Town of Carbondale
Source Water Protection Plan

Garfield County, Colorado
March 31, 2015

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Colorado Rural Water Association
and
Steering Committee Members:
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For the Community Water Provider:
Town of Carbondale, PWSID#123167

If you have comments regarding this plan please contact Mark O'Meara, Town of Carbondale Utilities Director at: 970-963-3140 or momeara@carbondale.net

Cover photo: Carbondale, CO by Quazoo.com

This Source Water Protection Plan for the Town of Carbondale 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 (bmp's) 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 Carbondale 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 October 2012 to February, 2015, at Carbondale Town Hall. During the development of this Plan, a Steering Committee was formed to develop and implement it. Colorado Rural Water Association was instrumental in this effort by providing technical assistance in the development of this Source Water Protection Plan.

Town of Carbondale obtains its drinking water from two surface water sources at North and South Nettle Creek, respectively, three groundwater wells within the greater Roaring Fork River alluvium and one groundwater well within the Crystal River alluvium. Additionally, there is a second Crystal River well that is not currently in use. The Source Water Protection Areas for these water sources are defined as:

Nettle Creek drainage

Zone 1 is defined as a 1,000 foot wide perimeter on both sides of Nettle Creek.

Zone 2 represents the watershed boundary for Nettle Creek.

Crystal River Wells near Carbondale

Zone 1 is defined as a 1,000 foot wide perimeter on both sides of the Crystal River and its tributaries.

Zone 2 represents a 156 square mile area that includes the Crystal River and its tributaries 15 stream miles upstream from the Crystal River Well.

Roaring Fork River Wells near Carbondale

Zone 1 represents the parcel ownership outline, a 4.8 square mile area.

Zone 2 is a 55 square mile area to the north, south and west of the wells.

This Source Water Protection Area is the area that the Town of Carbondale 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 wildfire (Nettle Creek Intakes), oil and gas operations and, transportation and roadways (Crystal Wells), septic systems (Crystal Wells and Roaring Fork River Wells) and future land use planning (Crystal Wells).

Other noted water quality threats include:

- Nettle Creek Intakes: residential, agricultural, stormwater, agriculture, outdoor recreation and, camping and hiking
- Crystal Wells: oil and gas operations, wildfire, residential practices, agricultural practices, above/below ground storage tanks and, degraded riparian areas
- Roaring Fork River Wells: transportation and roadways, agricultural practices, solid/hazardous waste, gravel pits, developed and degraded riparian areas and, future land use planning

The Steering Committee developed several bmp's to help reduce the risks from the potential contaminant sources and other issues of concern. The bmp's 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 bmp's which pertain to the highest priority potential contaminant sources and other issues of concern.

- Nettle Creek Intakes: wildfire mitigation, source water protection signage, custom brochures at sporting goods and outdoor recreation stores.
- Crystal River Wells: education and outreach to residents and residents with septic systems, education and outreach to storage tank owners, source water protection signage, brochures at ranching stores.
- Roaring Fork River Wells: education and outreach to residents and residents with septic systems, brochures at ranching stores.
- General: Provide a copy of the Source Water Protection Plan, Emergency Response Notification Cards and maps along with GIS Shapefiles of the protection areas to Town of Carbondale Departments, Garfield and Pitkin County Community Development, Environmental Health, Office of Emergency Management, Fire Departments and Road and Bridge Departments.

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 5-7 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 Carbondale operates a community water supply system that supplies drinking water to approximately 6600 area residents. Town of Carbondale obtains their drinking water from 4 wells, three that are located in the Roaring Fork alluvial aquifer and one that is located in the Crystal River alluvial aquifer. There are also two surface water intakes in the Nettle Creek drainage which lies within the Roaring Fork watershed. Town of Carbondale 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 Carbondale

PWSID	PWS Name	Name	Title	Address	Phone	Website
CO0123167	Town of Carbondale	Mark O'Meara	Utilities Director	511 Colorado Avenue, Carbondale, CO 81623	(970) 963-3140	carbondalegov.org

Purpose of the Source Water Protection Plan

The Source Water Protection Plan is a tool for Town of Carbondale 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

[1] The information contained in this Plan is limited to that available from public records and the Town of Carbondale 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.

state and federal governmental levels by filling protection gaps that can only be addressed at the local level.

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.

Source water protection planning efforts consisted of a series of public planning meetings and individual meetings. Information discussed at the meetings helped Town of Carbondale develop an understanding of the issues affecting source water protection for the community. The Steering Committee then made recommendations for bmp's 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 8, 2012	Water Provider Meeting – Water providers from City of Glenwood Springs, Town of Carbondale, Town of Basalt, Snowmass WSD, City of Aspen and Environmental Process Control convened to create a vision of source water protection in the Roaring Fork Valley
July 23, 2012	Garfield County Mayors Meeting – Presentation to local Garfield County mayors and County Commissioner.
October 30, 2012	Stakeholder Meeting - Presentation on the process of developing a Source Water Protection Plan for Town of Carbondale. Review of the State's Source Water Assessment for Town of Carbondale
December 4, 2012	Steering Committee Meeting – Discussion concerning the Nettle Creek drainage and intakes, landownership in the area and the potential for wildfire. The Roaring Fork River wells were also addressed along with associated potential sources of contamination (psoc's). CBO, Inc. also gave a presentation concerning a septic system outreach program.
January 30, 2013	Steering Committee Meeting - Discussion of septic system outreach and the initial re-delineation of the Roaring Fork and Crystal River source water protection areas.
March 11, 2013	Steering Committee Meeting – Continued discussion of the Roaring Fork and Crystal River re-delineation along with the need to delineate the Thompson Creek drainage.
April 15, 2013	Steering Committee Meeting – Continued discussion of the Crystal River and Thompson Creek source water protection areas and associated psoc's.
October 21, 2013	Steering Committee Meeting – Finalized all source water protection areas

November 3, 2014	Steering Committee Meeting – BMP discussion
November 17, 2014	Steering Committee Meeting – BMP discussion
December 15, 2014	Steering Committee Meeting – BMP discussion
January 12, 2015	Steering Committee Meeting – BMP discussion
February 9, 2015	Steering Committee Meeting – Draft SWPP discussion

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 its development.

Town of Carbondale's source water protection planning process attracted interest and participation from 13 stakeholders including water operators, local county and state governments, non-profit organizations and agency representatives. During the months of May, 2012 through February, 2015, 13 meetings were held 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 Town of Carbondale in the identification and prioritization of potential contaminant sources as well as bmp's 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. The Town of Carbondale 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
Mark O'Meara	Utilities Director	Town of Carbondale	X
Morgan Hill	Environmental Health Specialist	Garfield County Public Health	X
Justin Anderson	Hydrologist	United States Forest Service	X
Kurt Dahl	Environmental Health Manager	Pitkin County	X
Katrina Byars	Trustee	Town of Carbondale	X
Carla Ostberg	President	CBO, Inc.	
Zane Kessler	Executive Director	Thompson Divide Coalition	
Lorne Prescott	Oil & Gas Liaison	Olsson and Associates	
Bill Gavette	Deputy Fire Chief	Carbondale and Rural FPD	
Jake De Wolfe	Water Commissioner	Division of Water Resources	
Kirby Wynn	Oil & Gas Liaison	Garfield County	
Mike Samson	Commissioner	Garfield County	
Stacey Patch Bernot	Mayor	Town of Carbondale	

Development and Implementation Grant

The Town of Carbondale 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 Carbondale was approved for this grant in June, 2012, and it expires on June 30, 2016. All of the matching funds provided for the grant were in-kind. 100% of the funds will be used for the implementation of bmp's.

WATER SUPPLY SETTING

Location and Description

Carbondale, CO is a municipality covering an area of approximately two square miles, and is located in Garfield County on the Western Slope of Colorado. Primary access to the Town is through Colorado State Highways 82 and 133. Carbondale has 2251 households and a population of 6427 residents (according to the 2010 US census), and a small town charm. Future projections by Town of Carbondale estimate that growth will increase over the next ten years.

Carbondale takes its name from Carbondale, Pennsylvania, hometown of some of Carbondale's early settlers. Carbondale's economy was initially agriculturally based. Farmers and ranchers capitalized on open lands around Carbondale to supply food for miners in nearby Aspen, then a booming center of silver mining activity. Early in the 20th century, before the rise of industrial agriculture in Idaho, Carbondale's primary agricultural product was potatoes. The legacy lives on in Potato Day, an annual fall parade and cookout in Sopris Park. Despite the non-geologic origins of the town's name, the Carbondale area does in fact possess significant coal resources. Until the late 1980s Carbondale's economy was primarily based on coal operations up the Crystal River Valley. The coal mined from the area was favored for its high burning temperature, low sulphur content, and density. (US Gazetteer, 2014)

The majority of Town of Carbondale's source waters lie within municipal, county, public and private lands. Public lands are within the White River National Forest, managed by the Aspen - Sopris Ranger District and others managed by the Bureau of Land Management (BLM). Land use on private land consists of mainly agriculture and rural residential development.

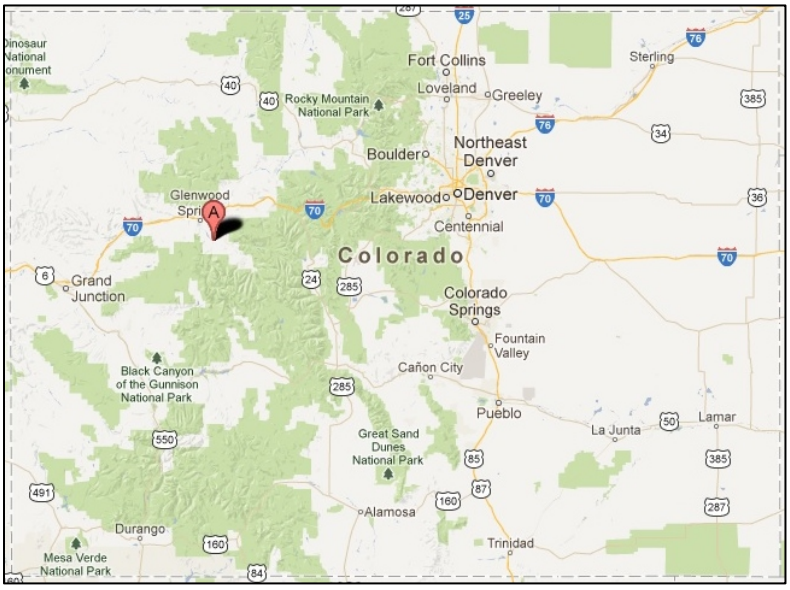

Figure 1: Town of Carbondale Location within Colorado. Source: Google Maps

Physical Characteristics

Carbondale is located at latitude 39^0 23' 39" N, longitude 107^0 12' 42" W. Mount Sopris, a 12,953 foot tall peak is the signature landscape marker and lies to the south of town. Carbondale lies within an open valley at the confluence of the Roaring Fork and Crystal Rivers. (Sperlings Best Places, 2013)

Carbondale has an average total precipitation of 16 inches, as indicated by long-term records for nearby Basalt and Glenwood Springs. (Western Region Climate Center)

Figure 2 shows a surface geology map of the watershed including a key for each geologic unit. Dr. John Emerick compiled this map, focusing on characteristics that could influence water quantity and quality. He relied on the following sources: Bryant, 1979; Freeman, 1971; Green, 1992; Tweto, 1979; and Olander et al., 1974. What follows is the geologic description that pertains to the Town of Carbondale area and an illustration that corresponds with Figure 2:

> Pennsylvanian evaporites reside in the area around Carbondale and were formed from the evaporation of shallow seawater. They are mostly found in the evaporitic parts of the Eagle Valley Formation. They are predominantly interbedded gypsum and dark grey shale beds of variable thickness, but believed to be around 3,000 feet thick at Cattle Creek. They have weak physical characteristics making it prone to unstable slopes; movement of surface or groundwater can produce serious subsidence problems; and the formation's minerals can contribute to chemical degradation or pollution of surface and groundwater. This formation presents serious problems and hazards to development. Pennsylvanian evaporites are found in patches north of Ruedi Reservoir, on lower Thompson Creek, and in several strips along the lower Roaring Fork River.

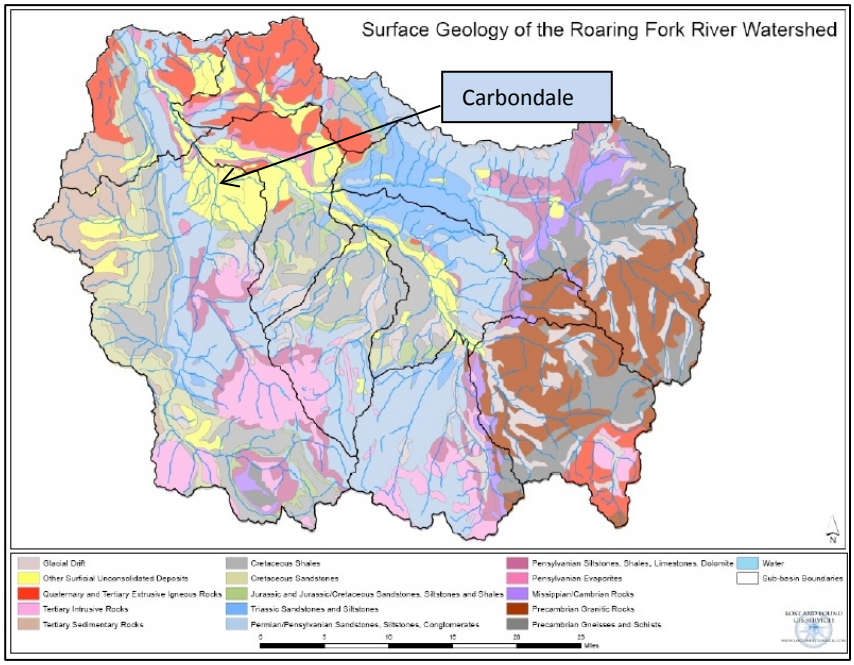

Figure 2: Surface geology of the Roaring Fork Watershed. *Source: Roaring Fork Watershed State of the River Report*

Hydrologic Setting

Nettle Creek is the principal source of drinking water for Town of Carbondale and lies on the western slope of Mount Sopris. Nettle Creek drains approximately five square miles and is part of the Roaring Fork River watershed (Hydrologic Unit Code (HUC) 1401004).

The secondary water supply is primarily from the Roaring Fork Wells. The Town has secured resources for this operation through advanced control systems and additional redundancy in mechanical equipment. The Town has also an off set with Solar production at the site which compliments energy efficiency in our water production. The Crystal well supply is normally operational throughout the year as a redundant back up supply.

The source water area for Town of Carbondale's ground water sources, Crystal River and Roaring Fork River Wells, respectively, overlies the greater Roaring Fork Aquifer. This is an unconfined aquifer consisting of alluvial sediments under gypsum which comes from the runoff from the nearby hillsides. Topography within the source water areas for the Crystal River and Roaring Fork River Wells is generally wide river bottomland and terraces with steep hillsides to the west.

Water Quality Standards

Under the Clean Water Act, every state must adopt water quality standards to protect, maintain and improve the quality of the nation's surface waters. Water quality is protected by the Colorado Water Quality Control Act through a number of state agencies. The CDPHE is the lead agency in Colorado.

The State of Colorado's Water Quality Control Commission has established water quality standards that define the goals and limits for all waters within their jurisdictions. Colorado streams are divided into individual stream segments for classification and standards identification purposes (Table 4). Standards are designed to protect the associated classified uses of the streams (Designated Use). Stream classifications can only be downgraded if it can be demonstrated that the existing use classification is not presently being attained and cannot be attained within a twenty year time period (Section 31.6(2)(b)). A Use Attainability Analysis must be performed to justify the downgrade.

To view the Stream Classifications and Water Quality Standards Table refer to Appendix A.

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.

Similar to surface water, the 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 or a designated use. The groundwater classifications are applied to groundwater 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. For an explanation of groundwater quality standards adopted by the CDPHE please refer to the following website: http://www.colorado.gov/cs/Satellite/CDPHE-Main/CBON/1251595703337

Town of Carbondale has petitioned the Water Quality Control Commission for the establishment of a classified groundwater area and associated site-specific ground water quality standards for its ground water intakes. Paul? Is this from your research?

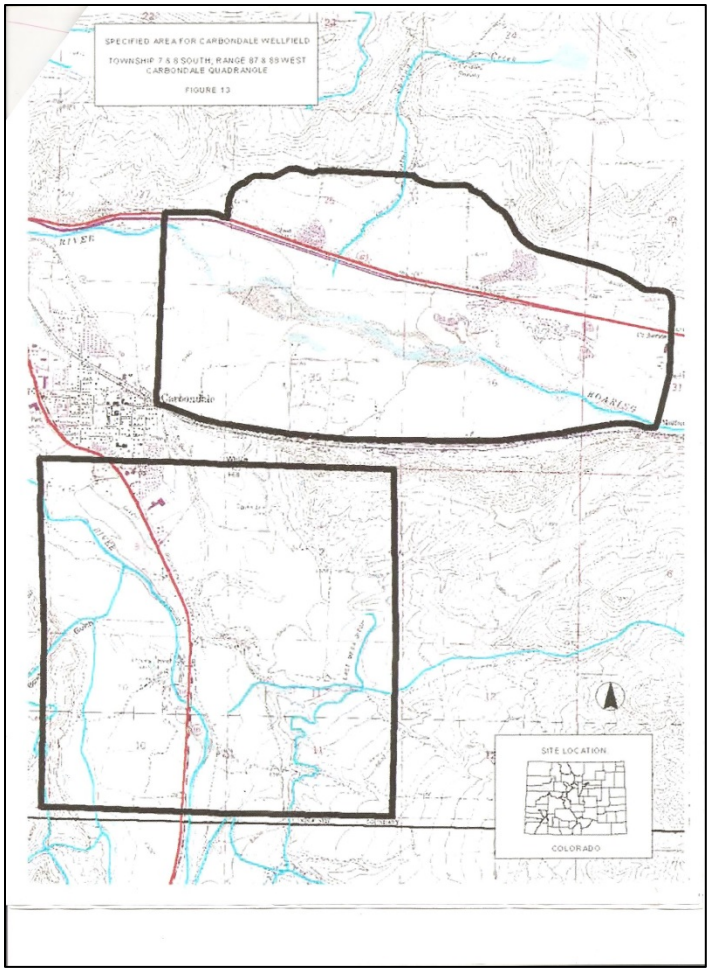

Figure 3: Groundwater Quality Standards Map for Carbondale Source: CDPHE

Water Quality Data

The water quality of Nettle Creek is spring fed from the northwest watershed basin of Mount Sopris. This water is known to have low alkalinity and low calcium carbonate hardness. Due to the sub surface and talus slope interface it is considered to be surface water although is not necessarily visible as surface water. Influences to water quality along South Nettle Creek are primarily snow melt which wash the talus rock as melt occurs in the spring. Rain events have the same effect. Water clarity (turbidity) is somewhat varied from this water supply due to precipitation events, coloring the water with sediments collected on the rock within the water shed. Generally the turbidity represents a clean mountain stream. Water from the South Nettle creek has been the main stay of the Town's water supply since the pioneers first established Carbondale. This water supply has been diverted to Town from South Nettle Creek along a nine mile conduit.

North Nettle Creek is very similar to South Nettle Creek. It is characterized as surface water which is visible as surface water throughout the watershed. It is typically fed from springs and seeps which is reflected in quantity by precipitation throughout the year. South Nettle Creek is the primary water supply to the town due to the high water quality and the fact that the water

flows by gravity to town from an elevation of ~7085 feet to the water plant at ~6831', then to town at an elevation of ~6242.

The Nettle Creek supply is treated with coagulation, filtration, and disinfection prior to delivery to the Town's customers.

The active Crystal Well is located within the Crystal River alluvium just south of town. The Crystal Well water quality is high and is presently classified as a tributary ground water supply, thus to date there is no need for a formal treatment process except for addition of disinfection. Water from this well is higher in alkalinity and calcium carbonate hardness than Nettle Creek which is typical of most ground water supplies in the area. Water from this source is evidenced to our customers as water which caused spotting on glass ware and calcium deposition where water evaporates off of glassware and plumbing fixtures which have a water to air interface. There is no evidence of this deposition occurring except where there is the air water interface. The well initially used for this supply had at one time been a source of taste and odor to the water supply. In 1997 a new well was put into production which does not have the taste and odor aspect. The Crystal Well is used to supplement the supply of Nettle Creek water mostly during the summer months for irrigation. This supply utilizes 2 pumps (from the well to a disinfection basin, then into the system).

The Roaring Fork Well system is a source for the Town as another ground water supply. There are three wells in production to supplement the Nettle Creek supply. This water is similar to the Crystal Well water, however this supply is considered to be a ground water under the influence of surface water (GWUDI). Due to this GWUDI classification, the Roaring Fork Wells supply needs to be formally treated with filtration and disinfection. The wells deliver water from the Roaring Fork Alluvium to a central pump station and reservoir which then pumps the water to a membrane filtration plant where filtration and disinfection takes place prior to pumping the supply into the delivery system.

All of the three water supplies are routinely tested for compliance with the constituent list of analytes for potable water supplies developed by the EPA and the Colorado Department of Public Health and Environment. The full list of constituents is available through the Utility Department.

In addition The Town of Carbondale has monitored water quality in the Crystal River, Town ditches, and the Roaring Fork River for a variety of analytes. The Town actively partners in on-going studies and inventory of the biota within the watersheds.
Water quality data for the Roaring Fork River and its' tributaries has been collected by multiple entities including the United States Geological Survey (USGS), CDPHE, Colorado Parks and Wildlife and, Roaring Fork Conservancy. Roaring Fork Conservancy trains and manages citizen volunteers made up of members of the community, including high school and middle school students.

The Colorado Data Sharing Network (CDSN) offers pertinent water quality data via their website and RFC has generated water quality summary reports for the Roaring Fork watershed, also available on their website.

For weblinks to these and other websites for water quality data please see Appendix B.

For further information on the water quality of the Town of Carbondale's drinking water please contact the Carbondale Water Department at 970-963-3140.

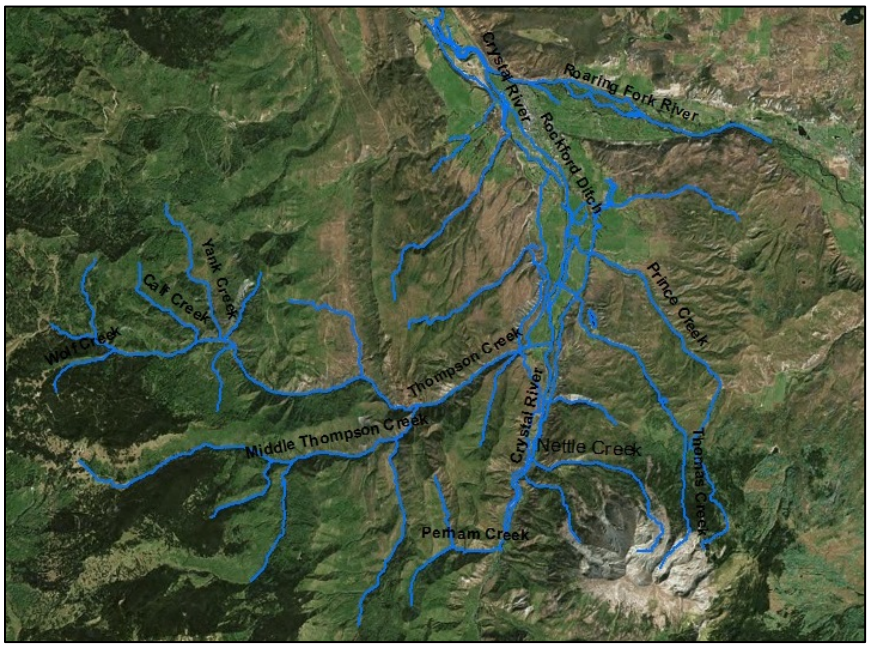

Figure 4: Nettle Creek, Thompson Creek and Crystal River Watersheds. *Source: CRWA*

Drinking Water Supply Operations

<u>Water Supply and Infrastructure</u>

South Nettle Creek is the principal source of drinking water for Town of Carbondale and lies on the western slope of Mount Sopris. The creek drains approximately five square miles and is part of the Roaring Fork River watershed (Hydrologic Unit Code (HUC) 1401004). The South Nettle Creek collection box captures flow at over 400 gallons per minute and from there the water is directed to the treatment plant. Flows are generated primarily from the annual melting of high-altitude snow fields.

The Crystal River Well lies within the Crystal River alluvium, is 75 feet deep and can draw up to 1 million gallons of water per day (gal/day). It operates year round based on need and utilizes chlorination for treatment.

The Roaring Fork River Wells consist of three shallow wells located on minimal use pasture on private property. They are approximately 75 feet deep and are used as a tertiary backup supply. Treatment is via membrane filtration and the treatment system can treat up to 1 million

gal/day. To view the Water System Process Schematic for Town of Carbondale please see Appendix C.

Table 5: Groundwater Supply Information * = groundwater under the influence of surface water

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)
Well Crystal River #2	123167-002	130 ft.	75 ft.	75 ft.	700 gpm	1997	045014	500 AF

Water System Facility Name	Water System Facility Number	Surface Water Source	Constructed Date	Appropriation Date	Appropriation Amount (af/yr)
*Well RFWF #1	123167-004	Roaring Fork River	1997	4/28/75	10 AF/Year
*Well RFWF #2	123167-005	Roaring Fork River	1997	4/28/75	10 AF/Year
*Well RFWF #3	123167-006	Roaring Fork River	1997	4/28/75	10 AF/Year

Table 6: Surface Water Supply Information

Water System Facility Name	Water System Facility Number	Surface Water Source	Constructed Date	Appropriation Date	Appropriation Amount (af/yr)
Nettle Creek South Spring	123167-003	Nettle Creek	1910	1910	2.88
Nettle Creek North Spring	123167-010	Nettle Creek	1997	1963	1.5

Figure 5: Nettle Creek Collection Box. *Source: CRWA*

Figure 6: Crystal River Well. *Source: CRWA*

Figure 7: Roaring Fork River Well #1 *Source: CRWA*

Water Supply Demand Analysis

Town of Carbondale serves an estimated 3,000 connections and approximately 6600 residents and other users in the service area annually. The water system currently has the capacity of meeting a peak (i.e., maximum) daily demand of 4 million gal/day. Current estimates indicate that the average daily demand by the water system's customers is approximately 600,000 gallons per day. Current estimates also indicate that the average peak daily demand is approximately 2 million gal/day. Using these estimates, the water system has a surplus average daily demand capacity of 1.4 million gal/day. Also using these estimates, the water system has a surplus average peak daily demand capacity of 2 million gal/day. The water system may not be able to meet the average daily demand of its customers if all of the water sources became disabled for an extended period of time. Also, the system may not be able to meet the average peak daily demand of its customers if as few as one of the water sources became disabled for an extended period of time.

The potential financial and water supply risks related to the long-term disablement of one or more of the community's water sources is a concern to the Steering Committee. To understand the potential financial costs associated with such an accident, Town of Carbondale 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 in excess of $1,000,000 in today's dollars to mitigate contaminant impacts to one of its water sources. Replacement costs could be significantly more than mitigation if contamination should necessitate the replacement of any of the Town's water sources.

The Steering Committee believes the development and implementation of a source water protection plan for Town of Carbondale and the community can help to reduce the risks posed by potential contamination of its water sources. Additionally, Town of Carbondale has developed an Emergency Response Plan utilizing a template created by Colorado Rural Water Association (CRWA) to coordinate rapid and effective response to any emergency incident that threatens or disrupts the community water supply. The Emergency Response Plan can be found in the Appendices of this plan.

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 8, respectively.

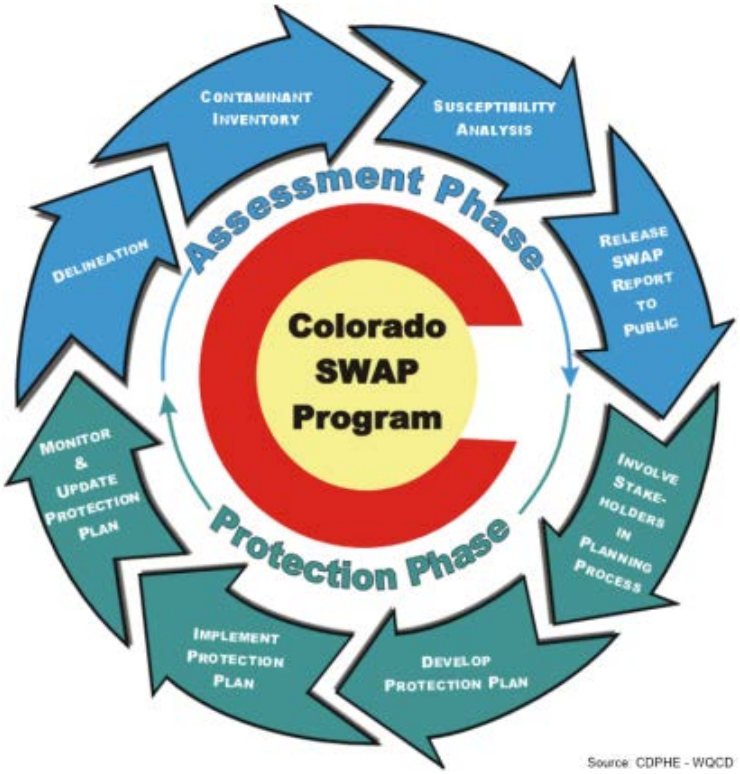

Figure 8: Source Water Assessment and Protection Phases.

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 the Town of Carbondale'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.

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 8, 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 8. 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.

To view the Source water Assessment Report and its Appendices for Town of Carbondale please see Appendices D and E.

SOURCE WATER PROTECTION PLAN DEVELOPMENT

Source Water Assessment Report Review

Town of Carbondale 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 best management practices to protect the source waters of Town of Carbondale from potential contamination. A copy of the Source Water Assessment Report for Town of Carbondale can be obtained by contacting Town of Carbondale or by downloading a copy from the CDPHE's SWAP program website located at: https://www.colorado.gov/pacific/cdphe/source-water-assessment-and-protection-swap

Defining the Source Water Protection Area

A source water protection area is the surface and subsurface areas within 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 the Town of Carbondale'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 Areas for each of Town of Carbondale'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 Area was created from the original source water assessment area based on the local issues of concern, conducting an onsite survey of land uses, immediacy of the potential contamination sources to the source water, the type of potential contaminants, parcel ownership and topographic mapping. Town of Carbondale delineated four Source Water Protection Areas including the Nettle Creek drainage, the Roaring Fork watershed near Carbondale, the Crystal River watershed near Carbondale and the Thompson Creek watershed. They are defined as:

Nettle Creek drainage

Zone 1 is defined as a 1,000 foot wide perimeter on both sides of Nettle Creek

Zone 2 represents the watershed boundary for the Nettle Creek.

Crystal River Wells near Carbondale

Zone 1 is defined as a 1,000 foot wide perimeter on both sides of the Crystal River and its tributaries.

Zone 2 represents a 156 square mile area that includes the Crystal River and its tributaries 15 stream miles upstream from the Crystal River Well.

Roaring Fork River Wells near Carbondale

Zone 1 represents the parcel ownership outline, a 4.8 square mile area.

Zone 2 is a 55 square mile area to the north and west of the wells.

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

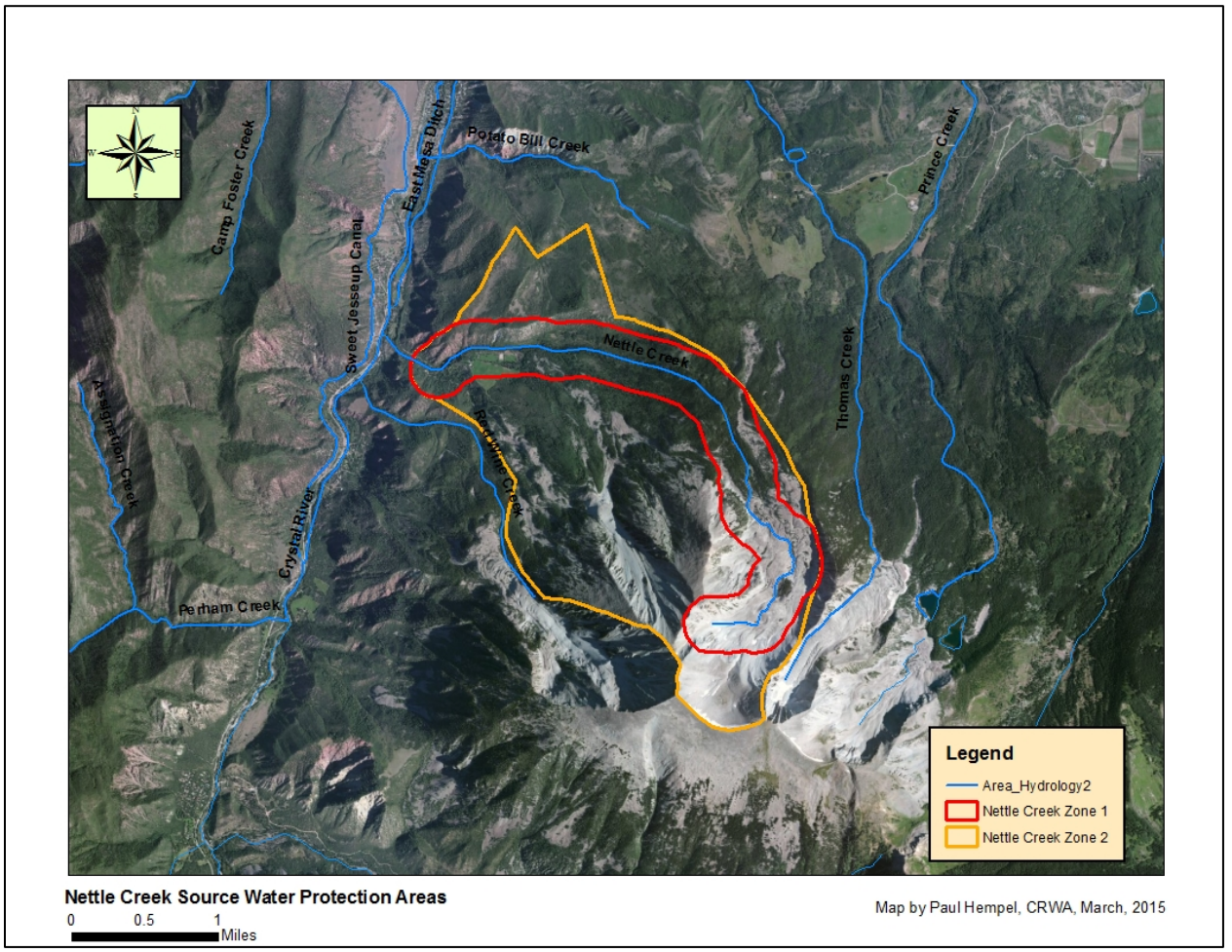

Figure 9: Nettle Creek Source Water Protection Areas. *Source: CRWA*

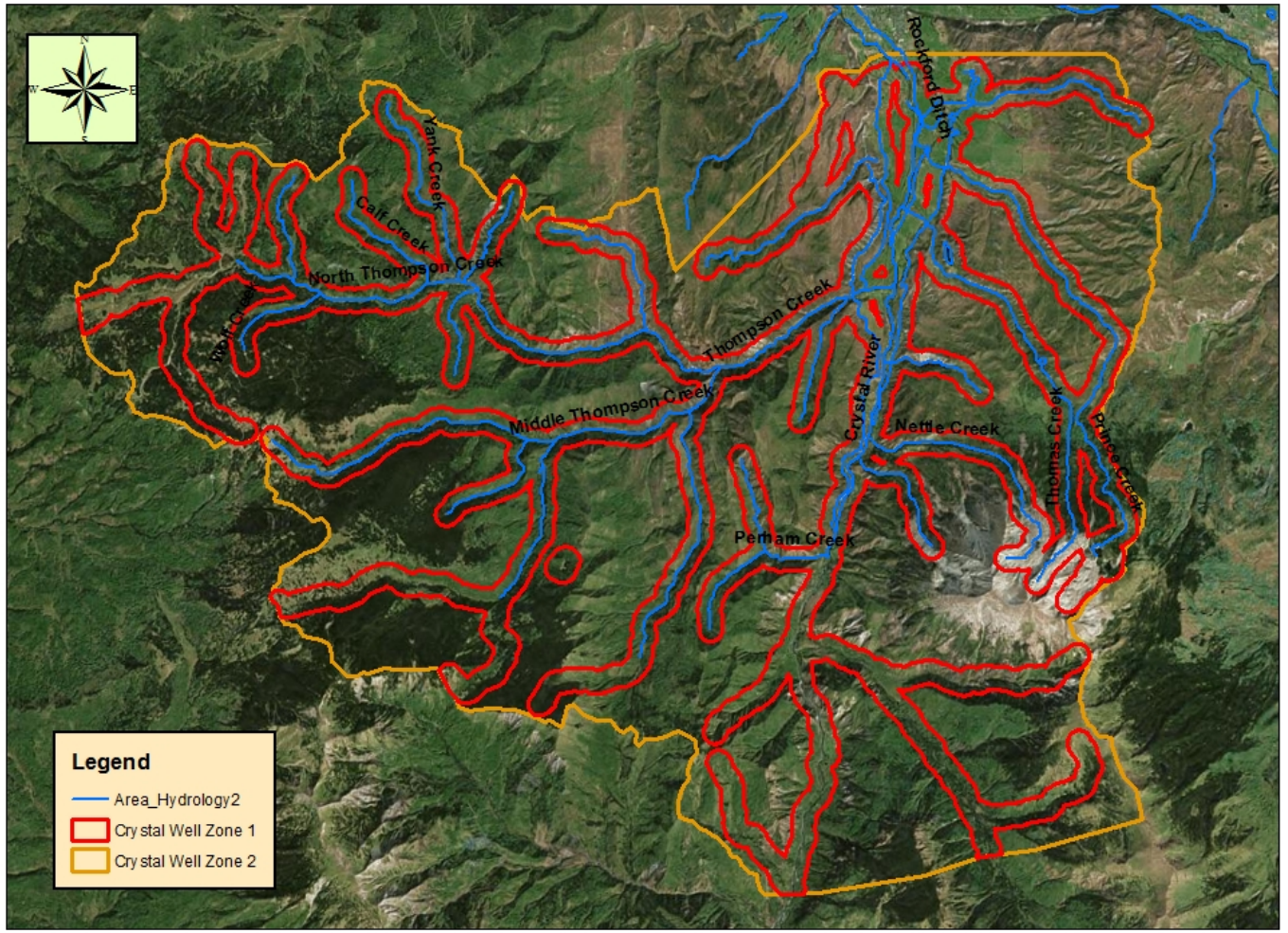

Figure 10: Crystal River Wells Source Water Protection Areas. *Source: CRWA*

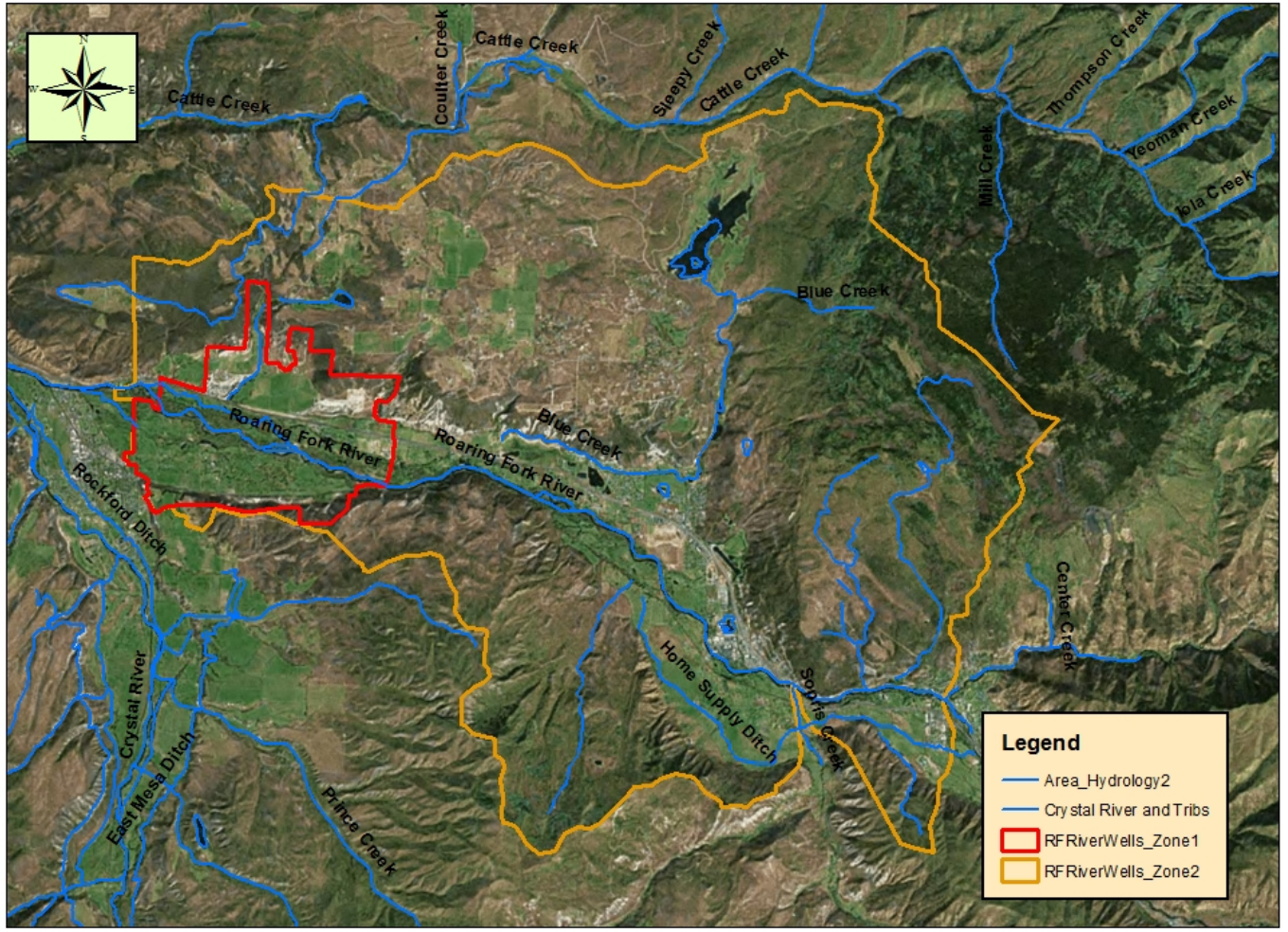

Figure 11: Roaring Fork River Wells Source Water Protection Areas. *Source: CRWA*

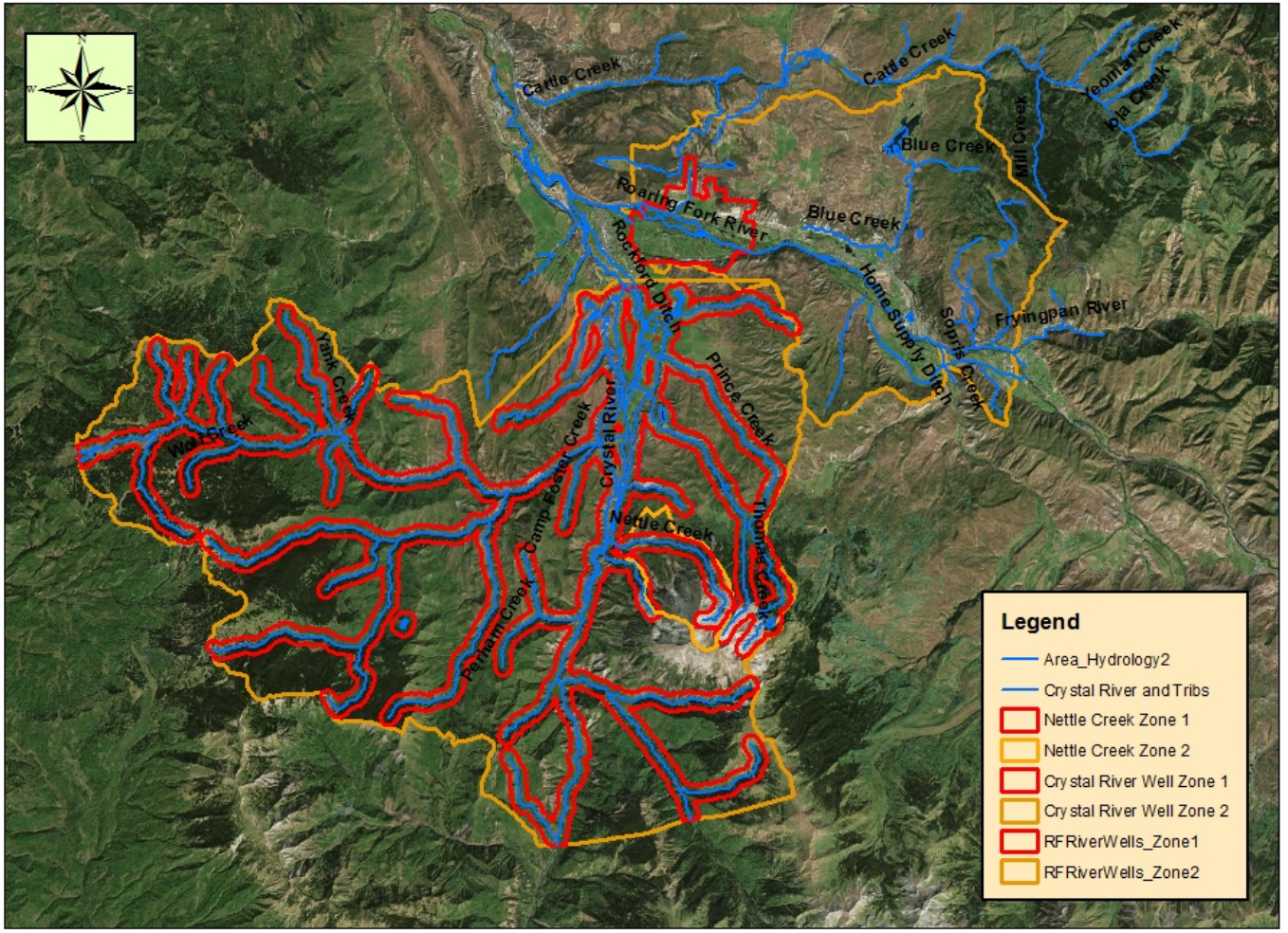

Figure 12: Town of Carbondale Source Water Protection Areas. *Source: CRWA*

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).

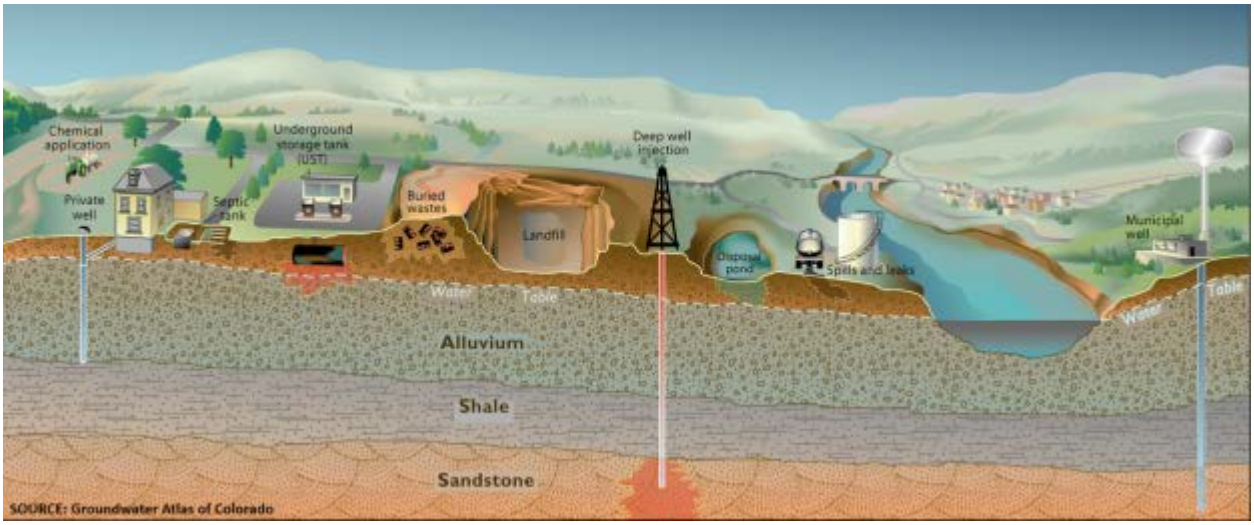

Figure 13: Schematic drawing of the potential source of contamination to surface and groundwater.

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. Discrete[2] 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 (non-point source) contaminant sources inventoried within the source water assessment area. The Town of Carbondale was asked, by CDPHE, to review the inventory

[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.).

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 Carbondale is reporting its findings to the CDPHE.

After much consideration, discussion, and input from local stakeholders, Town of Carbondale 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 Carbondale has decided to adopt it in place of the original contaminant source inventory provided by the CDPHE.

Nettle Creek Contaminant Source Inventory (in no particular order):
* There were no discrete or dispersed (non-point source) issues of concern identified in this watershed

Nettle Creek Additional Issues of Concern (in no particular order)**:**

- Residential
- Future Land development
- Stormwater
- Agriculture
- Wildfire
- Outdoor Recreation
- Plane Crashes

Crystal River Wells Contaminant Source Inventory (in no particular order):

- Oil and Gas Operations
- Septic Systems
- Above and Below Ground Storage Tanks
- Transportation and Roadways
- Residential Practices
- Agricultural Practices
- Storm Water Runoff
- Dry wells
- Existing Abandoned Mine Sites
- Commercial/Industrial Operations (see below businesses):
    - Asphalt, Sand and Gravel Operations
    - Automobile Shops
    - Carpet Cleaners
    - Cleaners
    - Copying and Printing
    - Furniture Repair
    - Golf Courses
    - Landscapers
    - Oil and Petroleum Companies

- Restaurants
- Sheet Metal Fabrication
- Veterinarians
- Welders

Crystal River Wells Additional Issues of Concern
(in no particular order)**:**

- Wildfire
- Outdoor Recreation
- Plane Crashes
- Developed and/or Degraded Riparian Areas
- Future Land Development

Roaring Fork River Wells Contaminant Source Inventory (in no particular order):

- Oil and Gas Operations
- Septic Systems
- Above and Below Ground Storage Tanks
- Transportation and Roadways - (Highway 82)
- Residential Practices
- Agricultural Practices
- Sludge Spray Disposal
- Storm water Runoff
- Permitted Wastewater Discharge Sites
- Solid/Hazardous Waste Sites
- Commercial/Industrial Operations (see below businesses):
  - Asphalt, Sand and Gravel Operations
  - Automobile Shops
  - Carpet Cleaners
  - Cleaners
  - Copying and Printing
  - Furniture Repair
  - Golf Courses
  - Landscapers
  - Oil and Petroleum Companies
  - Restaurants
  - Sheet Metal Fabrication
  - Veterinarians
  - Welders

Roaring Fork River Wells Additional Issues of Concern (in no particular order)**:**

- Developed and/or Degraded Riparian Areas
- Future Land Development
- Ranch at Roaring Fork Golf Course

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. The following was considered by the Steering Committee when devising this strategy:

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 potential sources of contamination to the Town of Carbondale 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 Tables 7 - 9 as a method to further rank their potential sources of contamination. Tables of discrete and dispersed contaminant sources can be found in Appendices F - I.

Table 7: Priority Strategy for Nettle Creek

Issue/Contaminant	In Our Control?	Impact (H, M, L)	Probability (H, M, L)	Total Factor (H, M, L)	Priority for Focus
Wildfire	Yes – via defensible space	Treatment Plant Structure - H	M	H	1
Outdoor Recreation	Yes - indirect	L	L	L	2
Camping and Hiking	Yes - indirect	L	L	L	2
Agricultural Practices	Yes*	H	L	M	2
Residential Practices	Yes*	M	L	M	2
Future Land Development	Yes*--indirect	M	L	M	2
Storm Water Runoff	Yes*	M	L	M	2
Plane Crashes	No	L	L	L	3

Table 8: Priority Strategy for Crystal River Wells

Issue/Contaminant	In Our Control?	Impact (H, M, L)	Probability (H, M, L)	Total Factor (H, M, L)	Priority for Focus
Oil and Gas Operations	Yes*	M	N	M	1
Septic Systems	Yes – indirect Cross County	M	M	M	1
Above/Below Ground Storage Tanks	Yes*	M	L	L	2
Transportation and Roadways	Yes - indirect	M	M	M	1
Residential Practices	Yes* – indirect	L	M	M	2
Agricultural Practices	Yes*	M	M	M	2

Storm Water Runoff	Yes*	L	L	L	3
Dry Wells	Yes – indirect	L	L	L	3
Existing/Abandoned Mine Sites	Yes*	M	L	L	3
Commercial/Industrial Operations	Yes* – indirect	L	L	L	3
Wildfire	No	L	M	L	2
Outdoor Recreation	Yes - indirect	L	L	L	3
Plane Crashes	No	M	L	L	3
Developed and/or Degraded Riparian Areas	Yes – indirect	M	M	M	2
Future Land Development	Yes –direct within Town limits, indirect beyond Town limits	H	H	H	1

Table 9: Priority Strategy for Roaring Fork River Wells

Issue/Contaminant	In Our Control?	Impact (H, M, L)	Probability (H, M, L)	Total Factor (H, M, L)	Priority for Focus
Oil and Gas Operations	Yes*	L* Depending upon future development	L	L	3
Septic Systems	Yes - indirect	M	M	M	1
Above and Below Ground Storage Tanks	Yes*	M	L	L	3
Transportation and Roadways	Yes – indirect	M	H	M	2
Residential Practices	Yes*	L	M	L	3
Agricultural Practices	Yes*	M	M	M	2
Sludge Spray Disposal	Yes	L	L	L	3
Storm Water Runoff	Yes*	M	M	M	3
Permitted Wastewater Discharge Sites	Yes – indirect	L	L	L	3
Solid/Hazardous Waste Sites	Yes – indirect	M	M	M	2
Gravel Pits (United Co & Western Slope Aggregates	Yes – indirect	L	L	L	2
Commercial/Industrial Operations (Catherine Store Area)	Yes – indirect	L	L	L	3

Developed and/or Degraded Riparian Areas	Yes – indirect	M	M	M	2
Future Land Development	Yes – indirect	M	M	M	2
Ranch @ RF Golf Course	Yes*	L	L	L	3

*The Town of Carbondale is expressly authorized by C.R.S. 31-15-707(1)(b) to prevent pollution of source water supplies within five miles of its water intakes. Pursuant to this statutory authority, the Town of Carbondale has established a 5 mile watershed protection ordinance which provides that "it is unlawful for any person or entity to pollute or contaminate . . . or to keep or conduct any business which will contaminate or pollute or lead to the contamination or pollution of" the Town's source water within 5 miles of the point(s) from which water is taken. Carbondale Municipal Code Section 13.32.030. The ordinance defines the terms "pollute" and "contaminate" to include "the manmade, man-induced, animal-induced, or natural alteration of the physical, chemical, biological, and radiological integrity of water." *Id.* § 13.32.010(B). This authority therefore applies to all such potential pollutants, including "non-point" sources such as contamination due to the use of herbicides or pesticides. In addition to the Town's 5-mile watershed protection authority, COGCC Rule 317B includes protective measures to safeguard against potential source water contamination due to oil and gas development activities within 15 miles of the Town's intakes.

Based on the above criteria and calculations from Tables 7 - 9, 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 (#1 Ranking)

- Wildfire (Nettle Creek Intakes)
- Septic Systems (Crystal Wells, RF River Wells)
- Oil and Gas Operations (Crystal Wells)
- Transportation and Roadways (Crystal Wells)
- Future Land Development (Crystal Wells)

Susceptibility Analysis of Water Sources

Town of Carbondale's Source Water Assessment Report contained a susceptibility analysis[3] 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

[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.

information at the time of the analysis. The 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 the susceptibility analysis, the Steering Committee determined that the Physical Setting Vulnerability Rating and the Total Susceptibility Rating needed to be updated to more accurately reflect the current situation.

Table 10: Updated Susceptibility Analysis

Source ID #	Source Name	Source Type	Total Susceptibility Rating	Physical Setting Vulnerability Rating
123167-003, 010	Nettle Creek	Surface Water	Medium	Moderately High
123167-002	Crystal Well	Groundwater	Moderately High	Medium
123167-004,5 & 6	Roaring Fork Wells	Groundwater	Moderately High	Moderately High

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 may pose a threat to the water source(s) and outlines best management practices. Discussion focuses on #1 and #2 priority strategies.

1. Wildfire – Nettle Creek Intakes and Crystal River Wells

Much of the attention paid to wildfire and its impacts on the hydrologic cycle focuses on increased danger from flooding and mudslides during the immediate post-fire period. While threats to human health and safety posed by floods, debris flows, and mudslides certainly cause the greatest concern, water quality impacts and their associated risks are nonetheless critical for water utilities and regulatory agencies to address. Important questions are:

1. What impact does wildfire have on surface water quality?
2. How long does the impact last?
3. How far away from burned areas can water quality impacts be felt?
4. What beneficial uses can be affected by the changes in water quality induced by wildfire?
5. How can adverse impacts of wildfire on water quality be prevented, mitigated, or otherwise minimized?

The quality of surface waters can be examined in terms of physical, chemical, and biological characteristics. Here we consider only the impacts of fire on physical and chemical water properties, based on research in the coniferous forests and chaparral watersheds of California. Biological impacts are inferred from the changes in the physical and chemical properties of surface waters.

Most impacts on the physical characteristics of fire-impacted streams are evidenced by changes in sediment load. Increased sediment flows following a fire can impact both ecological health and drinking water operations. The large quantities of post-fire sediment can overwhelm the biological habitat available for aquatic organisms such as fish, as well as organisms that depend on water for some life stage, such as amphibians and insects.

Large post-fire sediment fluxes impact drinking water systems two ways. First and perhaps foremost is the danger that reservoirs, infiltration basins, and treatment works will be filled, damaged, or otherwise disrupted by sediment. Second, high sediment load is likely to increase

pre-treatment processing needs (and costs) for suspended sediment removal. These impacts are highest in areas immediately adjacent to fires. (Meixner and Wohlgmuth, 2004)

Wildfire and related suppression activities are also potential sources for surface water contamination. Sources of contaminants from a burned area may include increased sediment, debris, and ash flows into surface waters. The chemicals used in fire retardants can also be a source of contamination should they migrate through runoff into drinking water supplies. The degree of contamination is controlled by the size of the burned area, distance to surface water, remaining vegetation cover, terrain, soil erosion potential, and subsequent precipitation and intensity (Walsh Environmental, 2012). The potential of a watershed to deliver sediments to surface waters after a wildfire depends on forest and soil conditions, the physical condition of the watersheds, and the sequence and magnitude of rain fall on the burned area. In cases of a high-severity fire, normal runoff and erosion processes can be dramatically altered and magnified.

Most of Colorado's wildfires are caused by lightning strikes from the many thunderstorms that pass through the state on a regular basis during the summer months. Lightning strikes sometimes create hotspots which can spread into full-fledged fires under the right conditions. Backcountry recreational activity involving irresponsible fire safety practices by campers and hikers can also lead to the occurrence of wildfire.

Figure 14: Wildfire in Relation to Community Water System Source: KMGH Channel 7

Figure 15: Debris and Mudflow from Post Wildfire Storm Event Source: CRWA

Community Wildfire Protection Plan

In 2005 Pitkin County Emergency Management developed the Pitkin County Wildland Fire Plan (PCWFP). Pitkin County adopted the use of the Colorado State Forest Service's (CSFS) State-wide Wildfire Hazard Map and the tools used in its development (Geographical Information System (GIS) based analysis). The map takes into consideration slope, aspect, fuel types, potential ignition sources, housing density, road density, and lighting strikes. The accuracy of the assessment was further enhanced by utilizing more accurate United States Forest Service (USFS) Vegetation Data, as well as GAP vegetation data from the State, and finally Pitkin County's own vegetation data layer. Using these other vegetation data resources, we produced more Wildland Fire Hazard Maps. Figure 18, below, shows the area around the Nettle Creek Intakes and Thompson Creek drainage as having moderately high ratings.

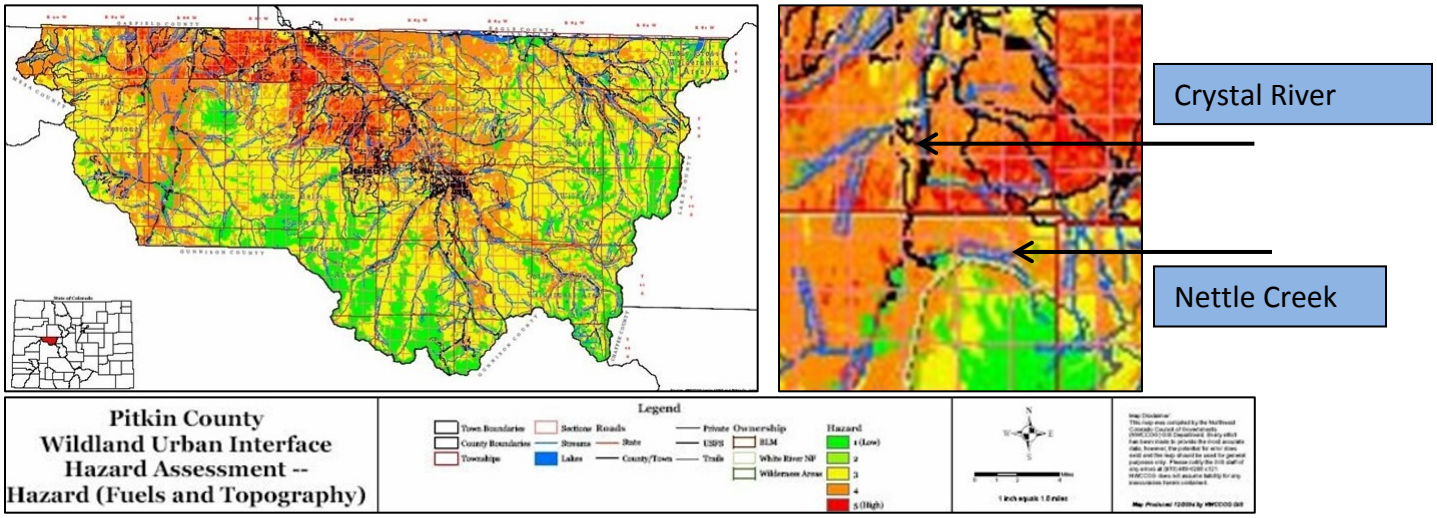

Figure 16: NWCCOG_WUI_hazard2, map showing hazard assessment (fuels and topography)
Source: Pitkin County Wildland Fire Plan


Figure 17: Fuels and topography near Nettle Creek intakes and treatment building Source: CRWA

Subsequently in 2012, Walsh Environmental Scientists and Engineers developed the Garfield County Community Wildfire Protection Plan (GCCWPP). The plan purposes include the assessment of wildfire risks (including fuel hazards, structure flammability, and vegetation-fuel) to Carbondale and the surrounding areas in Garfield County and to help communities and their local fire departments coordinate their preparation and response to a wildfire. The CWPP is focused on the Wildland-Urban Interface. As has been evidenced, wildfires can pose significant threats to water supplies.

A comprehensive community wildfire assessment takes into account a variety of factors in order to fully identify and assess wildfire risks and hazards. These include the nature of community infrastructure, terrain, proximity of hazardous fuels, and probability of wildfire occurrence. By analyzing these elements, including input from residents and FPDs, an understanding of wildfire risks and hazards can be developed that provides guidance for developing effective vegetation-fuel treatments and other mitigation opportunities to improve FPD response capabilities. (Walsh Environmental, 2012)

Table 11: Overall Risk Summary for the Wildland Urban Interface Areas in Garfield County
Source: Walsh Environmental, Garfield County Community Wildfire Protection Plan

Wildland Urban Interface	Community	NFPA 1144 Community Hazard Rating	FRCC Hazard Rating	FBFM Hazard Rating	WFSI Risk Rating	WFII Risk Rating	Overall Risk
Burning Mountains	Silt	Moderate	High	High	Low to Moderate	Low to Moderate	High
	New Castle	High					
Carbondale & Rural	Carbondale	Moderate	Low to High	High	Very High	Moderate	Extreme
	Missouri Heights	Moderate to Extreme[2]					
De Beque	Dispersed	High	High	High	Low	Low to Moderate	High
Glenwood Springs	Greater Glenwood Springs	High to Very High[1]	High	High	High to Very High	Low to Moderate	Extreme
Grand Valley	Battlement Mesa	Moderate	High	High	Low to Moderate	Low to Moderate	High
	Parachute	Moderate					
	Rulison	High					
Gypsum	Dispersed	High	Low to High	High	Low to Moderate	Low to Moderate	High
Lower Valley	Dispersed	High	High	High	Low	Low to Moderate	High
Rifle	Rifle	Moderate	High	High	Low	Moderate	High

[1] Based on Glenwood Springs Fire District CWPP
[2] Based on Carbondale & Rural Fire Protection District CWPP

As can be seen in Table 11 above, the area including and surrounding Carbondale has an "Extreme" wildfire hazard rating. The Steering Committee feels that there is enough of a potential danger to the intakes if a catastrophic wildfire should occur and has decided to proceed with education and outreach to the hunters and campers on how to prevent unwanted fire emissions from happening. Additionally, the steering committee recommends that wildfire mitigation occur with fuels treatment and infrastructure improvements to the treatment building.

Wildfire Best Management Practices:

1. Post Source Water Protection signage at trailheads.

2. Provide a copy of the final source water protection plan along with GIS shapefiles of the protection areas to local Fire Departments, Sheriff's Departments, Office of Emergency Management Departments, USFS, CSFS, BLM and any other agencies/departments involved in fire and land management for consideration during fire suppression as well as when planning and implementing wildfire mitigation projects.

3. Collaborate with consultants/engineers who authored the Pitkin County Wildland Fire Plan and Garfield County Community Wildfire Protection Plan, to overlay the SWPA's on the Wildfire Susceptibility Analysis maps to identify high-risk areas and determine recommended action items.

Future High Priority Wildfire Best Management Practices:

4. Wildfire mitigation around intakes and treatment plant including re-siding the treatment building and fuels mitigation utilizing a USFS Stewardship Contract.

5. Installation of a T and two valves to divert flows back to Nettle Creek to mitigate mud and debris from entering pipes that lead into treatment plant.

2. Oil and Gas Operations – Crystal Wells

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, the steering committee decided to include fracking as a potential threat to drinking water supplies. (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.

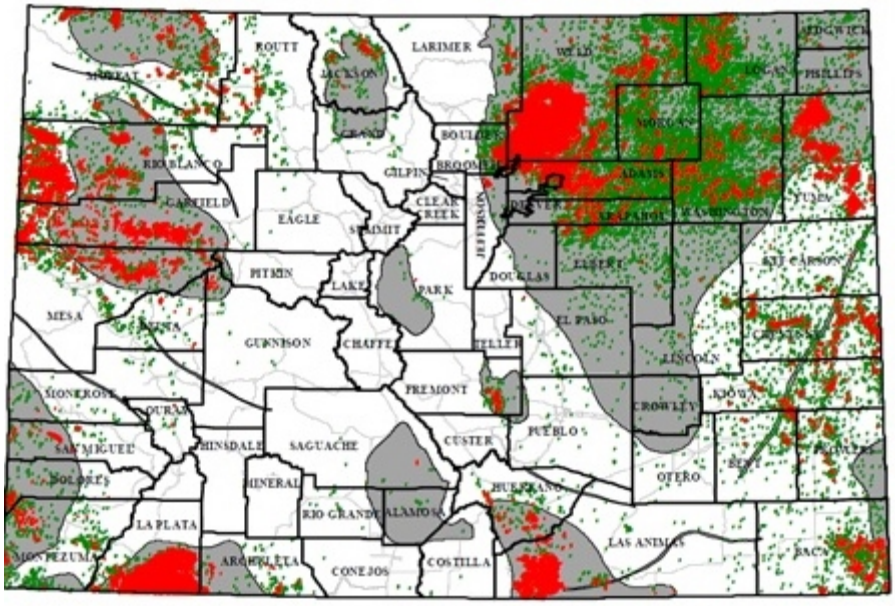

Figure 18: Oil and Gas Well Locations in Colorado Source: oilandgasbmps.org

While water withdrawals directly affect the availability of water for other uses, water withdrawals can also affect water quality. For example, withdrawals of large volumes of water can adversely impact groundwater quality through a variety of means, such as mobilizing naturally occurring substances, promoting bacterial growth, causing land subsidence, and mobilizing lower quality water from surrounding areas. Similarly, withdrawals from surface water can affect the hydrology and hydrodynamics of the source water (U.S. EPA 2011a), and reductions in the volume of water in a surface water body can reduce the ability to dilute municipal or industrial wastewater discharges.

Given the proposed expansion of drilling in many regions, conflicts between natural gas companies and other users are likely to intensify. More and better data are needed on the volume of water required for hydraulic fracturing and the major factors that determine the volume, such as well depth and the nature of the geological formation. Additional analysis is needed on the cumulative impacts of water withdrawals on local water availability, especially given that water for hydraulic fracturing can be a consumptive use of water. Finally, more research is needed to identify and address the impacts of these large water withdrawals on local water quality. This work must be done on a basin-by-basin level.

<u>Groundwater Contamination Associated with Well Drilling and Production</u>

Groundwater contamination from shale gas operations can occur through a variety of mechanisms. Natural gas is located at varying depths, often (but not always) far below underground sources of drinking water. The well bore, however, must be drilled through these drinking water sources in order to access the gas. Vibrations and pressure pulses associated with drilling can cause short-term impacts to groundwater quality, including changes in color, turbidity, and odor (Groat and Grimshaw 2012). Chemicals and natural gas can escape the well bore if it is not properly sealed and cased. While there are state requirements for well casing

and integrity, accidents and failures can still occur, as was demonstrated by an explosion in Dimock, Pennsylvania (see Box 2 for more information). Old, abandoned wells can also potentially serve as migration pathways (U.S. EPA 2011b) for contaminants to enter groundwater systems. States have estimated that there are roughly 150,000 undocumented and abandoned oil and gas wells in the United States (IOGCC 2008). Natural underground fractures as well as those potentially created during the fracturing process could also serve as conduits for groundwater contamination (Myers 2012). Finally, coalbed methane is generally found at shallower depths and in closer proximity to underground sources of drinking water and therefore accessing the natural gas from this source might pose a greater risk of contamination. (Pacific Institute, 2012)

Elevated levels of methane and other aliphatic hydrocarbons such as ethane and propane in shallow drinking water wells pose a potential flammability or explosion hazard to homes with private domestic wells. The saturation level of methane in near-surface groundwater is about ~28 mg/L (~40 cc/L) and thus the U.S. Department of the Interior recommends monitoring if water contains more than 10 mg/L (~14 cc/L) of methane and immediate action if concentrations rise above 28 mg/L. Several states have defined a lower threshold (e.g., 7 mg/L in PA), from which household utilization of methane-rich groundwater is not recommended. Stray gas migration in shallow aquifers can potentially occur by the release of gas-phase hydrocarbons through leaking casings or along the well annulus, from abandoned oil and gas wells, or potentially along existing or incipient faults or fractures with target or adjacent stratigraphic formations following hydraulic fracturing and drilling. The latter mechanism poses a long-term risk to shallow ground- water aquifers. Micro seismic data suggest that the deformation and fractures developed following hydraulic fracturing typically extend less than 600 m above well perforations, suggesting that fracture propagation is insufficient to reach drinking-water aquifers in most situations. This assertion is supported by noble gas data from northeastern Pennsylvania; yet stray gas migration through fractures and faults is considered a potential mechanism for groundwater contamination. (Environmental Science and Technology, 2014)

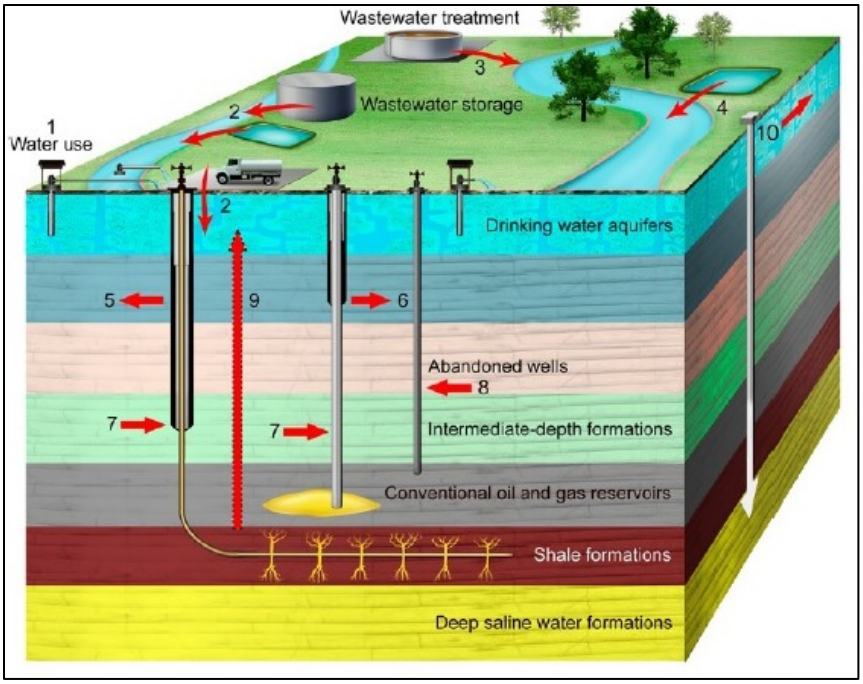

Figure 19: Schematic illustration (not to scale) of possible modes of water impacts associated with shale gas development: (1) overuse of water that could lead to depletion and water- quality degradation particularly in water-scarce areas; (2) surface water and shallow groundwater contamination from spills and leaks of wastewater storage and open pits near drilling; (3) disposal of inadequately treated wastewater to local streams and accumulation of contaminant residues in disposal sites; (4) leaks of storage ponds that are used for deep-well injection; (5) shallow aquifer contamination by stray gas that originated from the target shale gas formation through leaking well casing. The stray gas contamination can potentially be followed by salt and chemical contamination from hydraulic fracturing fluids and/or formational waters; (6) shallow aquifer contamination by stray gas through leaking of conventional oil and gas wells casing; (7) shallow aquifer contamination by stray gas that originated from intermediate geological formations through annulus leaking of either shale gas or conventional oil and gas wells; (8) shallow aquifer contamination through abandoned oil and gas wells; (9) flow of gas and saline water directly from deep formation waters to shallow aquifers; and (10) shallow aquifer contamination through leaking of injection wells.
Source: Environmental Science and Technology

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.

Town of Carbondale 5-mile watershed protection ordinance

Pursuant to C.R.S. 31-15-707(1)(b), which authorizes Colorado municipalities to prevent pollution of source water supplies within five miles of water intakes, the Town of Carbondale has established a 5 mile watershed protection ordinance which provides that "it is unlawful for any person or entity to pollute or contaminate . . . or to keep or conduct any business which will contaminate or pollute or lead to the contamination or pollution of" the Town's source water within 5 miles of the point(s) from which water is taken. Carbondale Municipal Code Section 13.32.030. The ordinance defines the terms "pollute" and "contaminate" to include "the manmade, man-induced, animal-induced, or natural alteration of the physical, chemical, biological, and radiological integrity of water." *Id.* § 13.32.010(B). This authority therefore

applies to potential contamination of source water from oil and gas development activity within five miles of the Town's intakes.

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, effective July 2013. Rule 609 mandates 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.

The COGCC Rule 317B can be found in Appendix J.

Storm Water Management Permitting

To prevent adverse impacts from construction activities associated with oil and gas development, the industry is required to obtain a Storm Water Management Permit from the CDPHE's Water Quality Control Division. Compliance with the permit requires the preparation and implementation of a Storm Water Management Plan for systematic monitoring of the site and establishment of site specific adaptive best management practices. These could consist of ditches or berms, silt fences, straw wattles, or other erosion control methods.

US EPA: Spill Prevention, Control and Countermeasure (SPCC) 40 CFR 112

To further prevent contamination to water supplies from spills, The U.S. Environmental Protection Agency (EPA) requires oil and gas facilities that have an aggregate aboveground oil storage capacity greater than 1,320 gallons implement an SPCC plan, including providing secondary containment for large tanks or other bulk storage containers. The plan must describe oil handling operations, spill prevention practices, discharge or drainage controls and the personnel, equipment and resources at the facility that are used to prevent oil spills reaching navigable waters.

Garfield County's Role

Within the Garfield County Building and Planning Department, the oil and gas liaison works with citizens, industry, local, State and Federal agencies and to understand and respond to oil and gas development issues. The County does not regulate down-hole aspects of oil and gas drilling and production, but does regulate the permitting for many aspects of the associated surface land uses including facilities and use of county roadways. The county oil and gas liaison serves as the local government designee to the COGCC to review location and drilling permit applications.

The Garfield County Board of County Commissioners formed the Garfield County Energy Advisory Board (EAB) in 2004. The Board's mission is to provide a forum for the oil and gas industry, the public, impacted landowners and local government to prevent or minimize conflict associated with oil and gas development through positive and proactive communication and actions that encourage responsible and balanced development of these resources within Garfield County. (Hill, 2013)

Garfield County will likely remain a major producer of natural gas for years to come, particularly as this energy source has been touted the "transition fuel" in our nation's search for cleaner energy sources. As of 2012, Garfield County represents 28% of oil and gas activity in the State of Colorado. The local economy has benefited from the jobs created by the industry as well as substantial tax revenues that are brought into the county.

Pitkin County's Role

Like Garfield County, Pitkin County regulates surface land uses associated with oil and gas development, including facilities and use of county roadways. The county's oil and gas liaison serves as the local government designee to the COGCC to review location and drilling permit applications. Since much of the land with oil and gas potential in Pitkin County is under federal ownership, the County also works with federal agencies of jurisdiction to advance the concerns of the County and its citizens as the federal government addresses oil and gas development proposals.

The Bureau of Land Management (BLM) and US Forest Service (USFS)

The US Bureau of Land Management (BLM) manages 261 million acres of public land and another 700 million acres of sub-surface minerals. They enforce conditions of approval to each well drilled under their jurisdiction through the NEPA (National Environmental Policy Act) process. In their 2004 Best Management Practice policy, the BLM instructs field offices to incorporate appropriate BMPs into Applications for Permit to Drill and associated on- and off-lease approvals. The US Forest Service (USFS) manages and permits surface uses on their lands; however, the BLM still manages sub-surface mineral extraction. A COGCC permit is required for all drilling on federal lands.

Piceance Basin

The Piceance Basin has been a center of oil and gas activity for decades. When oil shale was poised to become a major component of our national oil supply in the late 1970's, major

companies constructed housing and amenities in Garfield County for their proposed workers. This “boom went bust” in the early 1980s when oil prices dropped and government subsidies dried up.

These early endeavors were only the beginning of what has become a thriving natural gas industry in the Piceance Basin. New technology, rising demand and rising prices have made this area attractive to national energy development companies such as Williams, WPX Energy, EnCana, Ursa Resources, Vanguard Corporation, Shell, and Chevron. Large scale energy development has been underway since the late 90’s. While the recent economic recession has caused natural gas prices to fall and reduced resource development, the industry remains a prevalent part of Garfield County’s economy. (Hill, 2013)

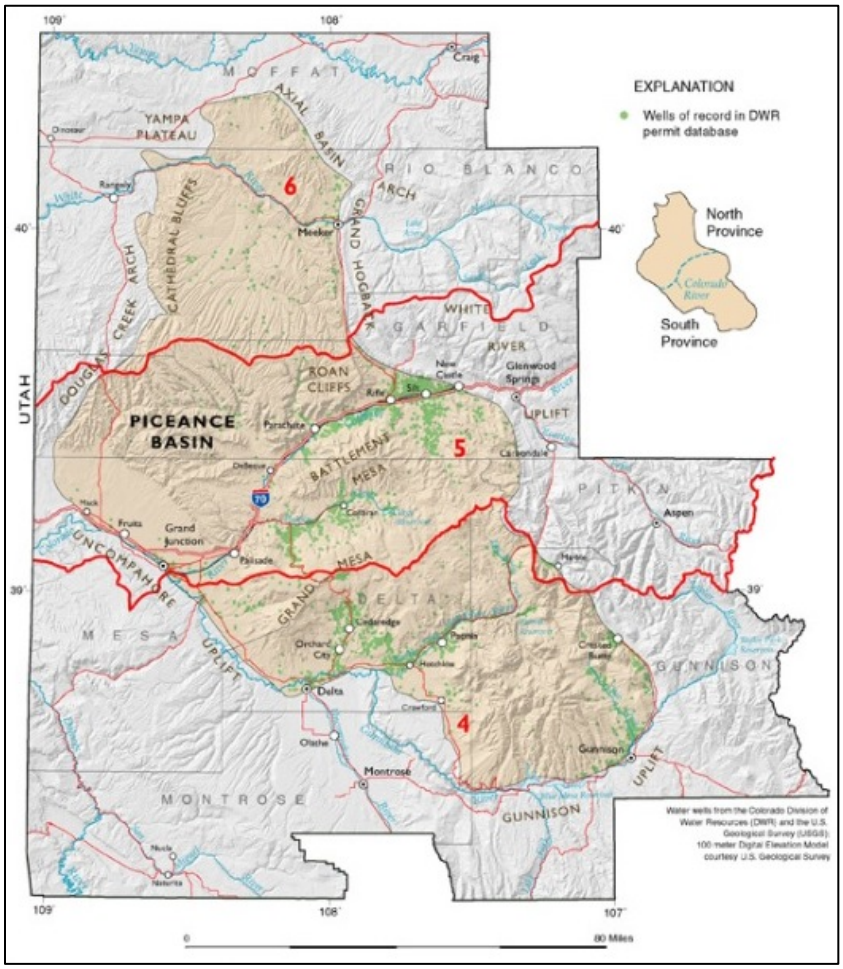

Figure 20: Piceance Basin *Source: Colorado Geological Survey*

The Crystal River Wells source water protection areas for Town of Carbondale includes Thompson Creek which is located at the southeastern edge of the Piceance Basin in an area known as the Thompson Divide. There are numerous oil and gas leases in this area.

The Thompson Divide area covers 221,500 acres of Federal land in Pitkin County (88,100 acres), Gunnison County (51,700 acres), Garfield County (43,500 acres), Mesa County (30,500 acres) and Delta County (7,700 acres). In 2003 the BLM issued 81 mineral leases in the Thompson Divide. There are currently 61 active lease holdings in the area covering approximately 105,000 acres. Half of the leases are in roadless areas and do not contain surface stipulations.

Existing leases in the Thompson Divide amount to less than 1 percent of active leases on public lands in the entire state of Colorado; meanwhile, 99 percent of the lands in the Thompson Divide area are used for agriculture, sporting and recreation.

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

- 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. (BMPs related to this bullet will be covered in the Transportation and Roadways section of the Discussion of Issues of Concern).
- Introduction of chemicals from oil/gas drilling into the aquifers through which the drilling passes, affecting the ground water wells and the springs in the area.

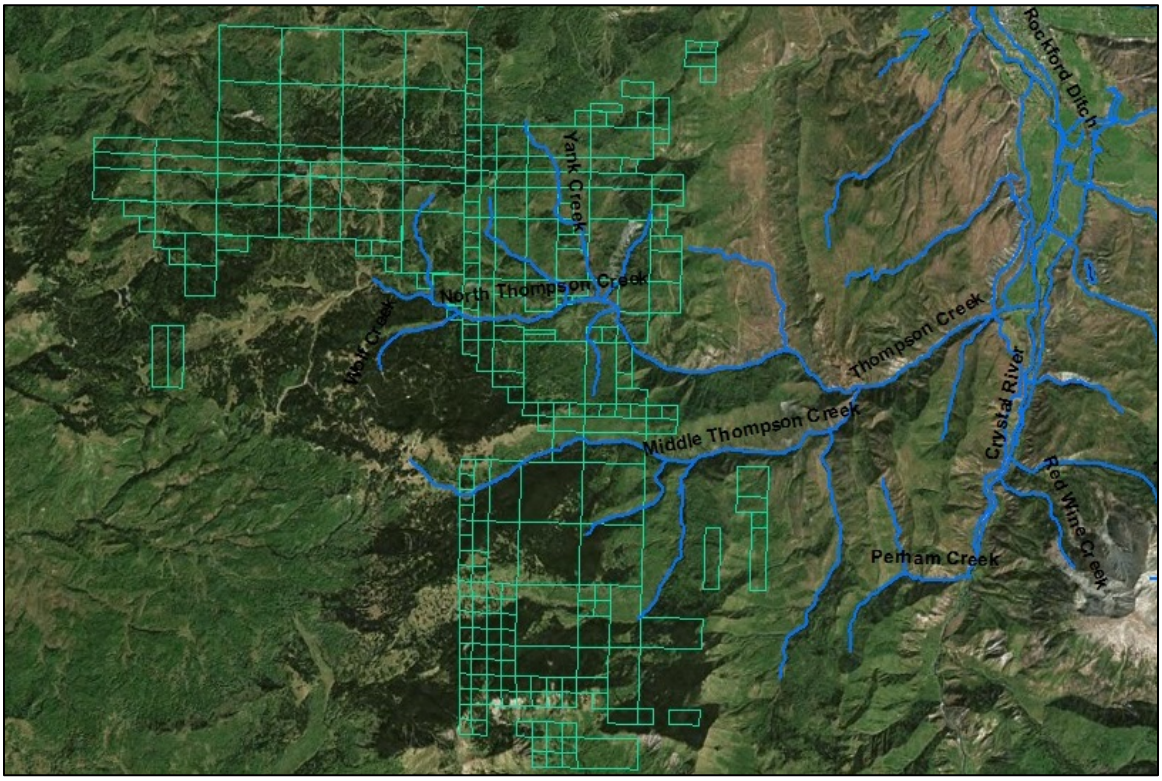

Figure 21: Oil and Gas Leases in the Thompson Creek drainage *Source: CRWA*

Rural economies in and around the Roaring Fork Valley rely, in part, upon existing uses in the Thompson Divide area. Collectively, hunting, fishing, ranching, and recreation in the Thompson Divide area support nearly 300 jobs and $30 million in annual economic output for our local communities.

The Colorado Water Quality Control Commission adopted an Outstanding Waters (OW) designation for this segment based on evidence presented by Trout Unlimited showing that the criteria of 31.8(2)a has been met for these waters. In addition to meeting the water quality requirements of 31.8(2)a, these waters support Colorado River cutthroat trout, including key conservation populations in North and Middle Thompson Creek. The Colorado River cutthroat trout is listed as a species of concern in Colorado and is subject to a conservation agreement to prevent potential federal Endangered Species Act listing. The Commission notes that the outreach undertaken by Trout Unlimited as proponent of this designation helps to demonstrate broad support for the conclusion that these waters constitute an outstanding natural resource and that the additional protection provided by this designation is appropriate. (Colorado Water Quality Control Commission, 2014)

USFS EIS

Town of Carbondale has made comment to the USFS for the draft White River National Forest Forest-Wide Final Oil and Gas Leasing Environmental Impact Statement for the White River National Forest in regard to this plan and Source Water Protection. Maps and specific information will be shared amongst agencies for a seamless communication path which will encompass the source water areas as a higher priority of regulation than those of non- source water areas. The Town has committed resources for the protection of the water supply and reduced activities within the Thompson Divide as it pertains to the Thompson Creek watershed.

Oil and gas operators, Garfield County, and other regulatory entities recognized there was a need for a unified connection between them and the public. Community Counts is a community-based program designed to offer residents a resource for open and respectful dialogue when they have issues, concerns or questions relating to the natural gas industry. Their response line provides 24/7 on-call contact with oil and gas operators to receive a resolution to a concern or answer to a question in a timely manner (http://communitycountscolorado.com/). This number is (866) 442-9034.

Additional information on Oil and Gas operations can be accessed in web sites listed in Appendix K.

Oil and Gas Operations Best Management Practices:

1. In the Source Water Protection Plan Appendices, incorporate surface water protection measures identified in COGCC Rule 317B and those stipulations recommended by the USFS In their draft EIS for the WRNF.

2. Continue rapport (and develop where it does not exist) with local O&G operators and maintain ongoing communication about present and future industry activity within the SWPA

to allow for ongoing protection from spills and other risks, including understanding of industry BMPs related to spill response plans and prevention measures. Additionally, share Final SWPP with these local operators.

3. Distribute Emergency Response Notification Cards to Oil and Gas operators.

3. Transportation and Roadways – Crystal Wells and Roaring Fork River Wells
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). Storm water runoff over these roads can deliver contaminants from the road surface into nearby streams and rivers.

Vehicular spills may occur along the transportation route within the source water protection areas from trucks that transport fuels, waste, and other chemicals that have a potential for contaminating groundwater and surface water. Chemicals from accidental spills are often diluted with water, potentially washing the chemicals into the soil and infiltrating into the groundwater. Roadways are also frequently used for illegal dumping of hazardous or other potentially harmful wastes.

During the winter season CDOT applies a salt-sand mixture and de-icer (magnesium chloride, M1000, or Ice Slicer) to highways along routes within the source water protection areas. Surface and groundwater quality problems resulting from the use of road de-icers are causing concern among federal, state, and local governments. Salt from the highway is introduced into the groundwater through a number of ways:

1) When runoff occurs from highways, flows are sometimes carried to ditches and unlined channels through which the water infiltrates into the soil and eventually into the groundwater.

2) Also, when snow is plowed together with the salt, the pile that is accumulated on the roadside melts during warmer weather. The water that results contains dissolved salt which can also infiltrate. Plowing and splashing of salt causes the salt to deposit along the pavement, especially near the shoulders where it melts causing runoff to enter drainage ways and then the groundwater system (Seawell, et al, 1998).

Salt contributes to increased chloride levels in groundwater through infiltration of runoff from roadways. Unlike other contaminants, such as heavy metals or hydrocarbons, chloride is not naturally removed from water as it travels through soil and sediments and moves towards the water table. Once in the groundwater, it may remain for a long time if groundwater velocity is

slow and it is not flushed away. Chloride may also be discharged from groundwater into surface water and can account for elevated levels of chloride throughout the year, not just in winter. Thus, regardless of the path that the runoff takes, salt poses a water quality problem.

The Thompson Creek drainage as a whole has high soil erosion potential and there are a number of unpaved roads within the drainage. Additionally, State Highway 133 is within 150 feet of the Crystal River Wells. Improper road maintenance or accidental vehicle spills in these areas could negatively affect the well. To a lesser extent, the same holds true for the Roaring Fork River Wells as they are within 2000 feet of State Highway 82.

Figure 22: Crystal River Wells and Highway 133 and Roaring Fork River Wells and Highway 82
Source: CRWA

<u>Transportation and Roadways Best Management Practices:</u>

1. Encourage Garfield and Pitkin County Road and Bridge to utilize best management practices (BMP's) to prevent road materials from entering the source waters. Keep informed on the road maintenance practices and schedules within the Source Water Protection Area including grading, de-icing, dust abatement and BMPs used.

2. Provide a copy of the Source Water Protection Plan, Emergency Response Notification Cards and maps along with GIS shapefiles of the protection area to County Offices of Emergency Management, Volunteer and Local Fire Departments, County Road and Bridge Departments, Sheriff's Departments, Local Police Departments, Town Offices, Local First Responders and other major users of the County Roads 104, 105 & 106 and State Highways 133 and 82.

3. Post Source Water Protection signage on the county roadways entering the protection area.
    a. Bridge at Willow Park
    b. 4 Mile Creek headwaters (USFS kiosk)
    c. Thompson Creek Fins trailhead/campground by Spring Gulch (Requires BLM Approval)
    d. Crystal River or Thompson Creek Bridges on Highway 133

4. Septic Systems – Crystal River Wells and Roaring Fork River Wells

A septic system, also known as an Onsite Wastewater Treatment System (OWTS), consists of sewage from a structure flowing to a tank and then a soil treatment area. The tank separates solids from the liquid effluent and the effluent is then dispersed through the soil treatment area for final treatment.

Septic systems are the second most frequently cited source of groundwater contamination in our country. Unapproved, aging, and failing septic systems have a large impact on the quality and safety of the water supply. The failure to pump solids that accumulate in the septic tank will also eventually clog the lines and cause untreated wastewater to back up into the home, to surface on the ground, or to seep into groundwater. If managed improperly, these residential septic systems can contribute excessive nutrients, bacteria, pathogenic organisms, and chemicals to the groundwater. If the storage tank overflows or soil treatment areas become saturated, runoff to surface waters can also result. (Amick, R. & Burgess, E., 2000)

In Garfield County, OWTS are permitted by the Community Development Department. The County administers and enforces the minimum standards, rules, and regulations outlined in the state of Colorado's Revised Statutes (CRS 25-10-105). Residents with septic systems are required to utilize the proper materials and spacing requirements in the construction process. The number of septic systems installed before the County began to take records is unknown at this time. Therefore, the exact number of septic systems within Garfield County, the number of unapproved systems currently in use and the age of many of the septic systems in the county are also unknown.

Pitkin County administers their OWTS program through the Environmental Health Department and Pitkin County OWTS Regulations. Residents who are served by OWTSs are required to properly design, install, and maintain their septic systems to protect water quality. In addition to permitting new construction and repairs, residents are required to have their septic system inspected when they remodel or sell their house.

While most residential dwellings in the source water protection areas are connected to the municipal waste water system, there are scattered areas of residential dwellings in the Crystal River Wells and Roaring Fork River Wells source water protection areas with septic systems including those belonging to members of residential developments. The most prominent residential developments include Marble Avalanche Estates, Red Dog and the Sewell Development located within the Crystal River watershed, Lazy Glen located near the banks of the Roaring Fork River and, unincorporated parcels within the Crystal & Roaring Fork watersheds. The Steering Committee feels that education and outreach to residents with septic systems is warranted.

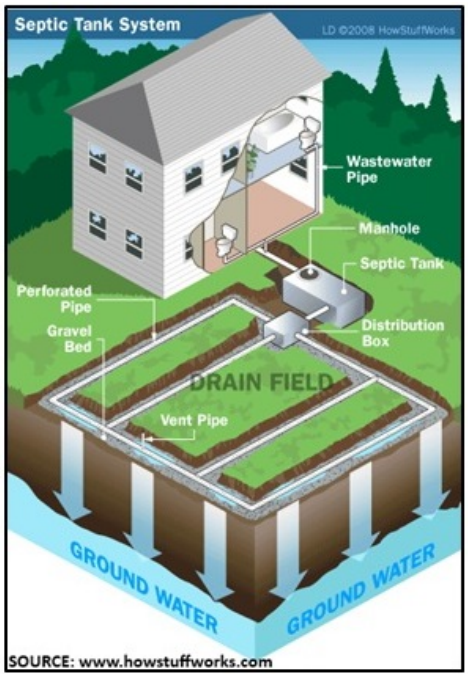

Figure 23: Schematic of septic System

Septic Systems Best Management Practices:

1. Distribute septic system maintenance outreach material to selected homeowners in Pitkin and Garfield Counties

2. Distribute septic system maintenance outreach material to septic system owners when CBO, Inc. conducts demonstrations. Potential locations/participants include:

* BRB Campground
* Sewell Subdivision
* Prince Creek
* Prim Ranch

3. CBO, Inc. will conduct a septic system maintenance demonstration to property owners at selected HOA's. The demonstration will be filmed.

4. Display septic system maintenance material on Pitkin and Garfield County websites. This would include a links to "You Tube" videos such as the one produced by Montana State University entitled "Taking Care of Groundwater: A Homeowner's Guide to Well and Septic Systems". This video connects septic system failure with the maintenance of private wells and is located at the link provided below:
http://waterquality.montana.edu/docs/WELL_EDUCATED/Well_and_Septic_DVD/Educational_Videos2.shtml

Additional information pertaining to septic system maintenance can be found at the below link:
http://search.yahoo.com/search?ei=utf-8&fr=tightropetb&type=11051_101414&p=utube+septic+system+maninenance

5. Future Land Development –Nettle Creek, Crystal Wells and Roaring Fork River Wells
As populations increase and land uses change, especially in the Crystal River Valley, effective land use planning and watershed management to protect water resources is imperative.

Effective watershed management includes developing a watershed management plan as well as implementing the recommendations within the plan. The plan recommendations should include a variety of measures – ranging from changes to local zoning, development regulations and programs, to installation of best management practices at specific priority locations – to protect sensitive watershed resources and restore resources that have already been degraded by agriculture or urbanization. Highly urban watersheds with little remaining undeveloped land will likely focus more on restoration versus a rural watershed with many sensitive pristine areas, but most watershed plans include a combination of both protection and restoration measures. Although protecting natural resources from degradation is generally more successful and cost-effective than trying to restore them after the fact, unfortunately, efforts to protect watersheds are frequently only begun after significant impacts have already occurred. (Center for Watershed Planning, 2015)

The Roaring Fork Watershed Plan describes how land use planning and development in the Roaring Fork Valley should adopt a "watershed perspective" whenever possible. For example, approval of a development in the headwaters that is reliant upon a nonexempt groundwater well may result in an augmentation plan that is satisfied by a release miles downstream on the Roaring Fork River. Absent a "watershed perspective", the land use approval may ignore potential impacts on stream flows between the point of withdrawal and the augmentation plan's point of release downstream. Individually, the impact from a single headwaters development approval may be small. Cumulatively, the impact from multiple development approvals with similar augmentation plans may be sufficient. (Roaring Fork Watershed Plan, 2012)

The Watershed Plan highlighted important action items in regards to future land use planning in the Roaring Fork Valley including:

- Improved collaboration among Roaring Fork Watershed decision makers on local land use and development issues and,
- Improved communication between local entities and state water commissioners on projects of common interest (e.g., local land use and development approvals for micro-hydro facilities and ornamental ponds).

The Steering Committee has decided to address this issue by implementing the best management practices highlighted below.

<u>Future Land Development Best Management Practices:</u>
1. Pitkin, Garfield and Eagle County Community Development departments will be encouraged to overlay the Town of Carbondale GIS source water protection area layers on their land use maps in order to make better informed decisions concerning future land use and/or land use changes within the source water protection areas. Modification of the Garfield County land use

codes will need to occur before Garfield County Community Development can move forward with this request.

6. Outdoor Recreation - Nettle Creek Intakes

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. (Atlas, et all, 1991)

Proper disposal of human waste is important to avoid pollution of water sources, minimize the possibility of spreading disease, and maximize the rate of decomposition.

In most locations, burying human feces in the correct manner is the most effective method to meet these criteria. Solid human waste must be packed out from some places, such as narrow river canyons.

Contrary to popular opinion, research indicates that burial of feces actually slows decomposition (at least in the Rocky Mountains). Pathogens have been discovered to survive for a year or more when buried. However, in light of the other problems associated with feces, it is still generally best to bury it. The slow decomposition rate causes the need to choose the correct location, far from water, campsites, and other frequently used places. (Center for Outdoor Ethics, 2015)

Day use and overnight camping occurs within the Nettle Creek drainage with access via hiking and horse trails. It is important that users of the backcountry are aware of proper sanitary habits to help ensure protection of Town of Carbondale's drinking water supply.

<u>Outdoor Recreation Best Management Practices:</u>

1. Post Source Water Protection signage (see wildfire, above), and a sub-sign that highlights cleaning up pet and human waste and no camping within 100 feet of Nettle Creek, in upper watershed at horse trails that drop into valley. Contact the Carbondale Parks and Recreation Department to see what signs they are utilizing.

2. Create and distribute a custom brochure and/or fact sheet highlighting source water protection at outdoor recreation stores (aka mountain biking, camping, hiking, AT vehicles).
* identify businesses that are willing to partake in this effort.
* address sanitary habits, pet waste, etc.
* reference language from Center for Outdoor Ethics web site, "Leave No Trace, Dispose of Waste Properly" found at https://lnt.org/learn/principle-3

3. Contact the Division of Parks and Wildlife to see if they would distribute educational material to hunters that describes the importance of cleaning up after pet and human waste in this particular GMU. Consider utilizing the custom brochure highlighted in #1, above.

4. Continue sampling for pathogens so that the quality of the drinking water supply is maintained to its highest level. If signs of degradation are apparent, then a determination of additional BMP's will be investigated.

7. Residential Practices – Nettle Creek, Crystal Wells and Roaring Fork River Wells

The source water protection area for the **Nettle Creek,** Crystal River Wells and Roaring Fork River Wells includes rural and sub-urban residential land use areas. Common household practices including washing vehicles, lawn fertilization, and pet wastes can allow chemicals and biologic pollutants to runoff residential property and enter the surface or ground water as indicated in Figure 24, below. The use of herbicides and pesticides in source water areas has been legally denied historically by the Town of Carbondale and continues to be monitored where water collection occurs for the water supply.

Prevention of ground water contamination requires education, public involvement, and people motivated to help in the effort. Educating the community and decision-makers is one of the challenges and cornerstones of this protection plan. Public education will help people understand the potential threats to their drinking water sources and motivate them to participate as responsible citizens to protect their valued resources.

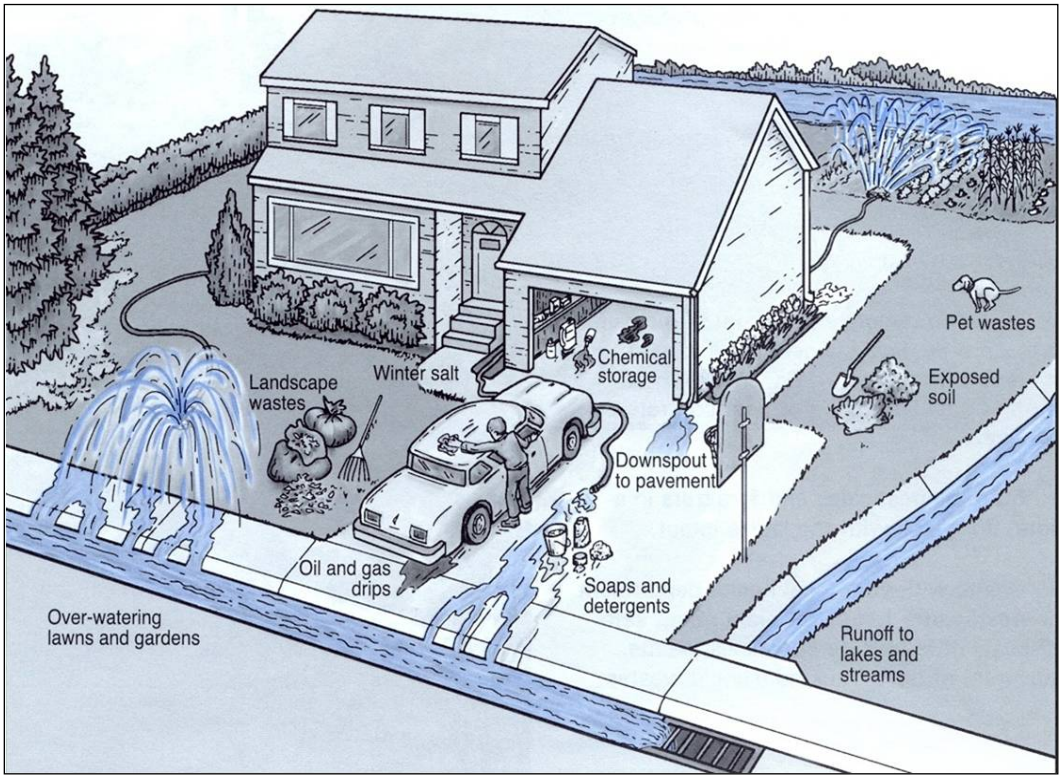

Figure 24: Residential Practices Source: CSU Extension

Residential Practices Best Management Practices:

1. Conduct a public education and outreach program to residents to encourage practices that will protect their drinking water sources. Opportunities for public education include brochures and other outreach material.

2. Post outreach material on Town of Carbondale and Pitkin and Garfield County websites.

3. Include education and outreach material in utility bills.

4. Install source water protection signage in select residential areas at NUCHE/Bull Pasture Park and another location TBD.

5. Educate the community to utilize the Garfield County prescription drug take back program.

6. Continue to utilize the Town of Carbondale local hazardous waste collection program for residents within the source water protection area.

8. Agricultural Practices – Nettle Creek, Crystal Wells and Roaring Fork River Wells

Agricultural land use has been a historical mainstay in Colorado for over a century. Even though land use changes have occurred over this time period with development of homes and businesses, agriculture will continue to be a presence in local communities and a key part of local heritage. "Right to Farm" laws and the preservation of private property rights are important to the landowners and will be respected when developing and implementing source water protection plans.

Small ranching operations are ubiquitous to the landscape of much of Garfield and Pitkin Counties. There are a few ranches within the source water protection areas that have cattle grazing near the waterways. When this is the case, the greatest risks to the water supply include fecal/bacterial contamination, sedimentation, and increased temperatures. Potential pathogens carried in animal waste include *E. coli*, *salmonella*, *cryptosporidium*, and *giardia*. Significant damage to wetland areas and stream-bank erosion may also occur. This damage can add large amounts of sediment directly into streams, particularly wet meadow streams or those with erodible topography that is prone to gully formation. (Hill, 2012)

Figure 25: Agricultural land surrounding the Crystal River well Source: CRWA

Figure 26: Agricultural land surrounding the Roaring Fork River wells Source: CRWA

Agricultural Practices Best Management Practices:

1. Create and distribute a brochure to COOP's, ranch stores and other agricultural related businesses that highlights the need for healthy riparian vegetation to persist adjacent to waterways and ditches and suggesting limited access to these areas by livestock.
   - identify businesses that are willing to partake in this effort (aka Feed and Tack & Saddlery stores)
   - address proper agricultural practices and the connection to source water protection

2. Conduct a presentation to the Mount Sopris Conservation District on Source Water Protection.

9. Developed and/or Degraded Riparian Areas - Crystal Wells and Roaring Fork River Wells

Riparian-zone restoration is the ecological restoration of riparian-zone habitats of streams, rivers, springs, lakes, floodplains, and other hydrologic ecologies. A riparian zone or riparian area is the interface between land and a river or stream. Riparian zones are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their habitat biodiversity, and the influence they have on fauna and aquatic ecosystems, including grassland, woodland, wetland or sub-surface features such as water tables. In some regions the terms *riparian woodland*, *riparian forest*, *riparian buffer zone,* or *riparian strip* are used to characterize a riparian zone.

The need for Riparian-zone restoration has come about because riparian zones have been degraded throughout much of the world by the activities of mankind affecting natural geologic forces. The unique biodiversity of riparian ecosystems and the importance of riparian zones in preventing erosion, protecting water quality, providing habitat and wildlife corridors, and maintaining the health of in-stream biota (Aquatic organisms) has led to a surge of restoration activities aimed at riparian ecosystems in the last few decades. Restoration efforts are typically guided by an ecological understanding of riparian-zone processes and knowledge of the causes of degradation. They are often interdependent with stream restoration projects. (Wikipedia)

In the Roaring Fork River sub-watershed, no high quality riparian habitat remains. On the right bank of the river, 21 percent is moderately modified, 32 percent heavily modified, and 46 percent severely degraded. On the left bank 12 percent is slightly modified, 55 percent heavily modified, and 33 percent severely degraded. (Figure 27)

In the Crystal River watershed, both historic and recent land uses have altered the condition of riparian habitat, and, consequently, the river channel. Riparian habitat continues to be impacted by historic land uses such as railroad grades built on stream banks, mill sites and town sites built in the floodplain, and by domestic livestock grazing. Recent impacts have resulted from agricultural, highway, residential, and recreational activities. Over time, much of the upland and riparian areas that were historically degraded have been restored by natural processes, although channel degradation has not been completely remediated and stream function continues to be impaired. Additionally, new and ongoing development activities continue to encroach into riparian habitat, alter stream bank vegetation, and degrade riparian

habitat. The majority of the segment's riparian habitat has been modified and ecosystem functions degraded. According to the Roaring Fork Conservancy's State of the Watershed Report, on the left bank, riparian habitat is high quality on 3 percent of the segment, slightly modified on 8 percent, moderately modified on 17 percent, heavily modified on 44 percent, and severely degraded on 28 percent. On the right bank, 3 percent of riparian habitat is high quality, 10 percent slightly modified, 13 percent moderately modified, 55 percent heavily modified, and 19 percent severely degraded. (Figure 28)

Riparian areas have been used extensively for domestic livestock grazing, transportation corridors, recreation, and residential development. Most of the native riparian habitat has been altered, replaced, or covered over with pastures, lawns, buildings, and roads. More than 50 percent of the Roaring Fork River segment in this sub-watershed is impacted by development. In many areas historic agricultural land has been replaced with rural or urban housing development. Small ranchettes and subdivisions with golf courses border much of the river. Higher housing density has increased impacts to riparian and stream habitat. Lawns often go to the river's edge, and most of the understory has been removed in many reaches. Road-based pollutants and sediment move into the river unfiltered by riparian vegetation, and culverts drain road runoff directly into the river. In developed areas, riparian zone width and percentage of native vegetative cover typically has been reduced. In residential areas the composition of the plant community has been altered through the replacement of native plants with non-native plants.

There are also reaches where riparian and stream habitat continues to be impacted by livestock grazing in the riparian zone and on streambanks. In some areas, plant diversity has been reduced because cattle select palatable plants like willow over unpalatable ones such as snowberry. Vegetation damage by anglers and boaters is common in the few areas of natural habitat that remain on this segment. (Stream Health Initiative, 2010)

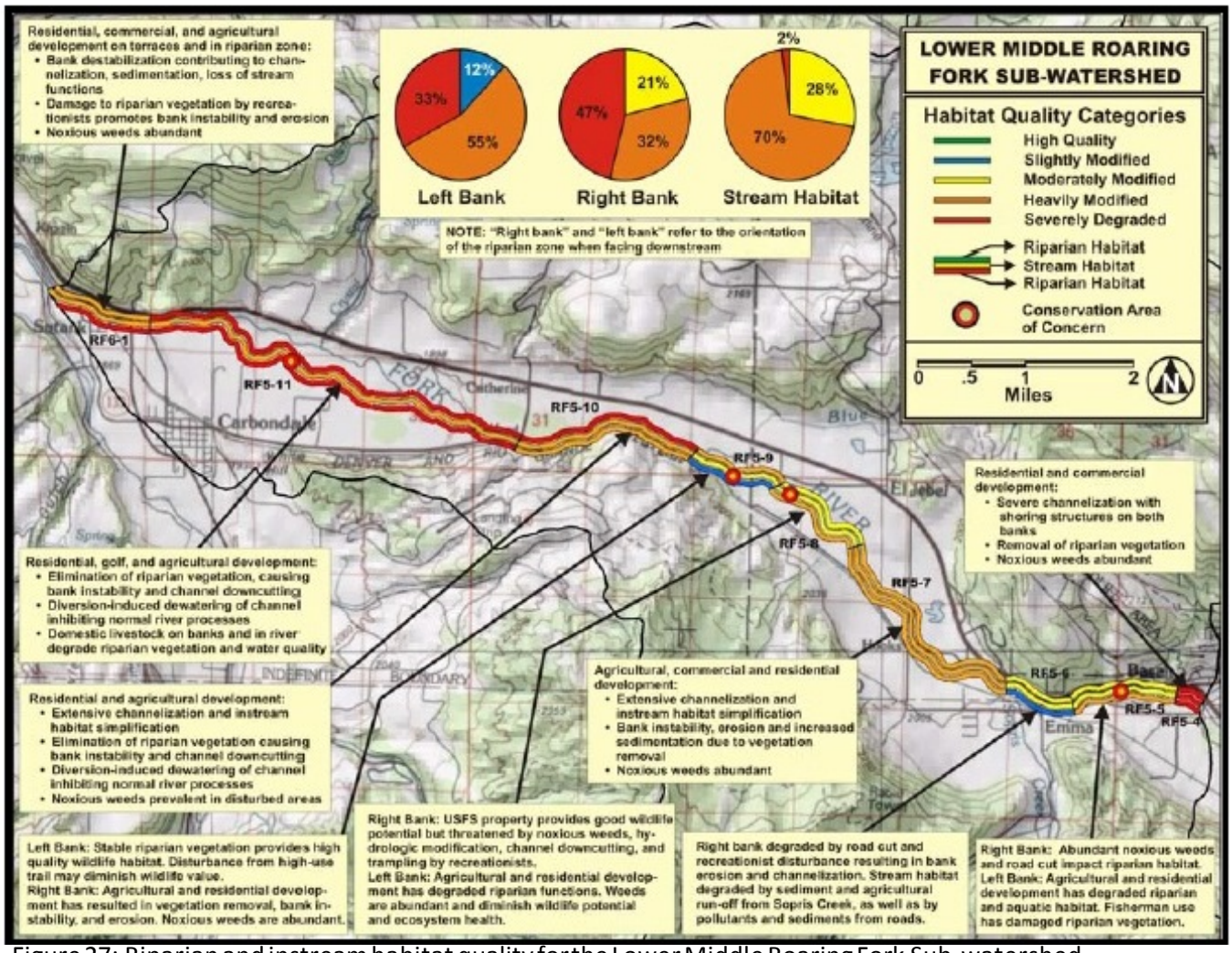

Figure 27: Riparian and instream habitat quality for the Lower Middle Roaring Fork Sub-watershed
Source: Stream Health Initiative

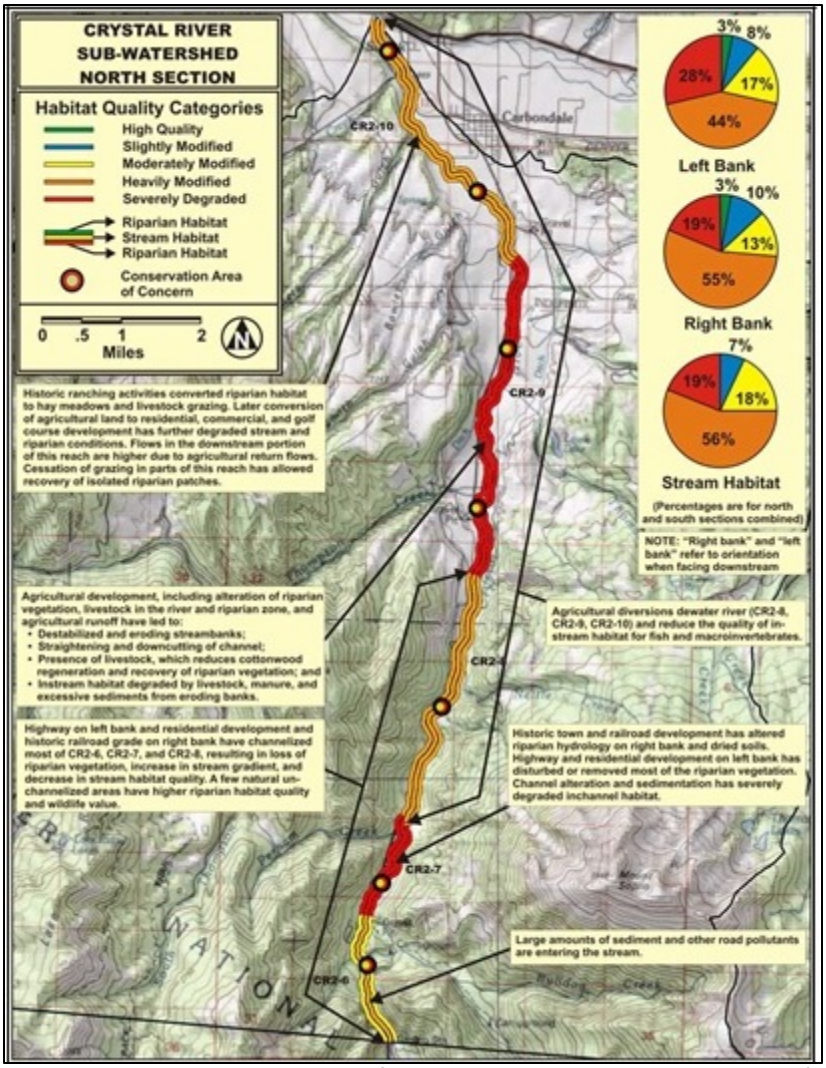

Figure 28: Riparian and instream habitat quality for the Crystal River Sub-watershed (north section)
Source: Stream Health Initiative

Degraded Riparian Areas Best Management Practices:

1. Within areas deemed to be high foot traffic develop plans to incorporate trail ways with water turnouts and hard surfaces where possible (rocks, timber).

2. Develop informational signage to display at the established trails.

3. Develop educational material to reach out to the communities via newspaper, radio and local television.

4. Televise Carbondale Town Trustee meetings where a topic of discussion would highlight the importance of riparian zones.

10. Above and Below Ground Storage Tanks – Crystal Wells and Crystal River Drainages

Above ground storage tank releases can contaminate soil and drinking water supplies. Petroleum products are composed of volatile organic compounds (VOCs). Any oil spill can pose a serious threat to human health and the environment, requires remediation that extends beyond your facility's boundary, and results in substantial cleanup costs. Even a small spill can have a serious impact. A single pint of oil released into the water can cover one acre of water surface area and can seriously damage an aquatic habitat. A spill of only one gallon of oil can contaminate a million gallons of water. It may take years for an ecosystem to recover from the damage caused by an oil spill. The location of the facility must be considered in relation to drinking water wells, streams, ponds and ditches (perennial or intermittent), storm or sanitary sewers, wetlands, mudflats, sandflats, farm drain tiles, or other navigable waters. Factors such as the distance to drinking water wells and surface water, volume of material stored, worse case weather conditions, drainage patterns, land contours and soil conditions must also be taken into consideration. (US EPA)

Discharges 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 29: Example fuel storage tanks with no secondary containment
Source: duboisswcd.org

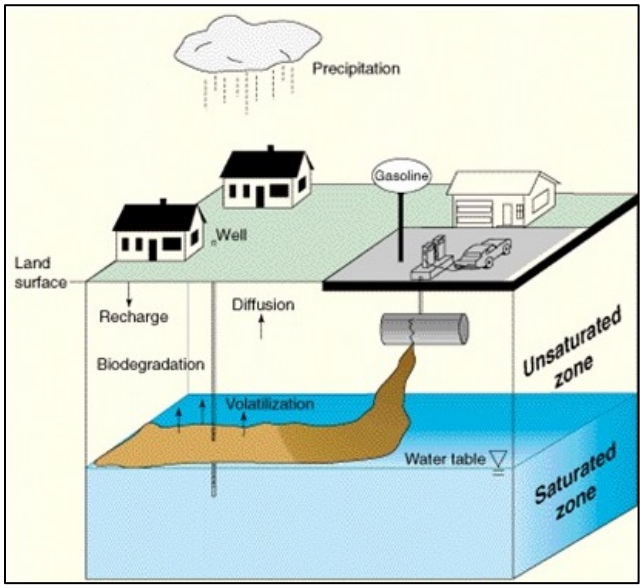

Figure 30: Schematic of LUST discharge site Source: AGWEB.org

Property owners own storage tanks in both the Thomson Creek and Crystal River Well source water protection areas.

<u>Above and Below Ground Storage Tanks Best Management Practices:</u>

1. Conduct targeted education and outreach to storage tank owners on how they can implement storage tank best management practices, including secondary containment, to prevent petroleum products from leaking onto the ground and entering the source waters.

11. Gravel Pits – Roaring Fork River Wells

Sand and gravel operations have the potential to adversely impact groundwater quality, both as a result of the extraction process and in site reclamation. However, sand and

gravel mining is also an important economic resource as well as a necessary resource for transportation and development purposes.

Sand and gravel mining within an aquifer recharge area will, at a minimum, increase the vulnerability of an aquifer to be contaminated because it decreases the distance between the ground water table and land surface. In some cases, the excavation actually penetrates the shallow aquifers, creating a pond or lake and a direct access to ground water.

The primary effluent discharged at a sand and gravel mine operation is turbid rinse water. Generally, operators are required to collect waste water on-site in retention and settling ponds where the fine sediment settles out. The collected water is then allowed toinfiltrate back to the water table. Often the excavation pit is a component of the treatment system. High concentrations of suspended solids in the wash water do not pose a serious ground water problem since sediment is unable to migrate beyond the immediate infiltration site. Even though the turbid wash water at a gravel mine is not a significant ground water pollutant, the excavation pit and the continual collection and infiltration of wash water doesraise the potential for other sources of contaminant to migrate to the aquifer. Hydrologic susceptibility is increased at the pit site when saturated or near saturated conditions exist under the pit. Any chemical contaminants that are allowed to enter the pit via wash water or spills in the area have quicker access to the aquifer. Once in the ground water, a chemical substance would be free to move with the water in the aquifer. Possible contaminants found at a mining site include lubricants and fuels. These materials may be stored on-site or may enter the excavation pit from contaminated road and work area runoff.

Beyond the risks associated with active mining, one of the largest threats to ground water appears to be the excavation pit itself. Reclamation of a site may include refilling a pit as well as slope and drainage stabilization. Within the recharge areas of a vulnerable aquifer, the decision to fill or not to fill an excavation pit is one of the most critical with regards to water quality. (Kitsap Public Utility District)

Western Slope Aggregate and United Companies operate gravel pits within Zone 1 of the source water protection area for the Roaring Fork River Wells. These gravel pits are approximately .5 and 1.5 miles, respectively, from the well field. These gravel pits operate under Federal, State and Garfield County regulations.

Figure 31: Gravel pit operations near Roaring Fork River Wells Source: CRWA

Gravel Pit Best Management Practices:

1. Have a discussion with the gravel pit operators from United Companies concerning their land use activities at the gravel pit, regulatory and permit requirements and take a tour of the gravel pit operation.

2. Based upon findings of #1, above, encourage United Companies to develop a monitoring plan to track potential contaminants, if necessary.

SOURCE WATER PROTECTION MEASURES

Best Management Practices

The Steering Committee reviewed and discussed 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 12, "Source Water Protection Best Management Practices" be considered for implementation by:

- Town of Carbondale
- Pitkin County
- Garfield County
- Eagle County
- USFS

Evaluating Effectiveness of Best Management Practices

The Town of Carbondale 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 5 – 7 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 Carbondale 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.

Table 12: Source Water Protection Best Management Practices

Issues	Best Management Practices	Implementers
Wildfire	1. Post Source Water Protection signage at trailheads.	Town of Carbondale
	2. Provide a copy of the final source water protection plan along with GIS shapefiles of the protection areas to local Fire Departments, Sheriff's Departments, Office of Emergency Management Departments, USFS, CSFS, BLM and any other agencies/departments involved in fire and land management for consideration during fire suppression as well as when planning and implementing mitigation.	CRWA
	3. Collaborate with consultants/engineers who authored the Pitkin County Wildland Fire Plan and Garfield County Community Wildfire Protection Plan, to overlay the SWPA's on the Wildfire Susceptibility Analysis maps to identify high-risk areas and determine recommended action items.	Town of Carbondale/CRWA
	4. Wildfire mitigation around intakes and treatment plant including re-siding the treatment building and fuels mitigation utilizing a USFS Stewardship Contract.	Town of Carbondale
	5. Installation of a T and two valves to divert flows back to Nettle Creek to mitigate mud and debris from entering pipes that lead into treatment plant.	Town of Carbondale
Oil and Gas Operations	1. In the Source Water Protection Plan, incorporate surface water protection measures identified in COGCC Rule 317B and those stipulations recommended by the USFS In their draft EIS for the WRNF.	CRWA
	2. Continue rapport (and develop where it does not exist) with local O&G operators and maintain ongoing communication about present and future industry activity within the SWPA to allow for ongoing protection from spills and other risks, including understanding of industry BMPs related to spill response plans and prevention measures. Additionally, share Final SWPP with these local operators.	Town of Carbondale
	3. Distribute Emergency Response Notification Cards to oil and gas operators.	Town of Carbondale

Transportation and Roadways	1. Encourage Garfield and Pitkin County Road and Bridge to utilize Best Management Practices to prevent road materials from entering the source waters. Keep informed on the road maintenance practices and schedules within the Source Water Protection Area including grading, de-icing, dust abatement and BMPs used. 2. Provide a copy of the Source Water Protection Plan, Emergency Response Notification Cards and maps along with GIS shapefiles of the protection area to County Offices of Emergency Management, Volunteer and Local Fire Departments, County Road and Bridge Departments, Sheriff's Departments, Local Police Departments, Town Offices, Local First Responders and other major users of the County Roads 104, 105 & 106 and State Highways 133 and 82. 3. Post Source Water Protection signage on the county roadways entering the protection area. a. Bridge at Willow Park b. 4 Mile Creek headwaters (USFS kiosk) c. Thompson Creek Fins trailhead/campground by Spring Gulch (Requires BLM Approval) d. Crystal River or Thompson Creek Bridges on Highway 133	Town of Carbondale Town of Carbondale/CRWA Town of Carbondale
Septic Systems	1. Distribute septic system maintenance outreach material to selected homeowners in Pitkin and Garfield Counties. 2. Distribute septic system maintenance outreach material to septic system owners when CBO, Inc. conducts a septic system maintenance demonstration. Potential Locations/participants include: BRB Campground, Sewell Subdivision, Prince Creek and Prim Ranch. 3. CBO, Inc. will conduct a septic system maintenance demonstration to property owners at selected HOA's. The demonstration will be filmed. 4. Display septic system maintenance material on Pitkin and Garfield County websites. This may include a link to a "You Tube" video such as the one produced by Montana State University entitled "Taking Care of Groundwater: A homeowner's	Town of Carbondale Town of Carbondale Town of Carbondale, Garfield and Pitkin Counties, CBO, Inc. Garfield and Pitkin Counties

	guide to well and septic systems". This video connects septic system failure with the maintenance of private wells.	
Future Land Development	1. Pitkin, Garfield and Eagle County Community Development departments will be encouraged to overlay the Town of Carbondale GIS source water protection area layers on their land use maps in order to make better informed decisions concerning future land use and/or land use changes within the source water protection areas. Modification of the Garfield County land use codes will need to occur before Garfield County Community Development can move forward with this request.	Town of Carbondale, Garfield and Pitkin Counties
Outdoor Recreation	1. Post Source Water Protection signage (see wildfire, above), and a sub-sign that highlights cleaning up pet and human waste and no camping within 100 feet of Nettle Creek, in upper watershed at horse trails that drop into valley. Contact the Carbondale Parks and Recreation Department to see what signs they are utilizing. 2. Create and distribute a custom brochure and/or fact sheet highlighting source water protection at outdoor recreation stores (aka mountain biking, camping, hiking, AT vehicles). * identify businesses that are willing to partake in this effort. * address sanitary habits, pet waste, etc. * reference language from Center for Outdoor Ethics web site, "Leave No Trace, Dispose of Waste Properly" found at https://lnt.org/learn/principle-3 3. Contact the Division of Parks and Wildlife to see if they would distribute educational material to hunters that describes the importance of cleaning up after pet and human waste in this particular GMU. Consider utilizing the custom brochure highlighted in #1, above. 4. Continue sampling for pathogens so that the quality of the drinking water supply is maintained to its highest level. If signs of degradation are apparent, then a determination of additional BMP's will be investigated.	Town of Carbondale Town of Carbondale CRWA Town of Carbondale
Residential Practices	1. Conduct a public education and outreach program to residents to encourage practices that will protect their drinking water sources. Opportunities for public education include brochures and other outreach material.	Town of Carbondale

	2. Post outreach material on Town of Carbondale and Garfield County websites. 3. Include education and outreach material in utility bills. 4. Install source water protection signage in select residential areas at NUCHE/Bull Pasture Park and another location TBD. 5. Educate the community to utilize the Garfield County prescription drug take back program. 6. Continue to utilize the Town of Carbondale local hazardous waste collection program for residents within the source water protection area.	Town of Carbondale, Garfield Counties Town of Carbondale Town of Carbondale Town of Carbondale Town of Carbondale
Agricultural Practices	1. Create and distribute a brochure to COOP's, ranch stores and other agricultural related businesses highlighting source water protection. * identify businesses that are willing to partake in this effort (aka Hyrup Feed Store, Roaring Fork Valley COOP, True Value Hardware and additional Tack & Saddlery stores) * address proper agricultural practices and the connection to source water protection 2. Conduct a presentation to the Mount Sopris Conservation District on Source Water Protection.	Town of Carbondale Town of Carbondale, CRWA
Developed and/or Degraded Riparian Areas	1. Within areas deemed to be high foot traffic develop plans to incorporate trail ways with water turnouts and hard surfaces where possible (rocks, timber). 2. Develop informational signage to display at the established trails. 3. Develop educational material to reach out to the communities via newspaper, radio and local television. 4. Televise Carbondale Town Trustee meetings where a topic of discussion would highlight the importance of riparian zones.	Town of Carbondale Town of Carbondale Town of Carbondale Town of Carbondale

Above/Below Ground Storage Tanks	1. Conduct targeted education and outreach to storage tank owners on how they can implement storage tank best management practices, including secondary containment, to prevent petroleum products from leaking onto the ground and entering the source waters.	Town of Carbondale
Gravel Pits	1. Have a discussion with the gravel pit operators from United Companies concerning their land use activities at the gravel pit, regulatory and permit requirements and take a tour of the gravel pit operation.	Town of Carbondale
	2. Based upon findings of #1, above, encourage United Companies to develop a monitoring plan to track potential contaminants, if necessary.	Town of Carbondale

TABLES AND FIGURES

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APPENDICES[4]

A. Water Quality Standards Table

B. Web Links for Water Quality Data

C. Water System Process Schematic

D. Source Water Assessment Report

E. Source Water Assessment Report Appendices

F. Table A-1 Discrete Contaminant Types

G. Table A-2 Discrete Contaminant Types (SIC Related)

H. Table B-1 Dispersed Contaminant Types

I. Table C-1 Contaminants Associated with Common PSOC's

J. COGCC Rule 317B

K. Oil and Gas Websites

L. Roaring Fork Watershed Plan

M. MOU between CDPHE and U.S. Forest Service Rocky Mountain Region

N. Contingency Plan

[4] All appendices are located on the CD version of this SWPP.