

Town of Elizabeth

Source Water Protection Plan

Elbert County, Colorado
February 24, 2015



Written by:
Paul Hempel
Colorado Rural Water Association
For the Community Water Provider:
Town of Elizabeth, PWSID#: 0120010

Cover Photo: Town of Elizabeth Welcome Sign, zillo.com

This Source Water Protection Plan for the Town of Elizabeth was developed using the Colorado Rural Water Association's Source Water Protection Plan Template.

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ACRONYMS

BLM	Bureau of Land Management
BMP	Best Management Practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
COGCC	Colorado Oil and Gas Conservation Commission
CRWA	Colorado Rural Water Association
EPA	Environmental Protection Agency
GIS	Geographic Information System
NRCS	Natural Resources Conservation Service
PSOC	Potential Source of Contamination
SDWA	Safe Drinking Water Act
SWAA	Source Water Assessment Area
SWAP	Source Water Assessment and Protection
SWPA	Source Water Protection Area
SWPP	Source Water Protection Plan
TOT	Time of Travel
USDA	United States Department of Agriculture
USFS	United States Forest Service
WFSI	Wildfire Susceptibility Index
WUI	Wildland-Urban-Interface

EXECUTIVE SUMMARY

There is a growing effort in Colorado to protect community drinking water sources from potential contamination. Many communities are taking a proactive approach to preventing the pollution of their drinking water sources by developing a source water protection plan. A source water protection plan identifies a source water protection area, lists potential contaminant sources and outlines Best Management Practices to implement to decrease risks to the water source. Implementation of a source water protection plan provides an additional layer of protection at the local level beyond drinking water regulations.

The Town of Elizabeth values a clean, high quality drinking water supply and decided to work collaboratively with area stakeholders to develop a Source Water Protection Plan. The source water protection planning effort consisted of public planning meetings and individual meetings with water operators, government, and agency representatives during the months of May, 2012 to January, 2015, at Elizabeth Town Hall. During the development of this Plan, a Steering Committee was formed to develop and implement this Source Water Protection Plan. Colorado Rural Water Association was instrumental in this effort by providing technical assistance in the development of this Source Water Protection Plan.

The Town of Elizabeth obtains its municipal drinking water from three groundwater wells, located in the Lower Dawson, Denver and Arapahoe Aquifers, (from shallowest to deepest), respectively. The Town of Elizabeth has also included two irrigation wells near the Elizabeth Middle School in the development of this plan, located in the Lower Dawson and Denver Aquifers, respectively. Further, Town of Elizabeth proactively took into consideration the potential for future surface water sources and their protection during development of this plan. The Source Water Protection Areas for the municipal wells includes a Zone 1A in the immediate area around the wells and a Zone 1 that is a 500 foot radius around the well. Zone 1 for the irrigation/school wells is a .098 square mile area surrounding the school property and adjacent land area. The Source Water Protection Areas are the areas that the Town of Elizabeth has chosen to focus its source water protection measures to reduce source water susceptibility to contamination.

The Steering Committee conducted an inventory of potential contaminant sources and identified other issues of concern within the Source Water Protection Area. Through this process, it was determined that the highest priority potential contaminant sources and/or issues of concern are fertilizers and herbicides on baseball field, integrity of the school wells, future oil and gas development, transportation and roads and both Town and private lift stations. Other noted water quality threats include the bus barn fuel storage tanks, the port-o-john at the baseball fields, below ground fuel storage tanks, domestic and abandoned wells, the sewer line under the Highway 86 Running Creek Bridge and auto repair shops.

The Steering Committee developed several Best Management Practices that may help reduce the risks from the potential contaminant sources and other issues of concern. The Best Management Practices are centered on the themes of building partnerships with community members, businesses, and local decision makers; raising awareness of the value of protecting community drinking water supplies; and empowering local communities to become stewards of their drinking water supplies by taking actions to protect their water sources.

The following list highlights Best Management Practices which pertain to the highest priority potential contaminant sources and other issues of concern.

- Abandoned/private well education and outreach to landowners
- Install concrete bollards to protect irrigation well near baseball field
- Install improved well seal to protect irrigation well near baseball field
- Create a berm to divert storm water runoff to protect irrigation well near baseball field
- Secondary containment of Elizabeth School District bus barn storage tank
- Install source water protection signage throughout source water protection area

The Steering Committee recognizes that the usefulness of this Source Water Protection Plan lies in its implementation and will begin to execute these Best Management Practices upon completion of this Plan.

This Plan is a living document that is meant to be updated to address any changes that will inevitably come. The Steering Committee will review this Plan at a frequency of once every 3-5 years or if circumstances change resulting in the development of new water sources and source water protection areas, or if new risks are identified.

INTRODUCTION

Town of Elizabeth operates a community water supply system that supplies drinking water to 1500 residents located within Elbert County, Colorado. The Town of Elizabeth obtains its municipal drinking water from three groundwater wells, located in the Lower Dawson, Denver and Arapahoe Aquifers, (from shallowest to deepest), respectively. The Town of Elizabeth has also included two irrigation wells, which the Town owns but leases to the school district, near the Elizabeth Middle School in the development of this plan, located in the Lower Dawson and Denver Aquifers, respectively. Further, the Town of Elizabeth proactively took into consideration the potential for future surface water sources and their protection during development of this plan. The Town of Elizabeth recognizes the potential for contamination of the source of their drinking water, and realizes that it is necessary to develop a protection plan to prevent the contamination of this valuable resource. Proactive planning and implementing contamination prevention strategies are essential to protect the long-term integrity of their water supply and to limit their costs and liabilities.¹

Table 1: Primary Contact Information for Town of Elizabeth

PWSID	PWS Name	Name	Title	Address	Phone	Website
CO0120010	Town of Elizabeth	Dick Eason	Town Administrator	PO Box 159 Elizabeth, CO 80107	303- 646-4166	townofelizabeth.org

Purpose of the Source Water Protection Plan

The Source Water Protection Plan (SWPP) is a tool for Town of Elizabeth to ensure clean and high quality drinking water sources for current and future generations. This Source Water Protection Plan is designed to:

- Create an awareness of the community's drinking water sources and the potential risks to surface water and/or groundwater quality within the watershed;
- Encourage education and voluntary solutions to alleviate pollution risks;
- Promote management practices to protect and enhance the drinking water supply;
- Provide for a comprehensive action plan in case of an emergency that threatens or disrupts the community water supply.

Developing and implementing source water protection measures at the local level (i.e. county and municipal) will complement existing regulatory protection measures implemented at the state and federal governmental levels by filling protection gaps that can only be addressed at the local level.

¹ The information contained in this Plan is limited to that available from public records and the Town of Elizabeth at the time that the Plan was written. Other potential contaminant sites or threats to the water supply may exist in the Source Water Protection Area that are not identified in this Plan. Furthermore, identification of a site as a "potential contaminant site" should not be interpreted as one that will necessarily cause contamination of the water supply.

Protection Plan Development

The Colorado Rural Water Association's (CRWA) Source Water Protection Specialist, Paul Hempel, helped facilitate the source water protection planning process. The goal of the CRWA's Source Water Protection Program is to assist rural and small communities served by public water systems to reduce or eliminate the potential risks to drinking water supplies through the development of Source Water Protection Plans, and provide assistance for the implementation of prevention measures.

The source water protection planning effort consisted of a series of public planning meetings and individual meetings. Information discussed at the meetings helped the Town of Elizabeth develop an understanding of the issues affecting source water protection for the community. The Steering Committee then made recommendations for management approaches to be incorporated into the Source Water Protection Plan. In addition to the planning meetings, data and other information pertaining to Source Water Protection Area was gathered via public documents, internet research, phone calls, emails, and field trips to the protection area. A summary of the meetings is represented below.

Table 2: Planning Meetings

Date	Purpose of Meeting
May 22, 2012	First Stakeholder Meeting - Presentation on the process of developing a Source Water Protection Plan for the Town of Elizabeth. Review of the State's Source Water Assessment for Town of Elizabeth.
March 10, 2014	Second Stakeholder Meeting – Additional presentation on the process of developing a Source Water Protection Plan for the Town of Elizabeth. Review of the State's Source Water Assessment for Town of Elizabeth.
May 7, 2014	Steering Committee Meeting – Delineation of source water protection areas.
August 13, 2014	Steering Committee Meeting – Confirm delineation of source water protection areas, potential sources of contamination discussion.
October 29, 2014	Steering Committee Meeting – Potential sources of contamination discussion.
November 10, 2014	Steering Committee Meeting – Prioritization of potential contaminant sources.
December 8, 2014	Steering Committee Meeting – Best Management Practices (BMP) discussion.
January 5, 2015	Steering Committee Meeting – Final plan review and timeline for BMP's.

Stakeholder Participation in the Planning Process

Local stakeholder participation is vitally important to the overall success of Colorado's Source Water Assessment and Protection (SWAP) program. Source water protection was founded on the concept that informed citizens, equipped with fundamental knowledge about their drinking water source and the threats to it, will be the most effective advocates for protecting this valuable resource. Local support and acceptance of the Source Water Protection Plan is more likely where local stakeholders have actively participated in the development of their Protection Plan.

Town of Elizabeth's source water protection planning process attracted interest and participation from 41 stakeholders including local citizens and landowners, private businesses, water operators, local and county

governments, and agency representatives. During the months of May 2012, through January, 2015, two stakeholder meetings and six steering committee meetings were held at the Elizabeth Town Hall to encourage local stakeholder participation in the planning process. Input from these participants was greatly appreciated.

Steering Committee

During the development of this Plan, a volunteer Steering Committee was formed from the stakeholder group to develop and implement this Source Water Protection Plan. Specifically, the Steering Committee's role in the source water protection planning process was to advise the Town of Elizabeth in the identification and prioritization of potential contaminant sources as well as management approaches that can be voluntarily implemented to reduce the risks of potential contamination of the untreated source water. All members attended at least one Steering Committee meeting and contributed to planning efforts from their areas of experience and expertise. Their representation provided diversity and led to a thorough Source Water Protection Plan. Town of Elizabeth and the Colorado Rural Water Association are very appreciative of the participation and expert input from the following participants.

Table 3: Stakeholders and Steering Committee Members

Stakeholder	Title	Affiliation	Steering Committee Member
Dick Eason	Town Administrator	Town of Elizabeth	X
Michael Gibbs	Public Works Director	Town of Elizabeth	X
Rachel Hodgson	Community Development	Town of Elizabeth	X
Brandon Lenderink	Office of Emergency Management	Elbert County	X
Jane Penley	District Manager	Kiowa Conservation District	X
Susan Shick	Landowner	County Resident	X
Eric Saenger	Senior Hydrogeologist/Geologist	HRS Water Consultants, Inc.	X
Eric Harmon	Principal Geophysicist & Hydrogeologist	HRS Water Consultants, Inc.	
Will Koger	Managing Engineer	Forsgren Associates	
Bob Hastings	Board of Directors	Colorado Rural Water Association	
H Clay Hurst	Mayor	Town of Elizabeth	
Diana Robins	Mayor Pro Tem	Town of Elizabeth	
Angela Ternus	Former Trustee	Town of Elizabeth	
June Jurczewsky	Board of Trustees	Town of Elizabeth	
Karl Hatfield	Former Trustee	Town of Elizabeth	
Rachel White	Board of Trustees	Town of Elizabeth	
Cynthia Nunnalee	Former Trustee	Town of Elizabeth	
Steve Gaither	Board of Trustees	Town of Elizabeth	
Sandy Tweedy	Finance Director	Town of Elizabeth	

Paul Whalen	Former Town Planner	Town of Elizabeth	
Bill Pharo	Former Planning Commission	Town of Elizabeth	
TJ Steck	Fire Chief	Town of Elizabeth	
Chris La May	Former Town Administrator	Town of Elizabeth	
Trudy Peterson	Former Town Administrator	Town of Elizabeth	
Michael Phibbs	Former Chief of Police	Town of Elizabeth	
Stacy Yarrington	Former Community Development	Town of Elizabeth	
Robert Rowland	County Commissioner	Elbert County	
Valerie Whitmarsh	Landowner	Elbert County	
Wendy Pearce	Landowner	Elbert County	
Kathleen Potter	Landowner	Elbert County	
Ken Peter	Board of Trustees	Town of Elizabeth	
Scott Hall	Landowner	Elbert County	
Chris Kuna	Landowner	Town of Elizabeth	
Richard Kuna	Board of Trustees	Town of Elizabeth	
Bob Ware	Landowner	Elbert County	
Rob Anderson	Senior Project Manager	Hatch Mott MacDonald	
Serena Carter	Former Town Clerk	Town of Elizabeth	
Corey Hoffman	Town Attorney	Town of Elizabeth	
Rene Gullickson	Landowner	Elbert County	
David Davis	Boy Scout	Troop 332	
James Christensen	Boy Scout	Troop 332	

Development and Implementation Grant

Town of Elizabeth has been awarded a \$5,000 Development and Implementation Grant from the Colorado Department of Public Health and Environment (CDPHE). This funding is available to public water systems and representative stakeholders committed to developing and implementing a source water protection plan. A one to one financial match (cash or in-kind) is required. Town of Elizabeth was approved for this grant in February, 2011, and it expires on April 1, 2015. 100% of the funds will be used for the implementation of Best Management Practices.

WATER SUPPLY SETTING

Location and Description

Town of Elizabeth, CO is a rural town, covering an area of 0.9 square miles, and is located in Elbert County on the northern edge of the Black Forest approximately 14 miles east of US Interstate 25. Primary access to the Town is through Colorado State Highway 86. The 2000 census reported a population of 1,434 people, 496 households, and 380 families residing in the Town. Future projections by Town of Elizabeth estimate that growth will level off over the next ten years.

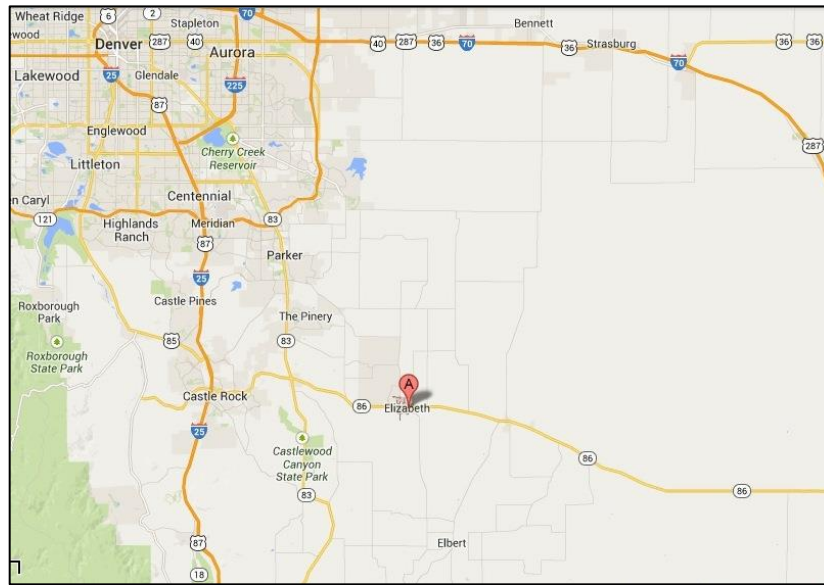


Figure 1: General Location of Elizabeth

Source: Google Maps

The majority of the Town of Elizabeth's source waters lie within the town boundaries. Private land ownership includes unincorporated areas of Elbert County where land use on private land consists of small scale agricultural and rural residential development.



Figure 2: Land Ownership Surrounding Elizabeth

Source: NRCS Rapid Watershed Assessments

According to records of the area the first settler was a man named Peter I. Van Wormer in 1859 on Running Creek, which today runs through Elizabeth. Following him on his journey was pioneer and trapper Justin Marlow. Aside from Marlow, others followed establishing small ranches in the area that was then forested with ponderosa pines in an open glade like growth habit suitable for both ranching and timber operations. The Elbert County History (ISBN 0-88107-128-5 edited by Margee Gabehart) is not clear on when exactly the mill that eventually caused the formation of the town of Elizabeth was set up. It was apparently on the far north end of the land belonging to Thomas Phillips (who settled in the area in 1865) and to the east of the creek to provide water to the steam engine. This first mill was wiped out in a flood and thereafter was reestablished by Alden Bassatt on the west side of the creek near what is today Main Street in Elizabeth. Thereafter it was sold to the Weber brothers of Kansas and became known as the Weber Mill. P.P. Gomer set up another mill operation in 1860 or 1861 to the north of the Weber operation on Leroy Evans' Ranch.

The workers settled near the Weber Mill and a community started to grow with the first three blocks being given by Charles Garland and Thomas Phillips in 1880. The Denver and New Orleans Railroad, which was started by Governor Evans among others, in 1881, arrived in the nascent town by May 1881. With trains eventually going through six times daily the town grew much faster than the other nearby settlements and Thomas Phillips applied for a town plot on June 19 of 1882.

The D&NO went through many changes, becoming the Denver, Texas, and Fort Worth and being purchased by the Colorado and Southern. The Memorial Day flood of 1935 speeded up a process of service being discontinued and track pulled out that started in 1913 along some parts of the line. Service to Elizabeth continued until 1936 when the Castlewood Canyon Dam broke destroying the track northwest of Parker, Colorado. The remaining track between Parker and Elizabeth was removed by 1937.

The town revived due to the usual Colorado pattern of artists and freethinkers moving to small towns in the late 1960s through the 1970s. By the 1980s many new residents were arriving as the town became a bedroom community for the Denver metro area with the area around Elizabeth becoming the most populous part of the county. Though few live in the town itself more than half of county residents use an Elizabeth address.

Physical Characteristics

Elizabeth is located at latitude 39° 21' 36" N, longitude 104° 36' 0" W. The topography of the area is rolling hills, at an elevation of 6,476 feet above sea level.

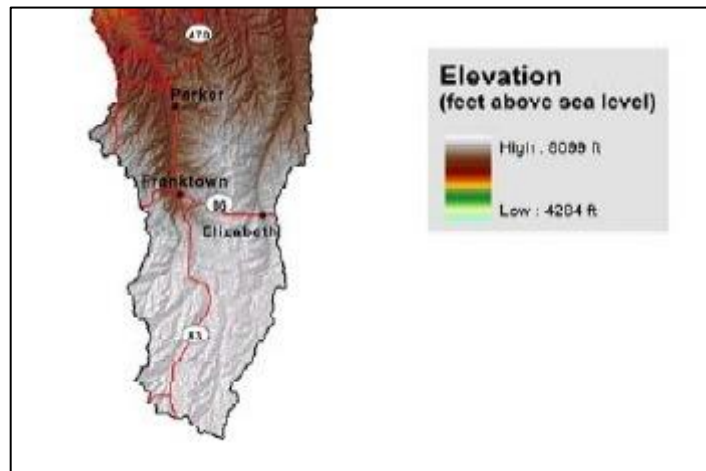


Figure 3: Elevation Surrounding Elizabeth Source: NRCS Rapid Watershed Assessments

The climate in Elizabeth is semi-arid. The precipitation generally is low to moderate with an estimated average annual precipitation range of 12 -18 inches. The heaviest rains fall during May, June, and July, the months that constitute the principal growing season. The July high average is 85 degrees Fahrenheit and the January low average is 18 degrees Fahrenheit. The average snowfall ranges from 20 inches to 49 inches. (Source: weatherchannel.com)

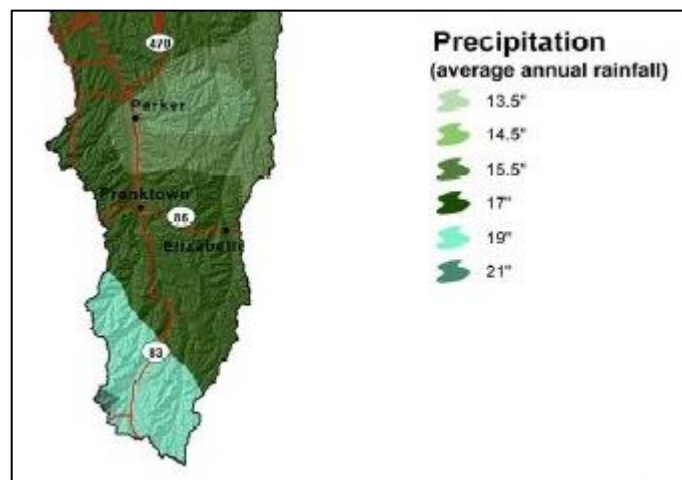


Figure 4: Precipitation in the Area Surrounding Elizabeth Source: NRCS Rapid Watershed Assessments

Hydrologic Setting

Town of Elizabeth obtains its drinking water from three wells. The source water overlies the Denver, Lower Dawson and Arapahoe Aquifers. Historically, water yields from these aquifers range from 50 to 150 gallons per minute.

The Town of Elizabeth has not petitioned the Water Quality Control Commission for the establishment of a classified ground water area and associated site-specific ground water quality standards for its ground water intakes.

Groundwater Protection

Groundwater protection is managed as two separate issues of quantity and quality in Colorado. Quantity issues are managed through the Colorado Division of Water Resources/Office of the State Engineer. The Division of Water Resources administers and enforces all surface and groundwater rights throughout the State of Colorado, issues water well permits, approves construction and repair of dams, and enforces interstate compacts. The Division of Water Resources is also the agency responsible for implementing and enforcing the statutes of the Groundwater Management Act passed by the Legislature as well as implementing applicable rules and policies adopted by the Colorado Groundwater Commission and the State Board of Examiners of Water Well Construction and Pump Installation Contractors. (Source: GWPC, 2008)

The CDPHE's Colorado Water Quality Control Commission is responsible for promulgating groundwater and surface water classifications and standards. Colorado's Water Quality Control Commission has established basic standards for groundwater regulations that apply a framework for groundwater classifications and water quality standards for all waters within their jurisdictions. Standards are designed to protect the associated classified uses of water for a designated use. The groundwater classifications are applied to groundwaters within a specified area based upon use, quality and other information as indicated in the CDPHE Water Quality Control Commission's Regulation No. 41, "The Basic Standards for Ground Water." Statewide standards have been adopted for organic chemicals and radionuclides. Significant areas of the state have been classified for site specific use classification and the remainder of the state's groundwater is protected by interim narrative standards.

Classifications and standards are implemented by seven separate state agencies through their rules and regulations for activities that they regulate. Regulated activities include mining and reclamation, oil and gas production, petroleum storage tanks, agriculture, Superfund sites, hazardous waste generation and disposal, solid waste disposal, industrial and domestic wastewater discharges, well construction and pump installation, and water transfers.

Colorado has proactive groundwater protection programs that include monitoring groundwater for agricultural chemicals and pesticides, issuing groundwater discharge permits; voluntary cleanup program, permitting for large hog farm operations, and educational programs. In addition, water wells must have a permit and meet minimum standards of construction and pump installation.

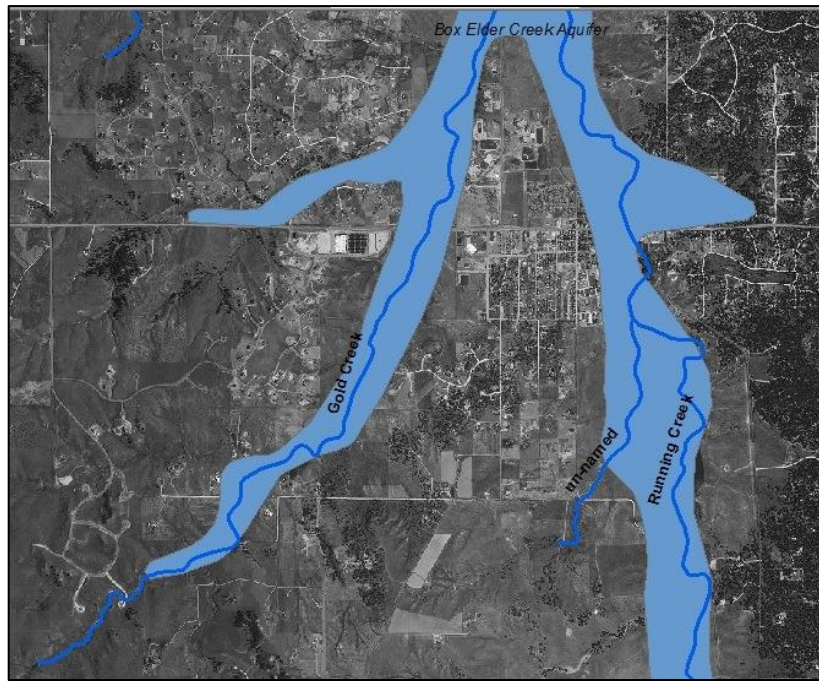


Figure 5: The Alluvial Aquifer and Surface Water in the Area Surrounding Elizabeth
Source: CRWA

Drinking Water Supply Operations

Water Supply and Infrastructure

Town of Elizabeth's source water supply comes from three groundwater sources. These water sources are located in the Southwest portion of Elbert County. The raw water diverted from the water sources is sent to a treatment system. The treatment system has a maximum capacity to treat 720,000 gallons of drinking water per day. The water system stores its treated water in three storage tanks prior to distributing the drinking water to the water system's customers.

Table 4: Groundwater Supply Information

Water System Facility Name	Water System Facility Number	Total Depth of Well (ft.)	Depth of Plain Casing (ft.)	Depth of Perforation (ft.)	Yield (gpm)	Year Drilled	Permit Number	Annual Permitted Amount (acre feet)
Lower Dawson Well	CO0120010-001	526	310	310 to 506 (multiple intervals screened)	80	2009	15617-F	50
Denver Well	CO0120010-002	1591	230	230 to 1581 (multiple intervals screened)	150	2012	46210-FR	150
Arapahoe Well	CO0120010-003	2149	1729 & 2110 to 2130	1729 to 2110 (multiple intervals screened)	400	1995	44454-F	132

Irrigation Well 1 Lower Dawson	CO0120010	564	301	301 - 564	80	1977	75162-F	21
Irrigation Well 2 Denver	CO0120010	1010	710 & 980 to 1010	710 - 980	150	1995	52511-FR	39.7

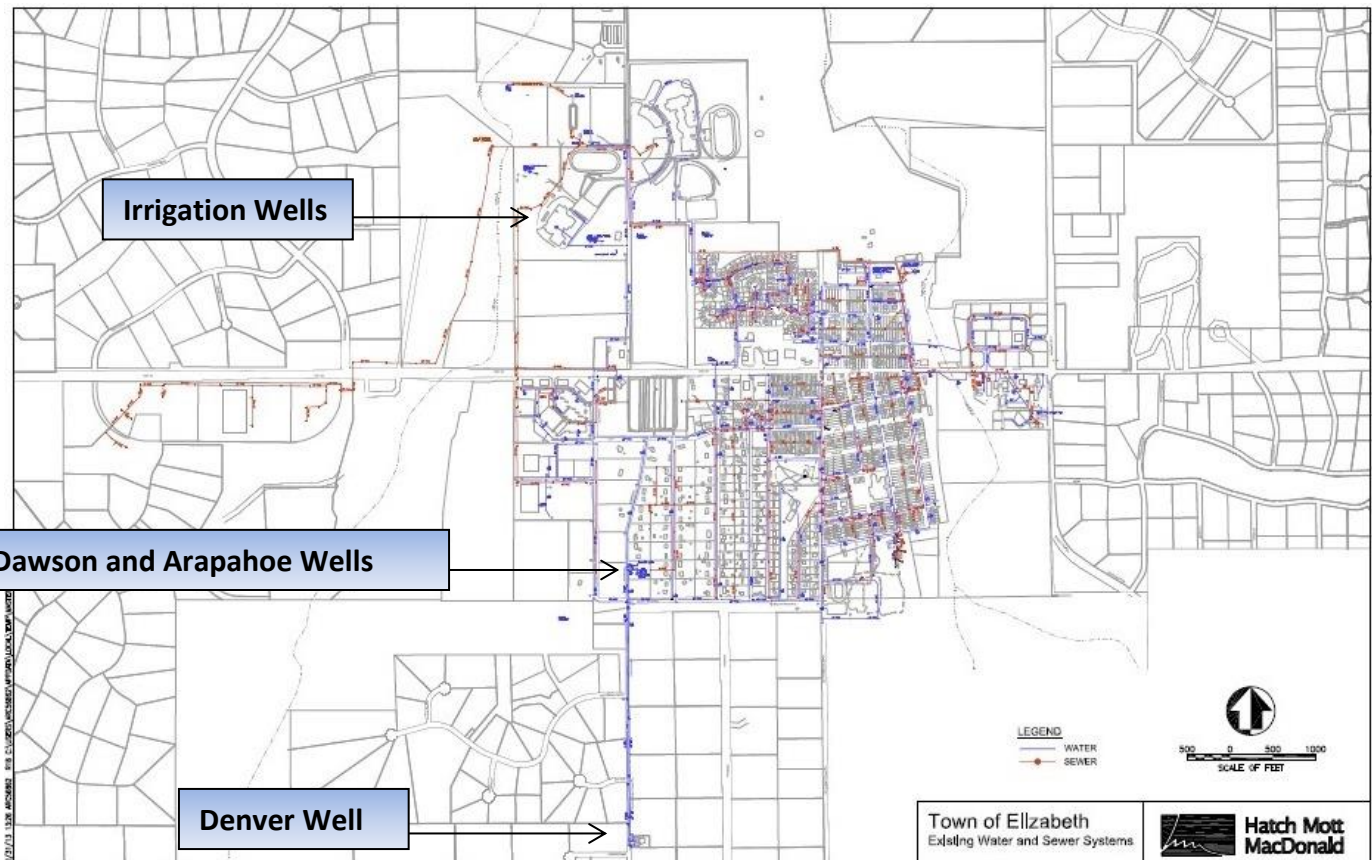


Figure 6: Water System Process Schematic

Source: Town of Elizabeth

Water Supply Demand Analysis

Town of Elizabeth serves an estimated 586 connections and approximately 1500 residents and other users in the service area annually. The water system currently has the capacity to produce 720,000 gallons per day. Current estimates by the water system indicate that the average daily demand is approximately 150,000 gallons per day, and that the average peak daily demand is approximately 175,000 gallons per day. Using these estimates, the water system has a surplus average daily demand capacity of 570,000 gallons per day and a surplus average peak daily demand capacity of 545,000 gallons per day.

Using the surplus estimates above, Town of Elizabeth has evaluated its ability to meet the average daily demand and the average peak daily demand of its customers in the event the water supply from one or more of its water sources becomes disabled for an extended period of time due to potential contamination. The

evaluation indicated that Town of Elizabeth may not be able to meet the average daily demand of its customers if as few as two of the water sources became disabled for an extended period of time. The evaluation also indicated that Town of Elizabeth may not be able to meet the average peak daily demand of its customers if as few as two of the water sources became disabled for an extended period of time. The ability of Town of Elizabeth to meet either of these demands for an extended period of time is also affected by the amount of treated water the water system has in storage at the time a water source(s) becomes disabled.

Town of Elizabeth recognizes that potential contamination of its ground water source(s) could potentially result in having to treat the ground water and/or abandon the water source if treatment proves to be ineffective or too costly. To understand the potential financial costs associated with such an accident, Town of Elizabeth evaluated what it might cost to replace one of its water sources (i.e., replacement of the intake structure and the associated infrastructure) if this occurs. The evaluation did not attempt to estimate treatment costs, which can be variable depending on the type of contaminant(s) that need(s) to be treated. The evaluation indicated that it could cost \$800,000 in today's dollars to replace one of its water sources.

The potential financial and water supply risks related to the long-term disablement of one or more of the community's water sources are a concern to the Steering Committee. As a result, the Steering Committee believes the development and implementation of a source water protection plan for Town of Elizabeth can help to reduce the risks posed by potential contamination of its water source(s). Additionally, Town of Elizabeth has developed an Emergency Response Plan (Appendix A) to coordinate rapid and effective response to any emergency incident that threatens or disrupts the community water supply.

OVERVIEW OF COLORADO'S SWAP PROGRAM

Source water assessment and protection came into existence in 1996 as a result of Congressional reauthorization and amendment of the Safe Drinking Water Act. The 1996 amendments required each state to develop a source water assessment and protection (SWAP) program. The Water Quality Control Division, an agency of the Colorado Department of Public Health and Environment (CDPHE), assumed the responsibility of developing Colorado's SWAP program. The SWAP program protection plan is integrated with the Colorado Wellhead Protection Program that was established in amendments made to the federal Safe Drinking Water Act (SDWA, Section 1428) in 1986.

Colorado's SWAP program is an iterative, two-phased process designed to assist public water systems in preventing potential contamination of their untreated drinking water supplies. The two phases include the Assessment Phase and the Protection Phase as depicted in the upper and lower portions of Figure 7, respectively.



Figure 7: Source Water Assessment and Protection Phases

Source Water Assessment Phase

The Assessment Phase for all public water systems consists of four primary elements:

1. Delineating the source water assessment area for each of the drinking water sources;
2. Conducting a contaminant source inventory to identify potential sources of contamination within each of the source water assessment areas;

3. Conducting a susceptibility analysis to determine the potential susceptibility of each public drinking water source to the different sources of contamination;
4. Reporting the results of the source water assessment to the public water systems and the general public.

The Assessment Phase involves understanding where Town of Elizabeth's source water comes from, what contaminant sources potentially threaten the water sources, and how susceptible each water source is to potential contamination. The susceptibility of an individual water source is analyzed by examining the properties of its physical setting and potential contaminant source threats. The resulting analysis calculations are used to report an estimate of how susceptible each water source is to potential contamination. A Source Water Assessment Report was provided to each public water system in Colorado in 2004 that outlines the results of this Assessment Phase. The Source Water Assessment Report provides a screening-level evaluation of potential contamination that could occur. It does not mean that the contamination has or will occur.

Town of Elizabeth will use the information generated in the report to evaluate the need to improve current water treatment capabilities and prepare for future contamination threats. This can help Town of Elizabeth ensure that quality finished water is delivered to customers. In addition, the Source Water Assessment Report acted as a starting point for developing this Source Water Protection Plan.

Source Water Protection Phase

The Protection Phase is a voluntary, ongoing process in which all public water systems have been encouraged to voluntarily employ preventative measures to protect their water supply from the potential sources of contamination to which it may be most susceptible. The Protection Phase can be used to take action to avoid unnecessary treatment or replacement costs associated with potential contamination of the untreated water supply. Source water protection begins when local decision-makers use the source water assessment results and other pertinent information as a starting point to develop a protection plan. As depicted in the lower portion of Figure 7, the source water protection phase for all public water systems consists of four primary elements:

1. Involving local stakeholders in the planning process;
2. Developing a comprehensive protection plan for all of their drinking water sources;
3. Implementing the protection plan on a continuous basis to reduce the risk of potential contamination of the drinking water sources; and
4. Monitoring the effectiveness of the protection plan and updating it accordingly as future assessment results indicate.

The water system and the community recognize that the Safe Drinking Water Act grants no statutory authority to the Colorado Department of Public Health and Environment or to any other state or federal agency to force the adoption or implementation of source water protection measures. This authority rests solely with local communities and local governments. The source water protection phase is an ongoing process as indicated in Figure 7. The evolution of the SWAP program is to incorporate any new assessment information provided by the public water supply systems and update the protection plan accordingly.

SOURCE WATER PROTECTION PLAN DEVELOPMENT

Source Water Assessment Report Review

Town of Elizabeth has reviewed the Source Water Assessment Report along with the Steering Committee. These Assessment results were used as a starting point to guide the development of appropriate management approaches to protect the source waters of Town of Elizabeth from potential contamination.

The Source Water Assessment Report for Town of Elizabeth generated by the CDPHE can be found at this website: <https://www.colorado.gov/pacific/cdphe/source-water-assessment-and-protection-swap>.

Once you open the link select "Assessment Phase" then "Assessment Report by County". Select Elbert County and find "120010". You can also obtain a copy of the report by contacting the Town of Elizabeth Public Works Director, Michael Gibbs, at 303-419-5631.

Defining the Source Water Protection Area

A source water protection area is the surface and subsurface areas from which contaminants are reasonably likely to reach a water source. The purpose of delineating a source water protection area is to determine the recharge area that supplies water to a public water source. Delineation is the process used to identify and map the area around a pumping well that supplies water to the well or spring, or to identify and map the drainage basin that supplies water to a surface water intake. The size and shape of the area depends on the characteristics of the aquifer and the well, or the watershed. The source water assessment area that was delineated as part of Town of Elizabeth's Source Water Assessment Report provides the basis for understanding where the community's source water and potential contaminant threats originate, and where the community has chosen to implement its source water protection measures in an attempt to manage the susceptibility of their source water to potential contamination.

After carefully reviewing their Source Water Assessment Report and the CDPHE's delineation of the Source Water Assessment Area for each of Town of Elizabeth's sources, the Steering Committee chose to modify it before accepting it as their Source Water Protection Areas for this Source Water Protection Plan. The Source Water Protection Areas were created from the original source water assessment area based on the local issues of concern, additional water sources, source location correction, conducting an onsite survey of land uses, immediacy of the potential contamination sources to the source water and the type of potential contaminants.

Town of Elizabeth's Source Water Protection Area is defined as:

School/Irrigation Wells

Zone 1 - a .098 square mile area with the east boundary being CR 13, the south boundary being 500 feet from Denver Well, the west boundary being along Gold Creek and north boundary being 500 feet from Arapahoe/Dawson Well.

Zone 2 – A 2.86 square mile area encompassing the Town boundaries

Zone 3 – A 19.5 square mile area encompassing the Towns urban growth boundaries

Municipal Wells:

Zone 1a –

- * Arapahoe and Dawson Wells: a .004 square mile area east to the end of the field, south to the north side of CR 136, west to the west side of Pine Ridge Street and north to under the white concrete pad.
- * Denver Well: a .002 square mile area surrounding the water tanks including to the west side of Pine Ridge Street.

Zone 1 - 500 foot radius around the wells

Zone 2 - A 2.86 square mile area encompassing the Town boundaries

Zone 3 – A 19.5 square mile area encompassing the Town urban growth boundaries

The Source Water Protection Areas are illustrated in the following maps.

Not Included in this Draft

Figure 8: School/Irrigation Wells Zone 1 Source: CRWA

Not Included in this Draft

Figure 9: Municipal Arapahoe and Dawson Wells Zones 1A and 1 Source: CRWA

Not Included in this Draft

Figure 10: Municipal Denver Well Zones 1A and 1 Source: CRWA

Not Included in this Draft

Figure 11: Town of Elizabeth Source Water Protection Area Zone 2

Source: CRWA



Figure 12: Town of Elizabeth Source Water Protection Area Zone 3

Source: CRWA

Potential Contaminant Source Inventory and Other Issues of Concern

Many types of land uses have the potential to contaminate source waters: spills from tanks, trucks, and railcars; leaks from buried containers; failed septic systems, buried or injection of wastes underground, use of fertilizers, pesticides, and herbicides, road salting, as well as urban and agricultural runoff. While catastrophic contaminant spills or releases can wipe out a water resource, groundwater degradation can result from a plethora of small releases of harmful substances. According to the USEPA, nonpoint-source pollution (when water runoff moves over or into the ground picking up pollutants and carrying them into surface and groundwater) is the leading cause of water quality degradation (GWPC, 2008).

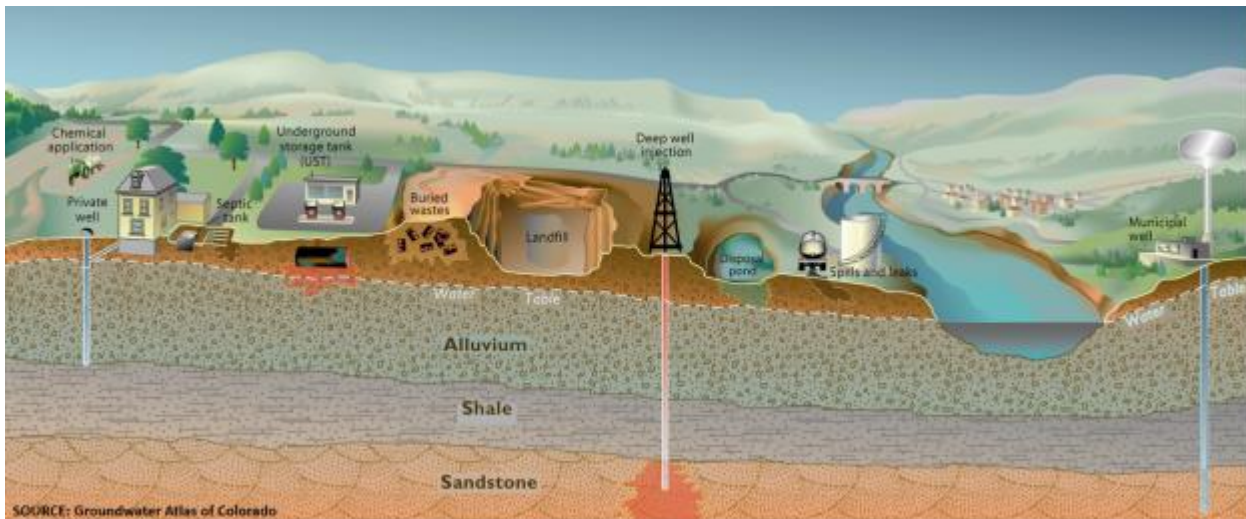


Figure 13: Schematic drawing of the potential source of contamination to surface and groundwater

In 2001 – 2002, as part of the Source Water Assessment Report, a contaminant source inventory was conducted by the Colorado Department of Public Health and Environment to identify selected potential sources of contamination that might be present within the source water assessment areas. Discrete² contaminant sources were inventoried using selected state and federal regulatory databases including: mining and reclamation, oil and gas production, above and underground petroleum tanks, Superfund sites, hazardous waste generators, solid waste disposal, industrial and domestic wastewater dischargers, and water well permits. Dispersed contaminant sources were inventoried using then recent land use/land cover and transportation maps of Colorado, along with selected state regulatory databases. The contaminant inventory was completed by mapping the potential contaminant sources with the aid of a Geographic Information System (GIS).

The State's contaminant source inventory consisted of draft maps, along with a summary of the discrete and dispersed contaminant sources inventoried within the source water assessment area. Town of Elizabeth was asked, by CDPHE, to review the inventory information, field-verify selected information about existing and new contaminant sources, and provide feedback on the accuracy of the inventory. Through this Source Water Protection Plan, Town of Elizabeth is reporting its findings to the CDPHE.

² The WQCD's assessment process used the terms "discrete" and "dispersed" potential sources of contamination. A discrete source is a facility that can be mapped as a point, while a dispersed source covers a broader area such as a type of land use (crop land, forest, residential, etc.).

After much consideration, discussion, and input from local stakeholders, Town of Elizabeth and the Steering Committee have developed a more accurate and current inventory of contaminant sources located within the Source Water Protection Area. Upon completion of this contaminant source inventory, Town of Elizabeth has decided to adopt it in place of the original contaminant source inventory provided by the CDPHE.

Contaminant Source Inventory (in no particular order):

School/Irrigation Wells:

- Fertilizers and herbicides on the baseball field
- Residential and Commercial septic systems
- Elizabeth School District bus barn fuel storage tanks
- Transportation and roads - County Road 13
- Port-O-John at the baseball fields
- Jeep Trail runoff

Municipal Wells:

- Above and below ground fuel storage tanks
- Abandoned Upper Dawson well
- Domestic and abandoned wells

Future Surface Water Sources:

- Sewer line over Running Creek Bridge
- Casey Jones Park RV Septic System
- Town and private lift stations
- Future oil and gas development
- Transportation and roads
- Residential practices
- Above Ground Fuel Tanks
- Equestrian operations
- Small quantity hazardous waste generators
 - lawn mower repair
 - automobile repair shops
 - car washes

In addition to the discrete and dispersed contaminant sources identified in the contaminant source inventory, the Steering Committee has also identified other issues of concern that may impact Town of Elizabeth's drinking water sources.

Additional Issues of Concern (in no particular order):

- Integrity of well near baseball field
- Vacant property at 165 Main Street
- Dog Park near municipal wells
- Community Garden near municipal wells
- Cattle Grazing

Priority Strategy

After developing a contaminant source inventory and list of issues of concern that is more accurate, complete, and current, the Steering Committee began the task of prioritizing this inventory for the implementation of the Best Management Practices outlined in this Source Water Protection Plan (see Table 7).

The strategy which Town of Elizabeth and Steering Committee used is based on four criteria.

1. **Migration Potential or Proximity to the Water Source** - The migration potential generally has the greatest influence on whether a contaminant source could provide contaminants in amounts sufficient for the source water to become contaminated at concentrations that may pose a health concern to consumers of the water. Shorter migration paths and times of travel mean less chance for dilution or degradation of the contaminant before it reaches water sources. The proximity of a potential contaminant source of contamination to the Town of Elizabeth's water sources was considered relative to the three sensitivity zones in the Source Water Protection Area (i.e. Zone 1, Zone 2, and Zone 3).
2. **Contaminant Hazard** - The contaminant hazard is an indication of the potential human health danger posed by contaminants likely or known to be present at the contaminant source. Using the information tables provided by CDPHE (see Appendices E-H), the Steering Committee considered the following contaminant hazard concerns for each contaminant source:
 - **Acute Health Concerns** - Contaminants with acute health concerns include individual contaminants and categories of constituents that pose the most serious immediate health concerns resulting from short-term exposure to the constituent. Many of these acute health concern contaminants are classified as potential cancer-causing (i.e. carcinogenic) constituents or have a maximum contaminant level goal (MCLG) set at zero (0).
 - **Chronic Health Concerns** - Contaminants with chronic health concerns include categories of constituents that pose potentially serious health concerns due to long-term exposure to the constituent. Most of these chronic health concern contaminants include the remaining primary drinking water contaminants.
 - **Aesthetic Concerns** - Aesthetic contaminants include the secondary drinking water contaminants, which do not pose serious health concerns, but cause aesthetic problems such as odor, taste or appearance.
3. **Potential Volume** - The volume of contaminants at the contaminant source is important in evaluating whether the source water could become contaminated at concentrations that may pose a health concern to consumers of the water in the event these contaminants are released to the source water. Large volumes of contaminants at a specific location pose a greater threat than small volumes.
4. **Likelihood of Release** - The more likely that a potential source of contamination is to release contaminants, the greater the contaminant threat posed. The regulatory compliance history for

regulated facilities and operational practices for handling, storage, and use of contaminants were utilized to evaluate the likelihood of release.

The Steering Committee then utilized Table 5, below, as a method to further rank their potential sources of contamination.

Table 5: Priority Strategy (sw = contaminants to potential future surface water intakes)

Potential Source of Contamination or Issue of Concern	Controllable (Direct, Indirect, No)	Impact to Water System (Minor, Moderate, Major)	Probability of Occurrence (Unlikely, Possible, Likely, Very Likely)	Risk (Very Low, Low, Intermediate, High, Very High)	Priority (1 - 5)
Irrigation/School Wells					
Fertilizers and Herbicides on Baseball Field	indirect	moderate	likely	high	2
Residential/Commercial Septic Systems	no	minor	possible	low	4
Casey Jones Park RV Septic System	indirect	minor	possible	low	4
Elizabeth School District Bus Barn Fuel Storage Tanks	indirect	moderate	possible	intermediate	3
County Road 13	no	minor	possible	low	4
Port-o-John at Baseball Field	indirect	moderate	possible	intermediate	3
Jeep Trail Runoff	indirect	minor	possible	low	4
Integrity of Well Near Baseball Field	indirect	major	possible	high	2
Vacant Property at 165 So. Main (formerly) Gesins Grocery Store	direct	minor	unlikely	very low	5
Municipal Wells					
Below Ground Fuel Tanks	no	moderate	possible	intermediate	3
Domestic/Abandoned Wells	no	moderate	possible	intermediate	3
Dog Park	direct	minor	unlikely	very low	5
Community Garden	direct	minor	unlikely	very low	5
Upper Dawson Well (cemetery location) Properly abandoned?	direct	moderate	possible	intermediate	3

Future Surface Water Sources					
8 Inch Sewer Line Over RCB	direct	major (sw)	unlikely	intermediate	3
2 Town Lift Stations	direct	major (sw)	possible	high	2
1 Private Lift Station	indirect	major (sw)	possible	high	2
Future Oil & Gas Development	no	major (sw)	possible	high	2
Transportation and Roads	no	major (sw)	possible	high	2
Residential	no	minor	possible	low	4
Above Ground Fuel Tanks	no	minor	possible	low	4
Small Quantity Hazardous Waste Generators					
Auto Repair Shops	no	moderate	possible	intermediate	3
Car Washes	no	minor	possible	low	4
Lawn Mower Repair CR 17 & 86	no	minor	unlikely	very low	5
Equestrian Operations	no	minor	Very likely	Low	4

Based on the above criteria, the Steering Committee has ranked the potential contaminant source inventory and issues of concern in the following way:

Prioritized Potential Contaminant Sources and Issues of Concern

School/Irrigation Wells:

- Fertilizers and herbicides on the baseball field
- Integrity of well near baseball field
- Elizabeth School District bus barn fuel storage tanks
- Port-O-John at the baseball fields

Municipal Wells:

- Below ground fuel storage tanks
- Abandoned Upper Dawson well
- Domestic and abandoned wells

Future Surface Water Sources:

- Sewer line over Running Creek Bridge
- Town and private lift stations
- Future oil and gas development
- Automobile repair shops
- Transportation and roads
- Equestrian operations

Susceptibility Analysis of Water Sources

Town of Elizabeth's Source Water Assessment Report contained a susceptibility analysis³ to identify how susceptible an untreated water source could be to contamination from potential sources of contamination inventoried within its source water assessment area. The analysis looked at the susceptibility posed by individual potential contaminant sources and the collective or total susceptibility posed by all of the potential contaminant sources in the source water assessment area. The CDPHE developed a susceptibility analysis model for surface water sources and ground water sources under the influence of surface water, and another model for groundwater sources. Both models provided an objective analysis based on the best available information at the time of the analysis. The two main components of the CDPHE's susceptibility analysis are:

1. **Physical Setting Vulnerability Rating** – This rating is based on the ability of the surface water and/or groundwater flow to provide a sufficient buffering capacity to mitigate potential contaminant concentrations in the water source.
2. **Total Susceptibility Rating** – This rating is based on two components: the physical setting vulnerability of the water source and the contaminant threat.

Upon review of CDPHE's susceptibility analysis, the Steering Committee determined that both the Physical Setting Vulnerability Rating and the Total Susceptibility Rating for each of the Town of Elizabeth's sources are accurate and should remain the same. Additionally, the steering committee conducted a susceptibility analysis for their irrigation and monitoring wells. Please refer to Table 7, below.

Table 6: Updated Susceptibility Analysis

Source ID #	Source Name	Source Type	Total Susceptibility Rating	Physical Setting Vulnerability Rating
CO0120010-001	Lower Dawson Well	Groundwater	Moderately Low	Moderate
CO0120010-002	Denver	Groundwater	Moderately Low	Moderately Low
CO0120010-003	Arapahoe Well	Groundwater	Moderately Low	Moderately Low
	Denver Monitoring Well	Groundwater	Moderately Low	Moderately Low
	Lower Dawson Monitoring Well	Groundwater	Moderately Low	Moderate
	Abandoned Upper Dawson Well at Cemetery	Groundwater	NA* or Moderate	NA* or High
	Irrigation Well 1	Groundwater	Moderate	Moderate
	Irrigation Well 2	Groundwater	Moderate	Moderate

* NA if well found to be properly abandoned

³ The susceptibility analysis provides a screening level evaluation of the likelihood that a potential contamination problem could occur rather than an indication that a potential contamination problem has or will occur. The analysis is NOT a reflection of the current quality of the untreated source water, nor is it a reflection of the quality of the treated drinking water that is supplied to the public.

DISCUSSION OF POTENTIAL CONTAMINANT SOURCES AND ISSUES OF CONCERN

The following section provides a brief description of potential contaminant sources and issues of concern that have been identified in this plan, describes the way in which they threaten the water source(s) and outlines Best Management Practices. Part I will describe potential contaminant sources and issues of concern for both the Municipal and Irrigation Wells and Part II will describe potential contaminant sources and issues of concern for Future Surface Water Sources.

Part I: Municipal and Irrigation Wells

1. Fertilizers and Herbicides on the Baseball Field – Denver Irrigation Well

If improperly managed, elements of fertilizer can move into surface water through field runoff or leach into ground water. The two main components of fertilizer that are of greatest concern to source water quality (ground water and surface water used as public drinking water supplies) are nitrogen (N) and phosphorus (P).

Improper or excessive use of fertilizer can lead to nitrate pollution of ground or surface water. Nitrogen fertilizer, whether organic or inorganic, is biologically transformed to nitrate that is highly soluble in water. In this soluble form, nitrate can readily be absorbed and used by plants. On the other hand, soluble nitrate is highly mobile and can move with percolating water out of the soil, thus making it unavailable for plant uptakes. Fertilizer applicators, therefore, need to match nitrogen applications to plant uptake to minimize nitrate leaching and maximize efficiency.

As mentioned above, nitrogen-containing fertilizers can contribute to nitrates in drinking water. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants. Due to this health risk, EPA set a drinking water maximum contaminant level (MCL) of 10 milligrams per liter (mg/l) or parts per million (ppm) for nitrate measured as nitrogen.

Another major component of fertilizer is phosphorus. Under certain conditions phosphorus can be readily transported with the soil. In fact, 60 to 90 percent of phosphorus moves with the soil. (USEPA, 2001)

Herbicides are chemicals used to manipulate or control undesirable vegetation. In suburban and urban areas, herbicides are applied to lawns, parks, golf courses and other areas. (Folmar, et al. 1979) Methods of application include spraying onto foliage, applying to soils, and applying directly to aquatic systems.

Herbicides may cause biological impairments of water bodies if they occur in water or sediment at sufficient concentrations. Most commonly, they enter surface water in runoff or leachate, but, because they have relatively low toxicity to fish and invertebrates acute toxicity is likely only when they are deliberately or accidentally applied directly to water bodies. Direct applications may result in direct toxicity to non-target plants and animals or indirect effects due to the death and decomposition of plants. Impairments also are more likely when herbicides are applied together or with other pesticides (Streibig et. al. 1998), resulting in additive or synergistic effects.

The Denver Irrigation Well lies adjacent to the baseball field. The well is in the Denver Aquifer and is approximately 1010 feet deep. Because of the depth of the well, fertilizers and herbicides are not a direct threat to the Town's drinking water but remain a priority to address. Town of Elizabeth intends to discuss

this issue with the Elizabeth School District to encourage them to use due diligence when applying fertilizer to the baseball field.



Figure 14: School/Irrigation Denver Well and port-o-john adjacent to baseball field Source: CRWA

Fertilizers and Herbicides on the Baseball Field Best Management Practices

a. Distribute BMP outreach material concerning the proper storage and application of fertilizer and herbicides to the Elizabeth School District Grounds Maintenance Department. Information will include:

- fertilizer usage and turf management
- irrigation practices
- storage, handling, and disposal of fertilizers, and washing of application equipment
- hazardous spills clean up and disposal plan

2. Integrity of Well Near Baseball Field – Denver Irrigation Well

The wellhead protects the well casing, which is the lining of the well, and the well cap, which provides a tight-fitting seal at the top of the well. The wellhead is the first line of defense to prevent pollutants from penetrating a drinking water system. Even small spills of pesticides, fertilizers or fuels near a well can seep into the ground and contaminate the water. (WSC, 1993)

The combination of fertilizer and herbicide application at the baseball field, the location of a port-o-john right next to the Denver Irrigation Well, a poor well seal and no physical protection for the well itself is cause for concern for Town of Elizabeth. Excess fertilizers and herbicides could migrate towards the well during a storm event and failure of the port-o-john at any time could cause contaminants to enter the drinking water supply via the poorly constructed well seal. Baseball fans attending games could mistakenly run into the well with their vehicles. Therefore, the Town of Elizabeth has decided to address this issue by improving the integrity of the well seal, fortifying the area around the well to ensure that no contaminants enter the drinking water supply and inform users of the area about the importance of protecting source waters.

Integrity of Well Near Baseball Field Best Management Practices

- a. Install bollards to protect the well
- b. Create a tighter seal for the well
- c. Install “Drinking Water Supply Protection Area” signs at the baseball field.

3. Port-O-John at the Baseball Fields – Denver Irrigation Well

Most water-borne human pathogens cause infections and human disease via ingestion of fecal contaminated water or food. Various human parasites and pathogens are transmitted in this way, including protozoa, virus and bacteria, transmitted via human fecal contamination of water used for drinking, bathing, recreation or washing/preparation of foods. (Atlas, et al, 1991)

As described above in 2 and illustrated in Figure 14, failure of the port-o-john could induce fecal contaminants into the Town of Elizabeth’s drinking water supply. Therefore, Town of Elizabeth has decided to address this issue by relocating the port-o-john.

Port-O-John at the Baseball Fields Best Management Practices

- a. Relocate port-o-john away from the well

4. Bus Barn Fuel Storage Tanks – Lower Dawson Irrigation Well

Above ground storage tanks (ASTs) are tanks or other containers that are above ground, partially buried, bunkered, or in a subterranean vault. These can include floating fuel systems. The majority of storage tanks contain petroleum products (e.g., motor fuels, petroleum solvents, heating oil, lubricants, and used oil). Storage tanks may be found in airports, school bus barns, hospitals, automotive repair shops, military bases, farms, and industrial plants. Discharges of chemicals, petroleum, or non-petroleum oils from storage tanks can contaminate source water. Product spilled, leaked, or lost from storage tanks may accumulate in soils or be carried away in storm runoff. Some of the causes for storage tank releases are holes from corrosion, failure of piping systems, and spills and overfills, as well as equipment failure and human operational error. (USEPA, 2001).

There is an above ground fuel storage tank operated by the Elizabeth School District just uphill and within 100 feet from the lower Dawson Irrigation Well. A jeep trail runs from the area of the storage tank down towards and past the well. Town of Elizabeth is concerned that the storage tank has minimal secondary containment and that any spill onto the ground might run into and follow the jeep trail down to the well area. Therefore, Town of Elizabeth has decided to address this issue by assisting the School District with secondary containment for the storage tank and diverting any potential contaminant spills away from the well.



Figure 15: Bus Barn Fuel Storage Tank Source: CRWA

Bus Barn Fuel Storage Tanks Best Management Practices

- a. Increase secondary containment around the storage tanks.
- b. Create a berm around the well to divert flows.

5. Below Ground Fuel Storage Tanks - Municipal Wells

Leaky underground storage tanks can release gasoline or “liquid phase hydrocarbon.” The Gasoline descends through the unsaturated soil zone to float on the water table (gasoline is lighter than water). The gasoline releases compounds like benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl tert-butyl ether (MTBE) to the groundwater and they are carried in the direction of groundwater flow. The extent of contamination is defined by the concentration of benzene (from 10 to 10,000 parts per billion) in the groundwater.

Spills from leaking underground storage tanks (LUST) sites can contaminate the groundwater and also present other hazards. Because gasoline is lighter than water, gasoline floats on the water table and remains relatively close to the land surface. The most hazardous compounds in groundwater (the BTEX compounds) are quite volatile and carcinogenic. Besides the potential for being consumed in drinking water, volatile compounds can enter nearby buildings. In poorly ventilated buildings, the compounds can accumulate and present a health risk through inhalation. In buildings, the volatile compounds can also present an explosion hazard (Ryan, 2006).

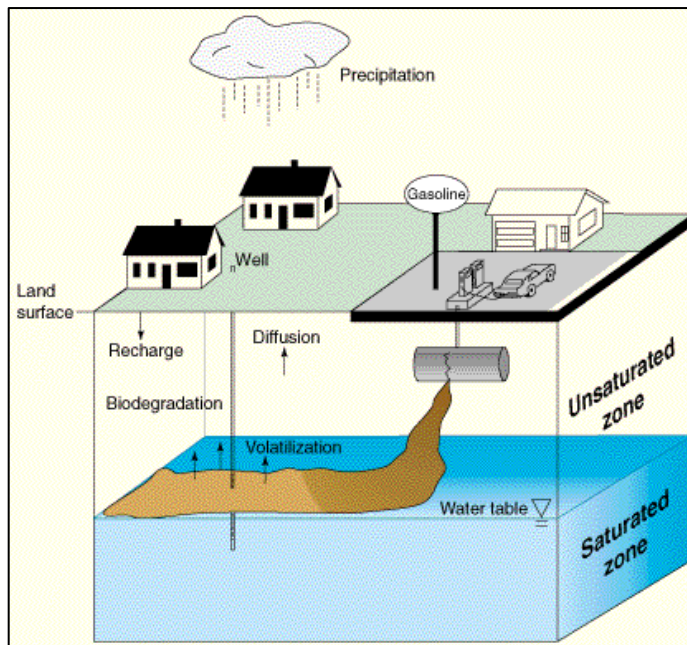


Figure 16: Schematic of a LUST spill site Source: Ryan, 2006

Below Ground Fuel Storage Tanks Best Management Practices

a. Distribute education and outreach material to landowners with below ground fuel storage tanks.

6. Domestic and Abandoned Wells/Abandoned Upper Dawson Well - Municipal Wells

Domestic and Abandoned Wells

Out-of-service wells must be properly closed and sealed. Otherwise, they pose a threat to ground water quality and a potential safety hazard.

Normally, ground water flows through soil and bedrock formations, known as aquifers, which filter unhealthy organisms, minerals and other substances. Water that enters an abandoned well bypasses this purifying action. Contaminants enter the aquifer through the unsealed well and may eventually harm the water quality in other wells nearby.

Contaminants usually get into an abandoned well through the casing pipe. It may not extend high enough above the ground surface to prevent runoff from washing into the old pipe. Or the well cap could be broken or in poor condition.

Abandoned large diameter, open wells also pose a real threat to children and animals. There have been numerous reports of children being trapped and even drowned in these types of old wells. (WSC, 1999)



Figure 17: Example of improperly abandoned well Source: CRWA

Town of Elizabeth has identified up to 18 properties within their source water protection area that have abandoned wells and up to an additional 240 properties that have private wells. These wells are located in the same aquifers where Town of Elizabeth has their municipal drinking water supplies (please refer to priority issue #2, page 34 for a description of potential contamination of wells). A property owner just to the west of Town of Elizabeth’s Lower Dawson well has a private well on their property. The Town of Elizabeth is hoping that the abandoned wells have been properly sealed and that all other private wells have proper well seals and are properly constructed. The Town of Elizabeth also feels that it is necessary to notify the public of their existing drinking water supplies.

Abandoned Dawson Well

Town of Elizabeth has an abandoned municipal well in the Dawson Aquifer located at the Elizabeth cemetery and will investigate if that well has been properly abandoned.

Domestic and Abandoned Wells Best Management Practices

- a. Contact the landowner to the west of the Arapahoe/Dawson wells to judge the integrity and location of his private well.
- b. Distribute well management outreach material to property owners with abandoned or private wells.
- c. Install “Drinking Water Supply Protection Area” signage near municipal wells.

Part II: Future Surface Water Sources

1. Future Oil and Gas Development

Water Quality Concerns

Many activities associated with natural gas drilling, completion, and production activities have the potential for adverse impacts to surface and ground water quality. Land disturbed from the construction of roads, well pads, pipelines, and compressor stations can lead to soil erosion and sediment transport to surface water bodies during storm water runoff. During the “well completion” phase of natural gas extraction, a process called hydraulic fracturing, also known as “fracking,” is used. As part of the hydraulic fracturing process, fluids comprised primarily of large volumes of sand, water, and a comparatively small volume of chemical additive are pumped into the wellbore and within hydrocarbon bearing rock formations to stimulate the flow

of natural gas into the wellbore. In consideration of heightened public awareness and concerns related to fracking, Town of Elizabeth decided to include fracking as a potential threat to future surface water drinking supplies. However, impacts to groundwater quality due to fracturing operations are not expected, because this process is isolated from near surface aquifers and occurs at depths below 5,000 feet, while fresh-water aquifers are typically less than 2,000 feet deep and most domestic wells are less than 500 feet deep. (Resource Management Plan, BLM, 2011). The primary source water threat relative to the fracking process is the handling and management of the water and chemicals at the surface to avoid spills.

Produced water, or water that co-resides with natural gas in geologic formations, is often brought to the surface along with the target hydrocarbons. Produced water quality can vary greatly depending on the producing formation, but is often highly saline and may include high concentrations of naturally occurring metals, radioactive substances, and other constituents. Produced water is typically re-used or recycled in the well completion process as much as is practicable and allowed by regulation. Un-usable and/or excess produced water may be stored in tanks on location then transported by truck or pipeline for disposal in licensed or permitted facilities or in “Class II” injection wells, in compliance with COGCC, BLM, and EPA regulations.

While a number of activities in the oil and gas industry have the potential for adverse impacts to surface and groundwater quality, the following are considered the greatest threat:

- Soil erosion and sediment transport to surface water bodies due to storm water runoff from roads, well pads and other heavy construction activities.
- Spills of drilling fluid, produced water, hydrocarbons, or other chemicals and fluids used or stored on location during the oil and gas extraction process.
- Spills that occur during transport/disposal of fluids as a result of vehicle incidents/accidents

Regulations and Associated Organizations

The following represents some of the regulations that industry operators are required to comply with in an effort to protect the quality of the State’s surface water and groundwater.

Colorado Oil and Gas Conservation Commission: Rule 317(b)

The oil and gas industry in Colorado is regulated by the Colorado Oil and Gas Conservation Commission (COGCC). House Bill 1341 directed the COGCC to make and enforce rules consistent with the protection of the environment, wildlife resources, and public health, safety, and welfare. In 2008, the COGCC developed and passed new rules that became effective on May 1, 2009 on federal land and April 1, 2009 on all other land.

One of the new rules, Rule 317(b), protects public water systems by protecting the source of their drinking water. It creates protection zones, or buffer zones, combined with performance requirements applicable within 5 miles upstream of the surface water intake. The most protected Internal Buffer Zone is located within 300 feet of a water segment and is a drilling excluded zone. The purpose for protecting this zone is that a significant release in these areas would likely contaminate surface water used as a drinking water source. The Commission also decided that enhanced drilling and production requirements should apply in areas ½ mile from the water supply segment, in an Intermediate and Extended Buffer Zone (COGCC, 2008). The Rule 317(b) buffer zones can be found on the COGCC’s website (<http://cogcc.state.co.us/>). In addition to its many other regulations, COGCC adopted rule 609 that went into effect July 2013. Rule 609 makes mandatory pre- and post- oil and gas well drilling and completion groundwater monitoring. This data will be

in addition to the water sampling data that many energy operators have been voluntarily providing to COGCC for public access in recent years.

Future Oil and Gas Development Best Management Practices

- a. When appropriate, encourage the COGCC and oil and gas operators to follow existing Rule 317B regulations and other regulations that may arise after the development of this source water protection plan.
- b. As oil and gas development approaches the Town lessons learned and Best Management Practices highlighted in other source water protection plans will be applied.

2. Town and Private Lift Stations

Three sewer lift stations (two municipal and one private) are located near potential future surface water drinking water sources for Town of Elizabeth and if they malfunction potential contaminants could enter future surface water drinking supplies.

Town and Private Lift Stations Best Management Practices

- a. Routine maintenance and inspection will continue to occur.

3. Sewer Line Under Running Creek Bridge

A municipal sewer line runs under Running Creek Bridge and if it malfunctions potential contaminants could enter future surface water drinking supplies. The Town of Elizabeth replaced the supporting brackets supporting this sewer line in 2014 and has in place an IGA for maintenance with CDOT for future maintenance.

Sewer Line Under Running Creek Bridge Best Management Practices

- a. Routine maintenance and inspection will continue to occur.

4. Auto Repair Shops

Auto repair shops can add to storm water sources of pollution. Urban and suburban areas are predominated by impervious cover including pavements on roads, sidewalks, and parking lots; rooftops of buildings and other structures; and impaired pervious surfaces (compacted soils) such as dirt parking lots, walking paths, baseball fields and suburban lawns.

During storms, rainwater flows across these impervious surfaces, mobilizing contaminants, and transporting them to water bodies. All of the activities that take place in urban and suburban areas contribute to the pollutant load of storm water runoff. Oil, gasoline, and automotive fluids drip from vehicles onto roads and parking lots. Storm water runoff from shopping malls and retail centers also contains hydrocarbons from automobiles. Landscaping by homeowners, around businesses, and on public grounds contributes sediments, pesticides, fertilizers, and nutrients to runoff. Construction of roads and buildings is another large contributor of sediment loads to waterways. In addition, any uncovered materials such as improperly stored hazardous substances (e.g., household cleaners, pool chemicals, or lawn care products), pet and wildlife wastes, and litter can be carried in runoff to streams or ground water. Illicit discharges to storm drains (e.g., used motor oil), can also contaminate water supplies. (Source, USEPA, 2001)

Impervious areas prohibit the natural infiltration of rainfall through the soil, which could filter some contaminants before they reach ground water. Also, impervious surfaces allow the surface runoff to move rapidly. Development reduces the amount of land available for vegetation, which can mitigate the effects of rapid runoff and filter contaminants. When the percentage of impervious cover reaches 10 to 20 percent of a watershed area, degraded water quality becomes apparent.

There are three primary concerns associated with uncontrolled runoff: (1) increased peak discharge and velocity during storm events resulting in flooding and erosion; (2) localized reduction in recharge; and (3) pollutant transport. (Source: USEPA)

Auto Repair Shops Best Management Practices

a. Distribute education and outreach material to auto repair shops that highlights the importance of preventing petroleum products from washing off their property into the surface water.

5. Transportation and Roads

Motor vehicles, roads and parking facilities are a major source of water pollution to both surface and groundwater. An estimated 46% of US vehicles leak hazardous fluids, including crankcase oil, transmission, hydraulic and brake fluid, and antifreeze, as indicated by oil spots on roads and parking lots, and rainbow sheens of oil in puddles and roadside drainage ditches. An estimated 30-40% of the 1.4 billion gallons of lubricating oils used in automobiles are either burned in the engine or lost in drips and leaks, and another 180 million gallons are disposed of improperly onto the ground or into sewers. Runoff from roads and parking lots has a high concentration of toxic metals, suspended solids, and hydrocarbons, which originate largely from automobiles (Gowler and Sage, 2006).

The Town of Elizabeth is concerned with vehicular spills contaminating future surface water supplies and recommends working with local emergency response teams to ensure that any spills within the protection areas be effectively contained.

Additionally, noxious weed abatement via the application of pesticides and herbicides could introduce harmful chemicals into future surface water drinking supplies via runoff. Please refer to page 33 of this document which highlights the impact that pesticides and herbicides may have on surface water.

Transportation and Roads Best Management Practices

- a. Provide a copy of the Source Water Protection Plan, maps, GIS shapefiles and Emergency Notification Cards to: County Office of Emergency Management, County Road and Bridge Department and other major users of the roads.
- b. Work with local emergency response teams (including OEM and fire departments) to ensure that any spills within the source water protection areas be effectively contained and proper protocols are followed for clean-up of hazardous materials spilled within the transportation corridors.

- c. Notify County Vegetation Management as to the location of the wells in order that they withhold application of herbicides within 100 feet of the wells.
- d. Place “Drinking Water Supply Protection Area” signage on public roads within the protection areas to educate the public about the Town of Elizabeth’s drinking water supply.

6. Equestrian Operations

Although horse wastes (manure, urine and soiled bedding) are organic, biodegradable materials, many of their physical, biological and chemical properties (such as sediment, phosphorous, nutrients, and bacteria) can be detrimental to water quality and can adversely affect human health and aquatic life in water bodies. Many of the nutrients ingested by horses return to the environment in feces and urine. When carried by runoff to streams and lakes, excessive amounts of these same nutrients can stimulate unwanted algae blooms in creeks and streams, causing a decrease in dissolved oxygen in water, which stifles aquatic life.

Some activities, such as heavy grazing or pasture use, remove the soil’s vegetative cover and can expose the soil surface. Exposed soil is easily transported by runoff to streams and creeks, and excessive sediment can fill pools, smother aquatic habitats, and cover food supplies.

Bacteria, such as fecal coliform, are present in horse manure. As previously discussed, the Regional Boards have listed fecal coliform as a pollutant of concern because it is an indicator of potential viruses and pathogens that cause swimmer-associated sickness in water bodies.

Chemicals used during horse grooming and shelter/living area maintenance may cause adverse health effects to humans and are toxic to aquatic life.

Proper manure management is an important concern for every horse keeper. Appropriate storage, handling, recycling or disposing of horse manure protects water quality and keeps both horses and people healthy and happy. Good manure management is essential for horses to be accepted as friendly residential neighbors in increasingly crowded suburban settings. (Council of Bay Area Resource Conservation Districts)

There exists as many as a dozen property owners within the source water protection areas that have equestrian operations. The Town of Elizabeth intends to distribute education and outreach material to equine owners that highlights the importance of preventing animal waste from washing off their property into the surface water.

Equestrian Operations Best Management Practices

- a. Distribute education and outreach material to equine owners that highlights the importance of preventing animal waste from washing off their property into the surface water.

SOURCE WATER PROTECTION MEASURES

Best Management Practices

The Steering Committee reviewed and discussed several possible Best Management Practices that could be implemented within the Source Water Protection Area to help reduce the potential risks of contamination to the community's source water. The Steering Committee established a "common sense" approach in identifying and selecting the most feasible source water management activities to implement locally. The focus was on selecting those protection measures that are most likely to work for the community. The Best Management Practices were obtained from multiple sources including: Environmental Protection Agency, Colorado Department of Public Health and Environment, Natural Resources Conservation Service, and other source water protection plans.

The Steering Committee recommends the Best Management Practices listed in Table 7, "Source Water Protection Best Management Practices" be considered for implementation by Town of Elizabeth.

Evaluating Effectiveness of Best Management Practices

Town of Elizabeth is committed to developing a tracking and reporting system to gauge the effectiveness of the various source water Best Management Practices that have been implemented. The purpose of tracking and reporting the effectiveness of the source water Best Management Practices is to update water system managers, consumers, and other interested entities on whether or not the intended outcomes of the various source water Best Management Practices are being achieved, and if not, what adjustments to the Source Water Protection Plan will be taken in order to achieve the intended outcomes. It is further recommended that this Plan be reviewed at a frequency of once every 3 - 5 years or if circumstances change resulting in the development of new water sources and source water protection areas, or if new risks are identified.

The Town of Elizabeth is committed to a mutually beneficial partnership with the Colorado Department of Public Health and Environment in making future refinements to their source water assessment and to revise the Source Water Protection Plan accordingly based on any major refinements.

Town of Elizabeth Commitment to our Customers

Please contact us to learn more about what you can do to help protect our drinking water sources. Feel free to stop by Town Hall to pick up a source water protection plan brochure or to ask us any questions you may have concerning this Source Water Protection Plan. We encourage you to learn more about our water system and we invite you to attend our public meetings. We want you, our valued customers, to be informed about the services we provide and the quality water we deliver to you every day.

Table 7: Source Water Protection Best Management Practices

Issues	Best Management Practices	Implementers
SCHOOL/IRRIGATION WELLS		
Fertilizers and Herbicides on the Baseball Field	a. Distribute BMP outreach material concerning the proper storage and application of fertilizer and herbicides to the Elizabeth School District Grounds Maintenance department.	Town of Elizabeth
Integrity of Well Near Baseball Field	a. Install bollards to protect the well. b. Create a tighter seal for the well. c. Install “Drinking Water Supply Protection Area” signs at the baseball field.	Town of Elizabeth in coordination with School District
Port-O-John at the Baseball Fields	a. Relocate port-o-john away from the well.	Town of Elizabeth in coordination with School District
Bus Barn Fuel Storage Tanks	a. Increase secondary containment around the storage tanks. b. Create a berm around the well to divert flows.	Town of Elizabeth in coordination with School District
MUNICIPAL WELLS		
Below Ground Fuel Storage Tanks	a. Distribute education and outreach material to landowners with below ground fuel storage tanks.	Town of Elizabeth
Domestic and Abandoned Wells	a. Contact the landowner to the west of the Arapahoe/Dawson wells to judge the integrity and location of his private well. a. Distribute well management outreach material to property owners with abandoned or private wells. a. Install “Drinking Water Supply Protection Area” signage near municipal wells.	Town of Elizabeth
FUTURE SURFACE WATER SOURCES		
Future Oil and Gas Development	a. When appropriate, encourage the COGCC and oil and gas operators to follow existing Rule 317B regulations and other regulations that may arise after the development of this source water protection plan. b. As oil and gas development approaches the Town lessons learned and Best Management Practices highlighted in other source water protection plans will be applied.	Town of Elizabeth

Town and Private Lift Stations	a. Routine maintenance will continue to occur.	Town of Elizabeth / private lift station owner
Sewer Line Over Running Creek Bridge	a. Routine maintenance and inspections will continue to occur.	Town of Elizabeth
Auto Repair Shops	a. Distribute education and outreach material to auto repair shops that highlights the importance of preventing petroleum products from washing off their property into the surface water.	Town of Elizabeth
Transportation and Roads	a. Provide a copy of the Source Water Protection Plan, maps, GIS shapefiles and Emergency Notification Cards to: County Office of Emergency Management, County Road and Bridge Department and other major users of the roads. b. Work with local emergency response teams (including OEM and fire departments) to ensure that any spills within the source water protection areas be effectively contained and proper protocols are followed for clean-up of hazardous materials spilled within the transportation corridors. c. Notify County Vegetation Management as to the location of the wells in order that they withhold application of herbicides within 100 feet of the wells. d. Place "Drinking Water Supply Protection Area" signage on public roads within the protection areas to educate the public about the Town of Elizabeth's drinking water supply.	CRWA/Town of Elizabeth
Equestrian Operations	a. Distribute education and outreach material to equine owners that highlights the importance of preventing animal waste from washing off their property into the surface water.	Town of Elizabeth
Public Outreach	a. Produce and make available at Town Hall a Source Water Protection Plan Brochure.	Town of Elizabeth

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APPENDICES⁴

- A. Contingency Plan
- B. Source Water Assessment Report
- C. Source Water Assessment Report Appendices
- D. MOU Between CDPHE and U.S. Forest Service Rocky Mountain Region
- E. Table A-1 Discrete Contaminant Types
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⁴ All appendices are located on the CD version of this SWPP.