytic Element Model, version 3.2.1) is a public domain software that is distributed and supported via the U. S. Environmental Protection Agency (USEPA) Center for Exposure Assessment Modeling (CEAM). Input parameters for these models may include:

- A model base map of the area, generally based on one or more USGS 7.5 Minute Series Topographic Maps;
- Aquifer base elevation (approximated if unknown);
- Aquifer Thickness (if unknown, this can be estimated using the WhAEM guidance information available through EPA);
- Hydraulic conductivity;
- Transmissivity;
- Porosity;
- Hydraulic gradient;
- Direction of ground water flow;
- Well location and wellhead elevation information;
- Well screen opening; and
- Pumping rates (maximum pump capacity).



$$\pm \frac{Y}{X} = \tan\left(\frac{2\pi Kbi}{Q} Y\right)$$

Uniform Flow Equation

$$X_L = \frac{Q}{2\pi Kbi}$$

Distance to Stagnation Point

$$Y_L = \pm \frac{Q}{2Kbi}$$

Lateral Boundary Limit

+ for Y > 0

- for Y < 0

Q = **Well Pumping Rate**
K = **Hydraulic Conductivity**
b = **Saturated Thickness**
I = **Hydraulic Gradient**
π = **3.1416**

Figure 5-8 Analytical Method Description (modified from U.S. EPA)

The input parameters are then entered into the computer modeling program and the output comprises a series of figures that represent various ground water capture zones that may be used as, or in the development of the source water protection areas. It is important to note that analytical models represent the conceptual analysis of local hydrogeology, and may not allow for variations in ground water conditions associated with localized features, such as fracture flow, faults and other flow barriers. Because detailed aquifer characteristic information is often unavailable, a conservative approach is recommended in identifying the final source water protection area. This conservative approach includes, for example, assuming that pumping rates are constant over time, rather than attempting to reduce the pumping rate to account for intermittent pump operation. Figure 5-9 below is an example of 2, 5 and 10 year capture zone delineations produced utilizing WhAEM2000.

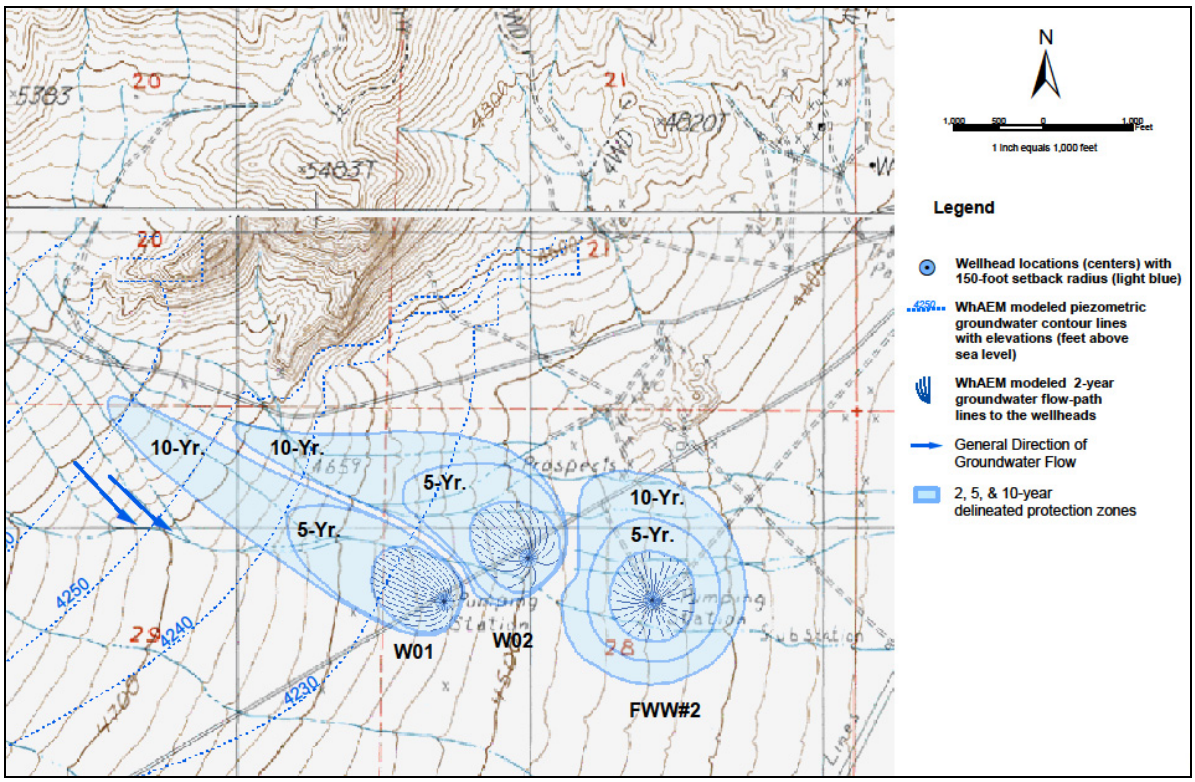


Figure 5-9 Sample SWPA Delineation Approach Using the Analytical Modeling Method (Silver Peak Water System, 2008).

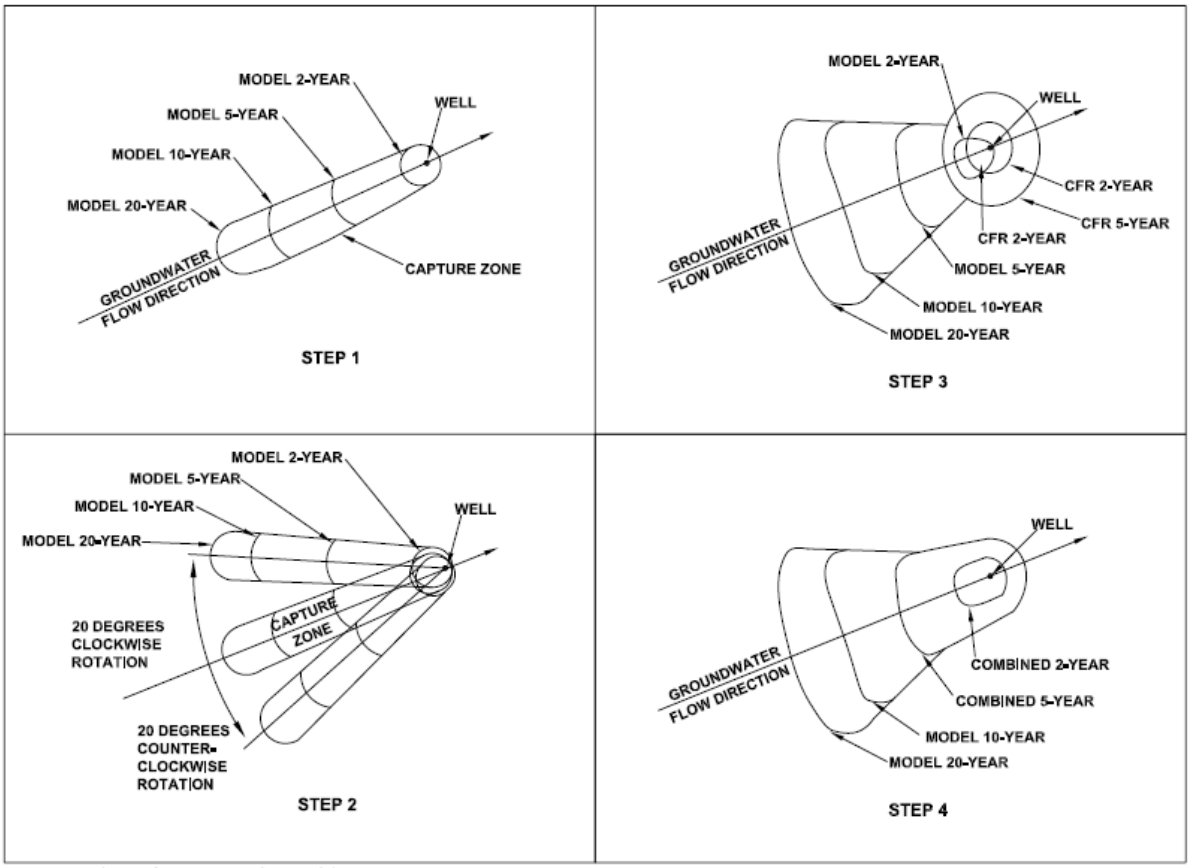
5.2.5 The Combined Analytical Model/CFR Method

Analytical model output shapes may vary depending upon the accuracy and availability of input parameters which can result in long and thin capture zones (commonly referred to as a "pencil" or "cigar" shapes). In situations where the model output creates some uncertainty, a combined modeling method can provide a more conservative delineation.

The Combined Analytical Model/CFR Method has been included in the guidance as an additional delineation option for communities which operate wells set in a basin-fill

alluvial aquifer. This method is available and recommended where single wells or multiple, non-interfering wells are in use and where site-specific aquifer data may not be readily available or where the model output shape may not provide a confident level of protection.

The Combined Method overlays the result of the CFR calculation (defined in Section5.2.3) with the TOT of a two-dimensional ground water flow model utilizing the Analytical Method or a two-dimensional modeling package such as WhAEM 2000. Figure 5-10 below presents the graphical progression of this method.



REFERENCE; MODIFIED FROM NJGS, 2003.

Figure 5-10 Combined Two Dimensional Analytical Model/CFR Method

The following is a description of the process for delineating a SWPA using the Combined Two-Dimensional Model/CFR Method (NJGS, 2003):

Step 1 Enter the input parameters into the selected modeling package; such as WhAEM 2000 (U.S. EPA, 2007). Then run the ground water flow model for the following time intervals; 2-years, 5- years, 10-years and 20-years. The default number of path lines (20) should be adequate for most alluvial wells. Each model run will generate a time of travel capture zone, which should be saved and used as an overlay on the final SWPA maps. The output scale should correspond with the scale of the final SWPA maps. The modeling packages allow for customized scales for the output files.

Step 2 The time of travel capture zones from step 1 should be transferred to the base map

(municipal planning and /or zoning map) as an overlay to the well. To address concerns about thin capture zones and variable ground water gradient directions, the TOT zones shall be rotated both clockwise and counter-clockwise about the well at a 20-degree angle of rotation, then plotted (as shown in Figure 5-10).

Step 3 Calculate the CFR for a 2- and 5-year period as described in Section 5.2.3. The resulting TOT capture zones should then be plotted as an overlay, with the well as the focal point, on the base map.

Step 4 The resulting outer boundary of the combined CFR and model TOT capture zones will then be established as the SWPA, with each time interval defined (See Figure 5-10). Both methods will produce TOT capture zones for the 2-year and 5-year interval. The combined area of these two intervals should be plotted as the final TOT capture zone, along with the 10-year and 20-year TOT capture zones computed by the model.

5.2.6 Hydrogeologic Mapping

Hydrogeologic Mapping is an effective way to visually depict the geology beneath the land surface. Knowing a region's geologic framework is fundamental to understanding the geologic controls on the occurrence and movement of ground water through confined bedrock aquifers, such as those in volcanic and carbonate formations. Hydrogeologic mapping uses flow boundary and TOT travel criteria to define the area contributing water to the well or spring. Geologic, geophysical, and dye tracing techniques may be utilized to define flow boundaries such as ground water divides, impermeable zones and aquifer extent.

Hydrogeologic mapping is a method of gathering and evaluating geological information to create a three-dimensional understanding of the subsurface hydrogeologic conditions. Hydrogeologic mapping is most useful in evaluating bedrock aquifers, such as those in volcanic and carbonate units, which are the primary sources of bedrock springs in Nevada. SWPA delineation methods in bedrock aquifers are presented in a USEPA publication ("Delineation of Wellhead Protection Areas in Fractured Rocks," EPA June 1991b).

Hydrogeologic surface mapping should be combined with geologic cross sections. A three-dimensional picture, or block diagram, of the subsurface can be created when two or more geologic cross-sections are drawn through an area. Geologic cross sections are often used to correlate surface geologic mapping with geologic descriptions obtained from well logs and other data sources. Constructing geologic cross sections allows one to visualize those correlations and interpret subsurface features such as lithologic contacts, faults and other unit thicknesses. Hydrogeologists also use cross sections to understand where ground water occurs, thereby enabling one to make inferences about recharge areas, confining layers, and structural boundaries to ground water flow.

An aquifer's characteristics can vary widely on a regional scale, depending on a number of pre- and post-depositional conditions. It is necessary to first develop an understanding of the regional geologic framework in order to understand the local ground water flow system. Figure 5-11 on the next page is a basic graphic of the SWPA delineation using hydrogeologic mapping.

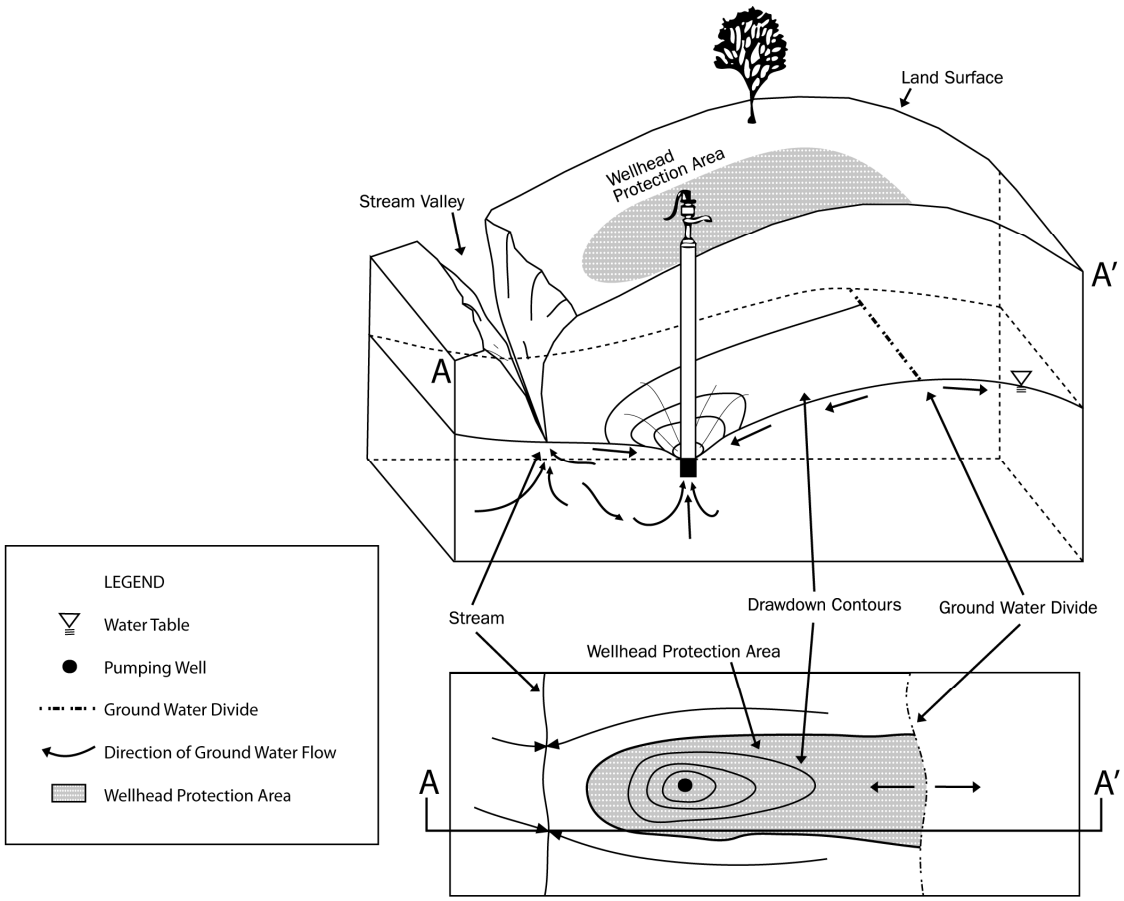


Figure 5-11 SWPA Delineation Using Hydrogeologic Mapping (Modified from U.S. EPA)

Hydrogeologic mapping should involve the interpretation of data from a wide range of sources. Gaps in field data often require that one extrapolate from surrounding data and/or make certain assumptions in order to create a continuous three-dimensional picture of the subsurface geology. It is therefore essential that this step involves a comprehensive data gathering exercise. Common data types include surface geologic maps and cross-sections, aerial photography, spring inventories and hydrographs, ground water elevation studies, surface and subsurface geophysical data, and well-drilling reports.

The most readily available information sources are surface geologic maps and geologic cross-sections. The US Geological Survey and the Bureau of Mines and Geology are good sources for these maps. The goal of this task is to identify rock units at the surface with distinctive physical or hydrologic properties that may be useful in understanding the characteristics of similar units in the subsurface. Additionally, contacts between different rock units, faults and fractures may impact ground water flow, causing spring flows at the surface.

A review of recent and historical aerial photographs can identify surface lineaments, faults and unusual structural and erosion features. Aerial photographs can also show visual trends in the occurrence and flow of springs.

Historical spring hydrographs and ground water elevation studies, when compared with meteorological data, can be very useful for establishing correlations between ground water flow and weather patterns. Spring hydrographic data and ground water elevation studies should exist in areas where springs are utilized as a source for public drinking water.

Geophysical data is another commonly used source of information in hydrogeologic mapping. Geophysical data comes from a number of surface and subsurface techniques that measure physical properties of rock units. The Bureau of Mines and Geology is a good source for geophysical data and its interpretation.

Borehole data is derived from the drilling of water wells, geotechnical borings and environmental testing. Through its webpage, the Nevada Division of Water Resources provides on-line access to well-drilling reports submitted after completion of water supply and test wells. Well report data of particular interest include the lithologic descriptions, the thickness and distribution of water-bearing zones, and results of pumping tests.

More detailed hydrogeologic maps will be expected from water supply systems that operate in complex or multiple aquifer systems, or obtain water from springs. Hydrogeologic mapping is an extremely useful first step towards development of a three-dimensional ground water model or analytical solution.

Sample Approach: Figure 5-12 below is a three dimensional view of the topographic expression of the west slope of Ward Mountain (a recharge area for the McGill Ruth Springs). The figure shows the distinct linear trends of the terraces and the relationship between the southwest trending structures that form Gubler, Pipeline, Blue spring and Holt Creek Canyons. In this example, the presence of impermeable formations has a pronounced effect on the ground water flow and distribution of recharge.

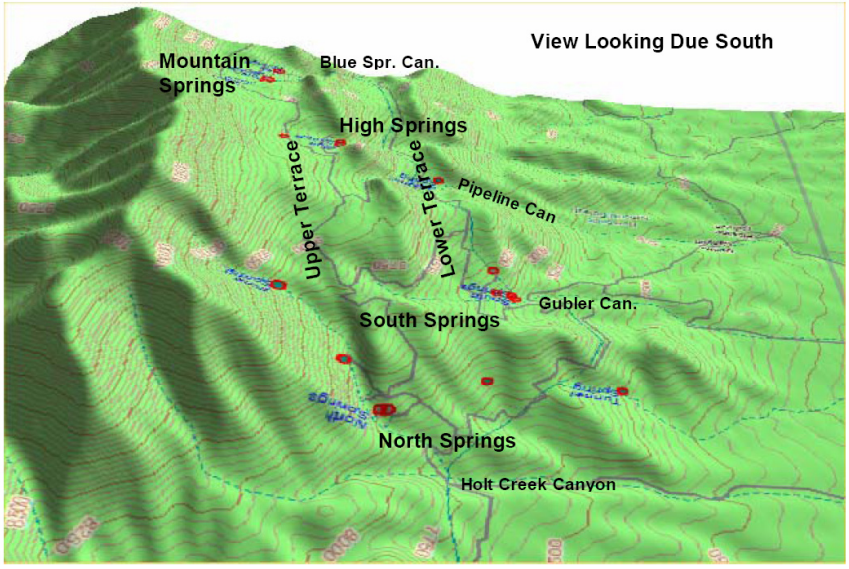
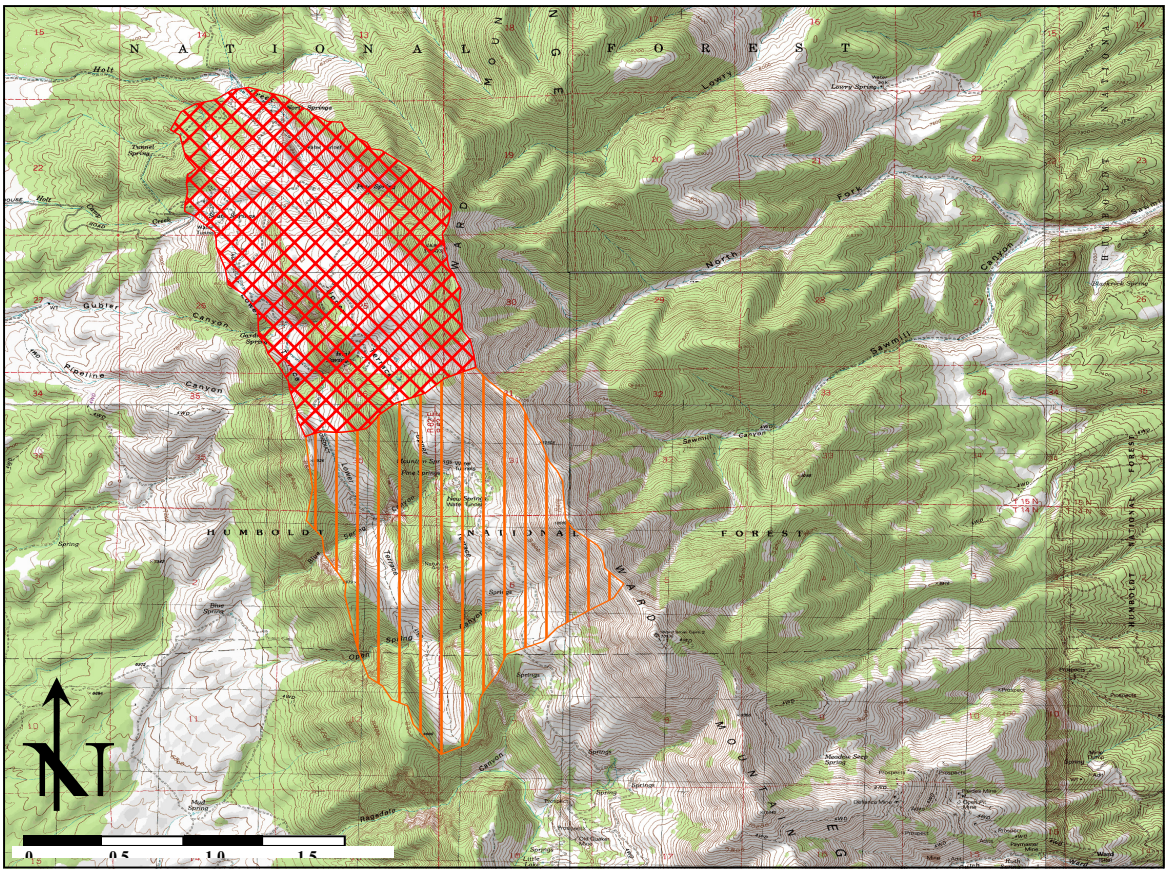


Figure 5-12 Topography for the West Slope of Ward Mountain (McGill Ruth, 2009)

This three dimensional expression of the recharge area and other maps including a depth to water table contour map, panchromatic (black and white) aerial photographs, and a geologic map and cross-section of the Ruth springs area were analyzed and considered with field investigation data, related climate data, aquifer system characterization information, and identified spring area aquitards, etc.

The resulting spring SWPAs are shown in Figure 5-13 on the following page. The designated time of travel or capture zones provide the community with an opportunity to look at what land uses or activities are currently happening within each zone, how they may impact the water supply and ultimately consider what should be done to manage and protect them from becoming contaminated.



ZONE 1 STRINGENT PROTECTION ZONE

ZONE 2 ACTIVE MANAGEMENT ZONE

Figure 5-13 McGill Ruth Springs SWPAs

5.2.7 Numerical Flow and Transport Models

A number of computer programs have been developed to simulate ground water flow and solute transport (e.g., MODFlow, FlowPATH, etc.). This method may be particularly useful in complex hydrogeologic situations, but requires a significant amount of detailed data and technical expertise.

The numerical flow and transport model method refers to a two or three-dimensional, numerical ground water flow simulation package. These models utilize either a finite element or finite difference equation to account for natural and pumping induced ground water flow through an aquifer. There are many numerical flow and transport models available and it is recommended that the selected model has been sufficiently and favorably peer reviewed and/or has been used extensively. Documentation for the selected model should be consulted for examples and sample data sets.

The process for performing a numerical flow and transport model method is outlined below and an example model output image for a 5-year time of travel capture zone is shown in Figure 5-14:

A. The model area should encompass the subject well(s) and extend laterally and vertically to include any significant physical conditions that are likely to impact the aquifer flow. These may include, but are not limited to, recharge areas, hydraulic barriers, constant flow boundaries, zones of high and low permeability, confining layers, faults, sinks, drains, etc. To assist during the review process, the input data, their sources, and rationale for all assumptions should be presented as a list or table within the CSWPP.

B. Grid cells containing pumping wells should be no greater than 100 ft by 100 ft. The thickness of individual model layers should be no greater than 100 ft. Consistency of the grid sizes will improve the mass balance accuracy. A sensitivity analysis and calibration should be performed on the model to show that the simulated results are consistent with field conditions.

C. A particle tracking package should be utilized to calculate the SWPA for a 2-, 5-, 10-, and 20-year TOT simulation.

D. The resulting TOT capture zones should then be plotted as an overlay, with the well as the focal point, to create SWPAs on the appropriate municipal planning and/or zoning map.

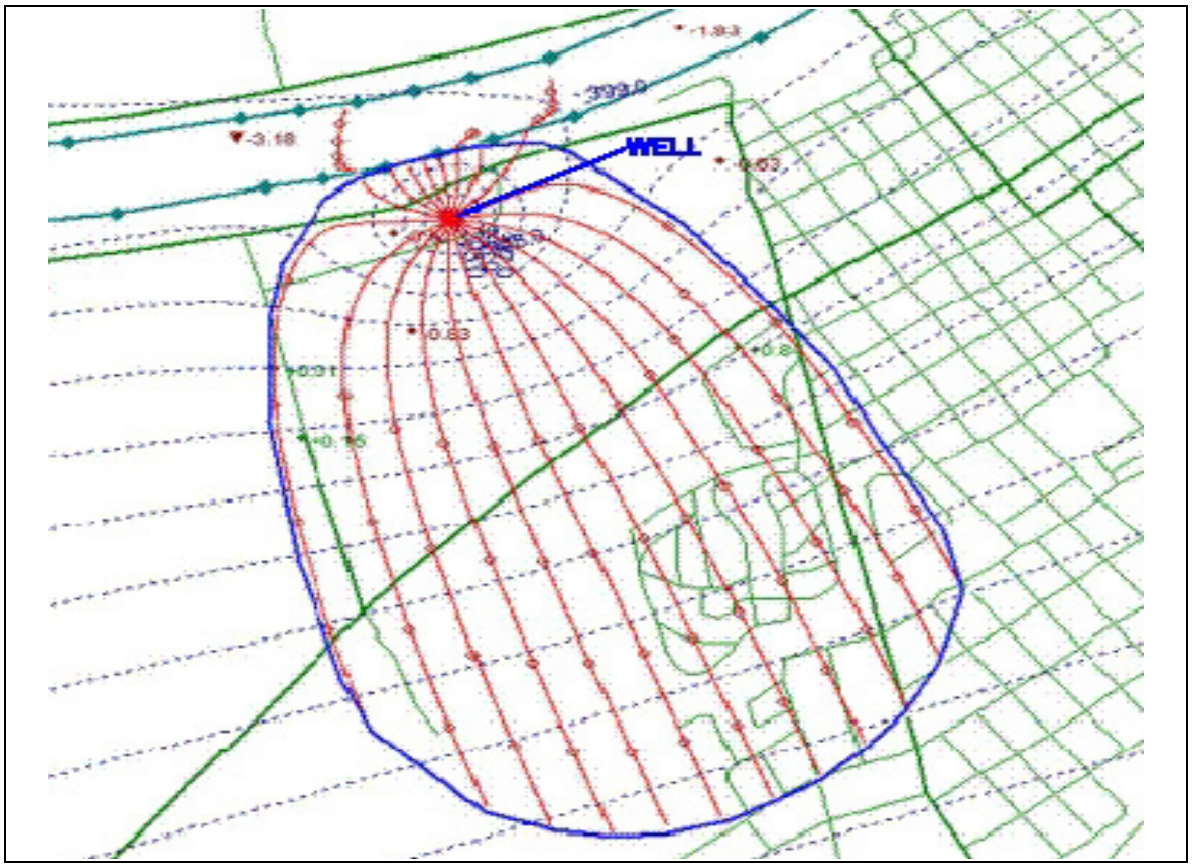


Figure 5-14 Example 5-year Time of Travel Capture Zone Model Output Image

5.3 Selection of a Source Water Protection Area Delineation Method

There are multiple considerations that factor into the decision of which SWPA method to select. An overview of considerations for specific delineation methods are summarized in Table 5-1 on the following page. Selecting a method for delineating a SWPA will be based on the availability of data, the site-specific aquifer characteristics of the study area, level of risk to a water source, resource availability, local community goals, and other factors, such as the cost of the recommended delineation method versus the benefits achieved from use of that method. Each community should select the SWPA delineation method which provides an adequate level of confidence that the community's source water protection goals will be met.

Communities may have certain constraints that must be considered when selecting a SWPA delineation method. These include limited finances, data availability, access to technical expertise, and complexity of the municipal supply and ground water systems. When possible, it is recommended that the most sophisticated method practicable be employed utilizing all available data. In this way, the most realistic and protective SWPA will be delineated.

The criterion, threshold, and method selected for delineating a SWPA must be appropriate for the hydrogeologic conditions. For example, a shallow, unconfined aquifer is highly vulnerable to contamination originating at the ground surface. Therefore, SWPA(s) delineated for wells in this type of aquifer should be larger and more

conservative. In contrast, in a deeper and more confined aquifer, the recharge area should be considered in the delineation. Depending upon the level of confinement in an aquifer, recharge area delineation may become more important.

Once the delineation method has been selected, the delineation criteria and thresholds must be evaluated and decided upon. Thresholds may vary depending on the contingency and management plans of a community. The recommended criterion for SWPA delineation is the time of travel criterion due to its allowance for hydrogeologic variation between sites and flexibility to define multiple areas around a well to manage differentially. NDEP recommends using a minimum 10 year threshold for the time of travel criterion, including 2, 5 and 10 year time of travel analysis for mapping associated capture zones and management strategy development purposes.

Communities will typically have varying needs for resource dedication necessary to address a contamination event that could reach a well in 2 years versus 5 or 10 years. The 2, 5 and 10 year capture zones allow communities to evaluate existing and potential future resource dedication needs for various contaminant response and source development efforts and to determine what activities may be acceptable within each capture zone to allow for the most reasonable level of protection.

In the event there is not sufficient data to perform a delineation based on time of travel criterion, then it is recommended a minimum radius of 3000 feet around the well be used as a temporary delineation until more data becomes available and a more sophisticated method may be used. In situations where the well is screened across multiple aquifers, one of which is an unconfined aquifer, the well should be considered to be in an unconfined aquifer; therefore a more conservative delineation method should be selected.

For confined aquifers, all wells either penetrating or reaching a depth close to the top of the confined aquifer should be surface-sealed or abandoned properly. [State regulations governing the drilling, construction, and plugging of wells are found in Administrative Code (NAC) 534.280 - 534.450. A copy of these regulations is available from the State Division of Water Resources].

In the case of a confined aquifer, the recharge area is often a large distance from the well. Therefore, a hydrogeologic study should be completed to determine the recharge area. The portion of the recharge area contributing water to the wells of interest should be identified. In this recharge area, a potential contaminant source inventory should be conducted, and management of potential threats to the water recharging the drinking water supply should be achieved. Contaminant source inventories and management strategies are discussed in Sections 3 and 4.

Fractured carbonate and bedrock aquifers must be considered differently. Water supplies from fractured rock aquifers may be particularly vulnerable to contamination because of high flow rates typical of fracture flow. Once contaminated, remediation is difficult and often ineffective in fractured rock aquifers. In addition, fracture flow directions and origins are often poorly understood. Currently, it is thought that a combination of hydrogeologic mapping and analytical or numerical methods might be appropriate for SWPA delineation in aquifers dominated by fracture flow. For more information, refer to the EPA technical assistance document entitled "Delineation of Wellhead Protection Areas in Fractured Rocks" (EPA, June 1991).

Table 5-1 Considerations for Selecting a Delineation Method

Delineation Method	Advantages	Disadvantages	Estimated Person-hours/Well	Level of Expertise[1]	Potential Overhead Costs[2]
Arbitrary Fixed Radius (AFR)	Inexpensive, easily implemented & requires little technical expertise.	Not based on hydrogeologic principles and limited information for determining an appropriate threshold radius.	1-5	1	Low
Calculated Fixed Radius (CFR)	Ease of application, low cost, and relatively limited need for technical expertise.	Does not consider all factors influencing contaminant transport which is a concern in regions of geologic complexity where hydrogologic boundaries exist.	1-10	2	Low
Analytical Method (using equations)	Useful in understanding ground water flow networks and contaminant transportation systems. Relatively inexpensive and most extensively used.	Costs may escalate if site-specific hydrogeologic data are not readily available and test holes must be drilled or pump tests performed. Generally, cannot calculate drawdown and do not assimilate geologic heterogeneities and hydrogeologic boundaries.	2-20	3	Medium
Analytical Modeling Method (using a computer model such as WhAEM 2000)	Provides rapid and a fairly precise solution of analytical equations combined with delineation of the zone of contribution. Can be used to model multiple pumping and injection wells and can simulate barrier or stream boundary conditions that exist over the entire aquifer depth.	Costs may escalate if site-specific hydrogeologic data are not readily available and test holes must be drilled or pump tests performed. Limitation of solving only two-dimensional flow problems, danger of hidden errors due to simplicity of operation, and homogeneous and isotropic assumptions.	2-20	3	Medium
Combined Analytical Model & CFR	See advantages for both methods above. Combining methods provides a more conservative delineation where uncertanties or odd shaped model outputs exist and additional data collection is not feasible.	See disadvantages for both methods above.	4-20	3	Medium
Hydrogeologic Mapping	Uses geological, geomorphic, geophysical and dye tracing methods to map flow boundaries and time of travel criteria. Geophysical investigations can determine the aerial extent and thickness of unconfined aquifers. Can be used to delineate conduit Karst aquifers.	Requires expertise in the geological sciences and professional judgment in determining flow boundaries. May prove expensive if little hydrogeologic data exist and field investigations are necessary. Care must be taken if extrapolated data are used.	4-40	3	Medium-High
Numerical Flow & Transport Models	Ability to model aquifers exhibiting complex hydrogeology. Computers can synthesize and manipulate large amounts of analytical data with a high degree of accuracy and predictive modeling techniques can allow the user to determine the system's response to proposed management options.	Requires detailed data and a high level of expertise and is costly.	10-200+	3-4	High

Source: Modified from USEPA, 1993

[1] Level of Expertise assumed to be:

1. Non-technical
2. Junior Hydrogeologist/Geologist
3. Mid-Level Hydrogeologist/Modeler
4. Senior Hydrogeologist/Modeler

[2] Potential Overhead Costs include those for equipment to collect hydrogeologic data, computer hardware and software, and the costs associated wit report preparation. These figures do not reflect the costs for consulting firms potentially engaged in this work.

In some cases, it may be appropriate for a community to protect the entire aquifer from which its drinking water is pumped. For example, a community with many wells distributed throughout a relatively small hydrographic basin would benefit from this approach, termed aquifer protection. A hydrogeologic study must be completed to determine the extent of the aquifer as well as the recharge zones of the aquifer. Even though protective measures will be applied to the whole aquifer, it is suggested that SWPA(s) be delineated and differential management be applied. In addition, more protective management strategies might be implemented in the recharge zones of the aquifer.

Once the SWPA delineations have been completed, modeled outputs and figures for selected methods discussed in this guidance should be included as an overlay on other community base maps used in community planning. For example the output modeled areas could be plotted as an overlay to a community's streets and road map, local land use designation map, parcel map, or other master planning maps where the community will be able to use the map as an effective planning and education tool.

NDEP recommends that individuals tasked with selecting and performing the various delineation methods also reference the State of Nevada Wellhead Protection Area Delineation Recommendations document which can be downloaded from the NDEP Water Pollution Control Website (http://ndep.nv.gov/bwpc/sourcewater.htm) as well as various EPA publications which are also available for download at the USEPA website (http://cfpub.epa.gov/safewater/sourcewater/index.cfm). These additional resources contain more detailed technical and planning information and guidance which may prove useful for various technical professionals.

5.4 State Endorsement Requirements for SWPA Delineation

Nevada communities will be utilizing the delineated SWPA(s) in numerous local planning and management decision making activities. Therefore it is important that all information and data related to how the SWPA(s) are delineated is included in the local Plan. Local planners and decision makers must have confidence that the SWPA(s) can be explained clearly and were developed using the best available information. This document has outlined the importance of documenting assumptions made, sources used in determining aquifer characteristics, explanations for why modeling methods were chosen, and utilizing appropriate criterion and thresholds. Subsequently, all SWPA delineations must meet the following criteria for state endorsement eligibility (Plans that meet state endorsement criteria are also eligible for further assistance in implementing their plans):

1. A review and assessment of the Source Water Assessment Program (SWAP) report must be conducted and pertinent information included in the CSWPP (Plan). The report may be obtained from NDEP Bureau of Safe Drinking Water.

2. A review of all references, well logs, pump test data, and available files (City, State, U.S.G.S. etc.) and include pertinent information and data for the wells, aquifers and springs in the Plan.

3. A conceptual model must be submitted to NDEP for review prior to modeling the SWPA(s).

4. At a minimum, the modular semi-analytical model (WhAEM 2000) or equivalent model must be used to delineate ground water (well) SWPA(s).

5. Aquifer parameters to be used as model inputs must be approved by NDEP and based upon the best available information (i.e. pump test data is the preferred source). Where feasible, NDEP will require a pump test for each general type of subsurface material screened by the water system wells (i.e. basin fill aquifer, carbonate rock aquifer, volcanic rock aquifer). In situations where this option may not be the most cost effective or feasible NDEP will make a determination on a case by case basis.

6. Outline the method, criteria, and thresholds selected in delineating the SWPA(s) and present the rationale for the selection. The final Plan must include maps delineating the SWPA(s). Maps must clearly and accurately depict these features at a scale consistent with community planning maps and digital formats. In the appendix of the Plan, include raw pump test data, field data sheets, and model assumptions and input data.

7. In the text of the Plan, identify the ground water recharge area(s) for the aquifer(s). For spring sources and confined aquifers, delineation of the recharge area may also be required.

8. In the text of the Plan, discuss geologic and hydrogeologic susceptibility to contaminant infiltration in the SWPA(s) and the recharge areas.

9. The Plan must include a poster size print or map of the SWPA(s). Each public water system should display the map in their water system offices and maps must be distributed to community planning agencies as well as NDEP.

It should also be noted that the SWPA(s) may need to be adjusted after the community performs a contaminant source inventory as described in Sections 3 and 4.

5.5 References

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