Pocahontas County
Water Resources Management Plan

Phase 1 – Water Resources Assessment

Prepared for:

Pocahontas County Commission
Water Resources Task Force
900 Tenth Avenue
Marlinton, WV 24954

Prepared by:

Downstream Strategies, LLC
295 High Street, Suite 3
Morgantown, WV 26505

Fritz Boettner, Anne Hereford, Nicolas Zegre, Jeff Bray,
Lynmarie Knight, Clay Condon, Sera Zegre, Roy Martin

Downstream
Strategies

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

ABOUT THE WATER RESOURCES TASK FORCE

The Pocahontas County Water Resources Task Force is a volunteer-led entity of the Pocahontas County Commission. The Task Force was formed in late 2008 at the behest of Pocahontas County citizens who approached the Commission to request the creation of a countywide Water Resources Management Plan.

Members of the steering committee (appointed in June 2010):

- Jo Lori Drake (Arbovale)
- Dennis Egan (Greenbank)
- Joshua Hardy (Mill Point)
- Beth Little (Lobelia)
- Donald McNeel (Hillsboro)
- Anne Smith (Greenbank)

ACKNOWLEDGEMENTS

This project is made possible by the support of our community and countless contributions of time, data, expertise, and funding. The Pocahontas County Water Resources Task Force would like to thank the following individuals and organizations for their assistance to this project.

For providing funding for this project: United States Environmental Protection Agency Environmental Justice Small Grants Program, United States Forest Service, and West Virginia Department of Environmental Protection.

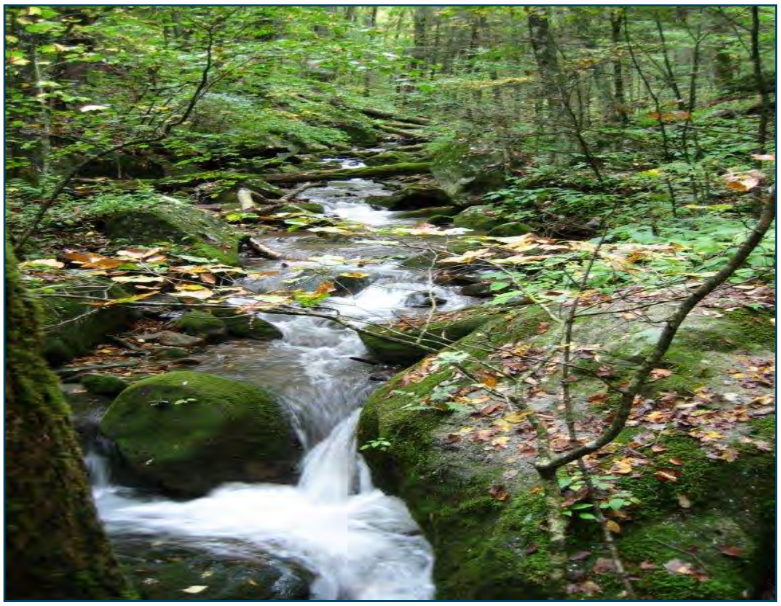
General contributions: Allegheny Mountain Radio, AmeriCorps VISTA, Boxley Materials Corporation, Cheat Mountain Water Company, David Henderson (Pocahontas County Health Department), Denmar Correctional Center, Ed Riley (Pocahontas County Solid Waste Authority), Edray Fish Hatchery, Gibbs Kinderman (Pocahontas Communications Cooperative), Green Bank Elementary and Middle School, Greg Hamons (West Virginia University Extension Agent), Marlinton Elementary School, Marlinton Middle School, National Radio Astronomy Observatory, Pocahontas Center Genesis Healthcare, Pocahontas County Commission, Pocahontas County Free Libraries, Pocahontas County High School, Pocahontas County Memorial Hospital, Pocahontas County Public Service District, Reta Griffith, Scott Triplett (Pocahontas County Assessor's Office), Snowshoe Mountain Ski Resort, Sue Helton, Susan Davis (Natural Resources Conservation Service), *The Pocahontas Times*, Tim Helmick (Pocahontas County Spring Water), Town of Durbin, Town of Hillsboro, Town of Marlinton, West Virginia Prison System, West Virginia Resource Advisory Committee, and many others who have volunteered their time for the Water Resources Task Force.

ABBREVIATIONS

ARC	Appalachian Regional Commission
BFI	baseflow index
BMP	best management practice
cfs	cubic feet per second
cfu	colony forming units
CNA	conditions not allowable
GIS	geographic information system
GWB	groundwater basin
mg/L	milligrams per liter
mL	milliliters
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
P	precipitation
PCB	polychlorinated biphenyl
PSA	public service announcement
PSD	Public Service District
Q	discharge
R	runoff
S	storage
TMDL	total maximum daily load
µg/L	micrograms per liter
US	United States
USCB	US Census Bureau
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USGS	US Geological Survey
VISTA	Volunteer in Service to America
WAP	Watershed Assessment Program
WRMP	water resources management plan
WRTF	Water Resources Task Force
WVASS	West Virginia Speleological Survey
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVGES	West Virginia Geological and Economic Survey
WVU	West Virginia University

EXECUTIVE SUMMARY

by the Pocahontas County Water Resources Task Force



Pocahontas County, West Virginia has exceptional water resources. Often referred to as the "Birthplace of Rivers," this county is home to the headwaters of eight rivers: The Williams, Gauley, Tygart Valley, Cheat, Cherry, Cranberry, Elk, and Greenbrier. All the surface water in Pocahontas County originates here. This fact makes our county unique and gives us an added responsibility to downstream communities.

Water is a finite and valuable resource and is important to the quality of life and economic vitality of Pocahontas County. It is important to be proactive in the management of our water in order to ensure future generations of Pocahontas County citizens are able to enjoy and benefit from this resource as we currently do. It is our intention to create a water resources management plan that accounts for the many varied uses of water. We aim to plan for a sustainable water future by balancing the needs of agriculture, business, industry, and tourism as well as those of the environment and individual citizens of Pocahontas County.

The State of West Virginia is currently creating its own water resources management plan as mandated by the Water Resources Protection and Management Act of 2008 (WV Code Chapter 22, Article 26). Pocahontas County's plan is being developed pursuant to WV Code §22-26-9 (f) & (g), which state that a county may enter into an agreement with the West Virginia Department of Environmental Protection to develop a local plan that will be filed as part of the state water resources management plan. It is the belief of the Pocahontas County Water Resources Task Force that our community will be best served by creating our own water resources management plan—one tailored to and created by the people of Pocahontas County.

This Phase 1 report is the first step in creating our county water resources management plan. It utilizes existing data to (a) assess current water quantity and quality for both surface and groundwater and (b) identify data gaps. This report also details our inclusive stakeholder process, an essential component of this project, designed to ensure this work reflects the perspectives and needs of county residents, businesses, and relevant agencies.

It is our hope that everyone with a responsibility for water resources management will participate in the development of our county water resources management plan and will commit to utilizing the guidelines developed therein in their daily water resources management activities.

1. INTRODUCTION

The purpose of this study is to evaluate and assess the water resources—surface and groundwater—of Pocahontas County, West Virginia. To this end, available water quality and quantity data were collected from various sources and analyzed to understand the present water resource conditions and propose future actions for proactive water resources management.

The goals of this water resources assessment and of Phase 1 of the county-wide water resources management plan (WRMP) include:

- a stakeholder process that engages local citizens, businesses, and water resource managers;
- an outline and general understanding of how to proceed with future WRMP phases;
- an assessment of water features (based on available data), including:
    - a surface water quality analysis and summary to document existing conditions
    - a surface water quantity analysis, examining water budgets, flooding, and potential vulnerability
    - a groundwater characterization and assessment, including basin delineations and discussion of groundwater use, quality, and quantity;
- an identification of data needs and gaps for future planning efforts;
- a water quality database that houses all water quality data collected for this assessment; and
- a geographic information system (GIS) geodatabase of all data gathered and produced during the assessment.

This initial assessment provides baseline information that will be needed for developing the WRMP. County practitioners, citizens, businesses, and agencies can use the information presented in this report as a planning and evaluation tool. A plethora of additional datasets can be developed that would help future phases of the planning process; this project helps to direct any such future efforts.

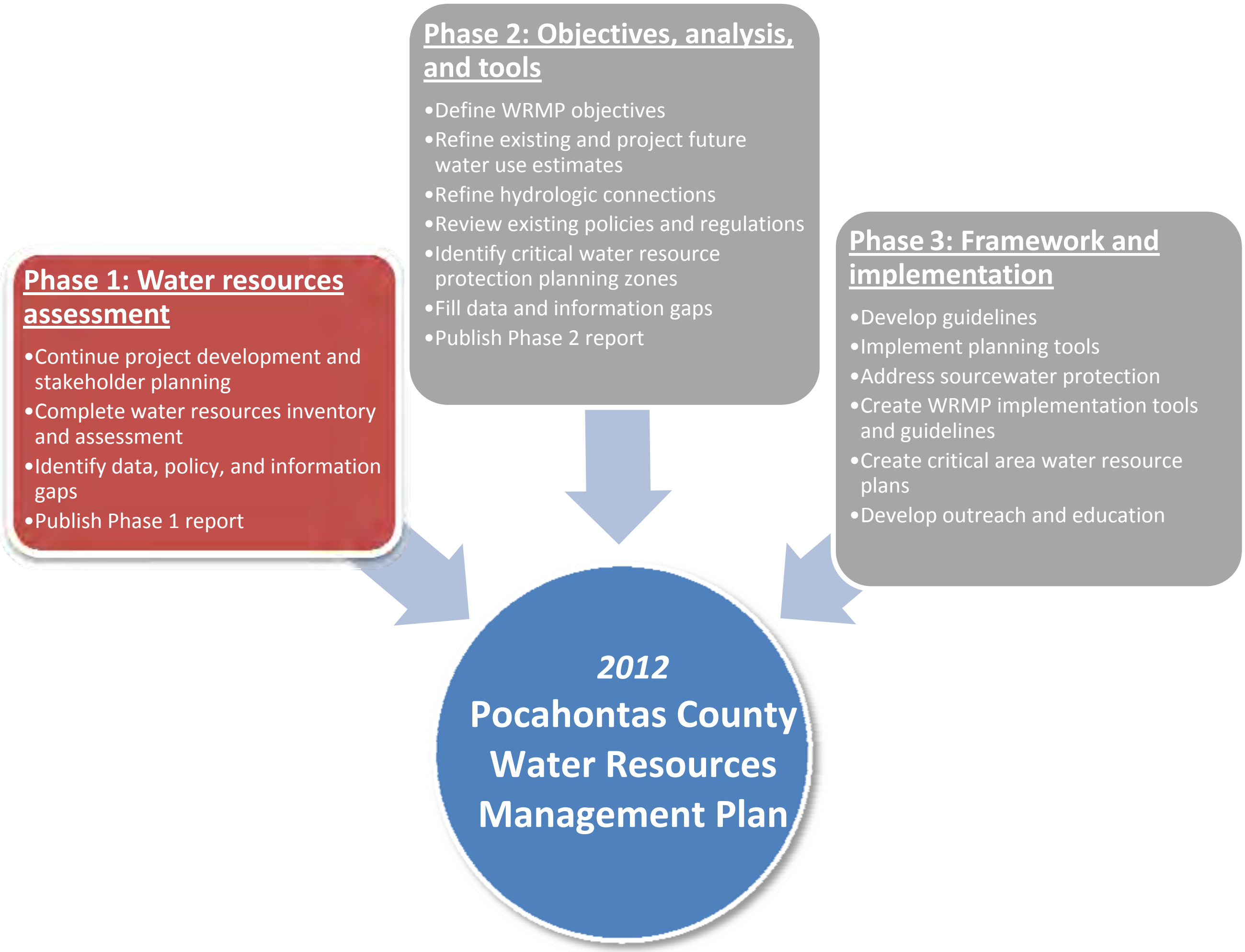
1.1 Water resources planning process

The WRMP will be developed in a series of phases; this report represents Phase 1. As part of this first phase of the project, Downstream Strategies and the Pocahontas County Water Resources Task Force (WRTF) engaged watershed organizations, residents, local and state governments, and other interested groups to identify a vision and goals for the WRMP. In addition to the stakeholder components, Phase 1 consisted of developing the project plan, performing a water resource inventory and assessment, identifying data gaps, and publishing a final report.

Phase 2 will focus on data analysis and tools, while Phase 3 will be geared toward implementation. Figure 1 outlines the proposed road map for creating the WRMP.

This phased approach is one way to develop a WRMP to meet the needs of Pocahontas County residents. The outline presented for future phases is still a work in progress and is open to revisions from the stakeholder group and WRTF. Scoping meetings, which can follow a review of this assessment, will inform future phases.

Figure 1: Proposed water resources management plan phases



Note: During Phase 1 of this plan, additional monies were procured through a grant to cover the costs of implementing Phase 2 and Phase 3. Therefore, Phases 2 and 3 will likely be combined and implemented together.

1.2 County description

Pocahontas County is the third-largest county in West Virginia, with a land mass of approximately 940 square miles. The county contains over 880 miles of streams, seven lakes and reservoirs, and the highest average elevation east of the Mississippi River. Pocahontas County is also home to over 340,000 acres of public land. This includes five state parks, two state forests, and more than one third of the Monongahela National Forest.

1.2.1 *Demographics*

Despite its large area, Pocahontas County has a relatively small population of 8,719 (USCB, 2011a). This equates to just 9.3 people per square mile and is a slight decrease from 2000, when the reported population was 9,131. The median age of the population is 47, with 24% of residents over the age of 62. While 47% of the housing in Pocahontas County is for seasonal, recreational, or vacation use, about 70% of full-time residents live in owner-occupied housing units.

There are 3,243 paid employees in the county, with health care, manufacturing, retail trade, other services, and construction employing the most people (USCB, 2011b). One in every four jobs in Pocahontas County is generated by tourism, and over one million tourists visit the county each year (Pocahontas County Convention and Visitors Bureau, 2012).

Additionally, agriculture is a major enterprise in Pocahontas County, even though it does not support a large employment base. Pocahontas County is home to 390 farms, with an average size of 313 acres and average sales of $20,935. While 94% of sales are livestock, only 29% of farmland is classified as pasture, with 46% woodland, 19% cropland, and 4% other. In terms of agricultural sales, Pocahontas County is the thirteenth most productive county in the state. (USDA, 2009)

1.2.2 *Geography, soils, and geology*

More than half of the land in Pocahontas County is managed by the US Forest Service (USFS) and owned by the federal government, with another 6% in state park land (NRAC, 2002). The primary land types in the county are forest and agriculture (Fry et al., 2011).

Pocahontas County is located primarily in two geographic provinces: the Allegheny Mountains in the west and northeast, and the Valley and Ridge in the central and eastern portions of the county (WVDNR, 2006). The transition between the two provinces takes place within Pocahontas County. The western part of the county is more mountainous and is characterized by higher elevation, lower temperature, and a greater amount of precipitation. The highest elevation in Pocahontas County is 4,842 feet at Bald Knob on Back Allegheny Mountain; the lowest elevation is 1,952 feet where the Greenbrier River flows out of the county (USGS, 2003).

The eastern valleys are comprised of primarily mesic, or intermediate, soils formed in old river deposits derived from sandstone, siltstone, shale, limestone, or chert. These soils are used primarily for intensive row crops, hay, or pasture. The ridges that separate these valleys also consist of mesic soils, but these are derived from folded, in-place rocks of the same types listed above. The ridgesides are used for high pasture or timbering, but activities are limited due to steep slope, poor access to surface water, and shallow depth to bedrock. Most areas within the national forest and the highlands region are derived from bedded and folded sandstone, where gently sloping to extremely steep conditions persist on well-drained loamy soils. Most of these areas are used for timber production, recreational activities, and wildlife habitat. (USDA, 1998)

The county’s geologic features range in age from Pennsylvanian (approximately 280 million years old) to Silurian (approximately 400 million years old), with a few outcrops from the Ordovician (up to 500 million years old) (Cardwell et al., 1968). Over 40% of the county has shales and sandstones at or near the surface (USGS, 2011). The oldest rocks tend to come to the surface in the eastern portion of the county, centered along the Browns Mountain Anticline, which parallels the Route 92 corridor. They are sedimentary in nature and include shales, sandstones, and limestones. The younger rocks tend to outcrop in the western portions of the county, and are primarily shales and sandstones.

The highly karstified Greenbrier Limestone is present along the United States (US) 219 corridor throughout Pocahontas County and contains numerous cave systems, both large and small. As a cave-forming formation, the Greenbrier Limestone poses a significant concern regarding water quality issues. The sinkholes and caves provide a conduit for water and contaminants into the subsurface with little opportunity for filtration.

There are several faults and folds in Pocahontas County, and even though many are not large enough to be mapped at a county level, they impact surface and groundwater flow routes.

1.3 Pocahontas County Water Resources Task Force

Purpose and goals

The foremost goal of WRTF is the completion and implementation of a WRMP in Pocahontas County. Through this WRMP, WRTF strives to (1) integrate efficient and effective water resources management, (2) coordinate and assist a diverse group of individuals and organizations responsible for water resources management, (3) promote sustainable economic development, and (4) ensure local input.

The four-fold mission of WRTF is as follows:

- to identify, inventory, and monitor Pocahontas County's water sources and uses;
- to promote public awareness and foster wise use of Pocahontas County's water resources;
- to protect the quality of life and economic vitality of Pocahontas County; and
- to contribute to the management and protection of West Virginia's water resources.

In order to serve this mission, WRTF also engages in water-related education and outreach throughout the county.

Partnerships

Since its inception, WRTF has enjoyed the support of many partners. Included among these partners are Elk Headwaters Watershed Association, Pocahontas County Health Department, Use Your Noodle afterschool program (sponsored by High Rocks Educational Corporation), United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), West Virginia Department of Environmental Protection (WVDEP), West Virginia Division of Natural Resources (WVDNR), West Virginia University (WVU) Extension Service, Friends of the Lower Greenbrier River Watershed Association, Greenbank Middle School, Pocahontas County Public Service District (PSD), and US Forest Service (USFS).

WRTF will continue to cultivate these partnerships and looks forward to further collaboration with all county municipalities, the Pocahontas County PSD, and others.

Ongoing activities

At the time of this report, WRTF is engaged in many ongoing activities. Various education and outreach efforts—including volunteer stream monitoring, watershed education, and workshops—will continue while the WRMP is being developed and once the plan is implemented.

Perhaps most relevant to Phase 1 of this project, however, is the community stakeholder survey. The online community survey and the mail-in version generated 264 responses. WRTF members attended several local festivals and worked to inform the community about this project and to encourage people to complete community surveys.

WRTF members also held five community stakeholder meetings in September and October 2011. These meetings included discussions of the purpose and progress of the WRMP and provided an opportunity for distributing additional surveys. The survey was closed at the end of October 2011.

2. STAKEHOLDER PROCESS

WRTF was established in late 2008 and conducted several well-attended meetings in early 2009. These meetings marked the beginning of the stakeholder development process. Representatives who participated in these preliminary meetings included local government, as well as agencies such as WVDEP, WVDNR, USDA NRCS, and USFS. Outcomes of the series of meetings included the following: the creation of a Google group to allow stakeholders to keep up with WRTF news, the procurement of an AmeriCorps Volunteers in Service to America (VISTA) member to build capacity for the WRMP project, and a conversation with Downstream Strategies about the possibility of being contracted for this work.

Due to a VISTA staffing issue, the process was put on hold for almost six months. This introduced additional challenges to the WRMP project and the stakeholder development process.

As a means of restarting the conversation about the WRMP, WRTF held several community meetings in 2010. These meetings focused on structuring the organization and recruiting a steering committee. There were also informational meetings and brainstorming sessions to discuss the purpose of WRTF. Attendance at the 2010 meetings ranged from five people at the Linwood Library meeting to over twenty people at the Hillsboro Library meeting. Outcomes of the 2010 meetings included the formation of a steering committee and the reopening of the stakeholder development process.

The formal stakeholder development process for the WRMP project began in early 2011; at that point, a US Environmental Protection Agency (USEPA) Environmental Justice Small Grant had been obtained and Downstream Strategies had begun work on Phase 1 of the WRMP. Clay Condon, WRTF's current VISTA, contacted representatives from all the organizations that had been present at WRTF meetings in early 2009. He relayed the news that (1) WRTF now had funding; (2) Phase 1 of the WRMP was underway; and (3) a stakeholder meeting was being planned for agency, industry, and agriculture stakeholders.

In response to this contact, many individuals candidly expressed their concerns regarding WRTF. These concerns included lack of organization, direction, cohesion, and follow-through. Concerns were addressed on an individual basis by updating stakeholders on the progress made in 2010. WRTF's new organizational structure and funding were highlighted in these discussions. Many stakeholders were reassured to hear that WRTF had gained financial resources and leadership to guide the WRMP and provide consistency. In some instances,

Stakeholder:
Stakeholders can consist of three overlapping groups: those who make and implement the decisions, those who are affected by the decisions made, and those who have the ability to assist or impede implementation of those decisions.

Stakeholders for this project fall into three general categories.

Federal, state, and local government:

- USDA
- NRCS
- USFS
- USEPA
- National Radio Astronomy Observatory
- WVDNR
- WVDEP
- W.Va. Conservation Agency
- W.Va. Department of Health and Human Services
- W.Va. State Prison
- Pocahontas County Health Department
- Marlinton town government

Businesses:

- Boxley Materials Company
- Beckwith Lumber Company
- Agricultural industry

Local citizens (WRTF):

- Jo Lori Drake (Arbovale)
- Dennis Egan (Greenbank)
- Joshua Hardy (Mill Point)
- Beth Little (Lobelia)
- Donald McNeel (Hillsboro)
- Anne Smith (Greenbank)
- Hundreds of additional county residents who provided feedback through the community survey

follow-up face-to-face meetings occurred with concerned stakeholders. The results of these meetings and phone conversations were positive. Ultimately, no stakeholders were lost from the original list.

The first stakeholder meeting, intended for representatives of agencies, agriculture, business, and industry, was held at the McClintic Library on May 12, 2011. The second stakeholder meeting, for members of the agricultural community, was held on August 2, 2011 at the Marlinton Municipal Building. The following sections offer more information about these stakeholder processes.

2.1 Meetings and survey summary for community stakeholders

The community stakeholder development process targeted all residents, as well as land and business owners in Pocahontas County. To date, public stakeholder engagement has been conducted through workshops, public education and outreach, and a community survey.

In 2011, WRTF completed two after-school watershed education programs, two in-school stream sampling field trips, two after-school stream sampling field trips, one water day at Greenbank Math and Science Camp, and one public workshop. WRTF also had an outreach booth at five local festivals: Durbin Days, Little Levels Heritage Fair, Pioneer Days, Autumn Harvest Festival, and Huntersville Tradition Days.

Through these outreach efforts, WRTF engaged community members in conversations about the county's water resources, informed them of WRTF and the WRMP project, recruited volunteers, and distributed community surveys. Surveys were also disseminated through Facebook, the Google group, and as an insert in *The Pocahontas Times.* In addition, public service announcements (PSAs) have run on Allegheny Mountain Radio since August 2011.

A series of five community stakeholder meetings were held at local public libraries in September and October 2011. The meetings served to update the community on the progress of WRTF and the WRMP. In addition, WRTF gained further input from the public regarding citizen concerns and how water resources can be managed to protect the interests of the people of Pocahontas County.

The online and paper-version community survey was open through October 2011. Through the survey, WRTF learned of existing water quality and quantity issues, heard many citizens' concerns, and received commitments from individuals to share private data.

A total of 264 community surveys were submitted. Sixty-four of these surveys were submitted online; 200 were submitted on paper through the mail, at local festivals, and at drop points around the county.

A summary of the community survey responses is included in Appendix D.

2.2 Meeting and survey summary for agriculture stakeholders

Originally, WRTF attempted to combine agencies and agriculture into one stakeholder group. Thus, the same survey was distributed to agency representatives and to farmers. The survey was mailed to a group of farmers selected with the help of the WVU Extension Service along with an invitation to the initial May 12 stakeholder meeting.

WRTF's initial efforts to engage stakeholders from the agricultural community produced little response. WRTF received only two surveys back from farmers. Similarly, only two farmers attended the first stakeholder meeting and both represented other interests as well. Apparently, there was concern within the agricultural community that survey responses might somehow be a detriment to farmers in the future.

After conversations among the WRTF steering committee, several local farmers, and representatives from agencies that work closely with farmers, WRTF decided to hold a meeting solely for members of the agricultural community. This meeting, held on August 2, 2011 at the Marlinton Municipal Building, was advertised on Allegheny Mountain Radio, in *The Pocahontas Times*, and by postcard invitations sent by the WVU Extension Service to every registered farm in the county.

The August 2 agricultural stakeholder meeting was attended by twenty representatives of the agricultural community, including a local WVU extension agent and a representative from NRCS. WRTF was represented by the current VISTA, the water resources coordinator, and members of the steering committee. A news director for Allegheny Mountain Radio also attended the meeting and reported on it in a radio story.

Concerns and questions raised at the August meeting included the following:

- property rights and water rights;
- potential future water regulations (like those in place in the Chesapeake Bay watershed) and how the WRMP might affect regulations;
- lack of financial resources to deal with further regulation;
- the purpose and use of the WRMP and whether it will have a regulatory component;
- potential recommendations from the WRMP, specifically regarding fencing cattle out of streams;
- not being able to remove trees that have fallen into streams and the permit process one must go through in order to use machinery in a stream;
- the State overreaching its authority to control streams that clearly are not navigable;
- potential collaboration with other counties developing WRMPs; and
- potential water contamination from hydraulic fracturing for natural gas.

The primary concern of the farmers in attendance at the August meeting was that of regulations and specifically the possibility of future regulations. Farmers in attendance gave examples of how their work is hindered when they need to adhere to government regulations. The meeting was helpful to better understand the perspective of the agricultural community on this issue. Overall, more discussion occurred at this meeting than at the May meeting that included agency stakeholders. This is likely due, in part, to a more informal meeting structure. The agricultural meeting was set up as a dialogue; there were no presentations, visual aids, or handouts. The meeting began with introductions and a brief history of WRTF and the WRMP project. This was followed with an open floor for discussion, where attendees expressed concerns and asked questions.

Meeting attendees were invited to complete the community stakeholder survey. Out of a total of 264 surveys, 27 respondents indicated they use water for livestock, and 25 reported using water for irrigation. As the surveys are anonymous, there is no way to know how many farmers have completed the community survey. Those reporting irrigation as a water use may just be watering their lawns. However, it is likely that farmers are now represented in the community survey.

From the beginning of the project, WRTF has understood the important role farmers play in Pocahontas County. Farmers are more closely tied to the land and the water than many of the county's citizens. WRTF respects this and acknowledges the opportunity to learn from and serve the county's agricultural community; WRTF is grateful to have begun a conversation with this important sector of the citizenry.

2.3 Meeting and survey summary for agency stakeholders

To inform the development of the Pocahontas County WRMP, information was solicited from agency stakeholders using a Web-based survey. The purpose of the survey was to understand water resources and management from the perspective of those with responsibilities related to water resources management. Results of the survey were presented at an agency stakeholder meeting; both this meeting and the survey served to coordinate with agency stakeholders interested in participating in the plan, as well as to ensure planning efforts are aligned with agency water resources management goals.

After developing a draft survey, it was pre-tested by soliciting project team members to complete the survey and offer feedback. Feedback was provided on the survey's content as well as on the wording and meaning of questions. Based on feedback, the survey was modified and a final version was created. A solicitation letter to participate in the meeting and Web-based survey was then sent to stakeholders in agencies with responsibilities for managing West Virginia's water resources. Of the 24 solicited stakeholders, 16 responded—a 67% response rate. Respondents included representatives from: USFS, WVDEP, WVDNR, West Virginia Department of Health and Human Services, USDA, West Virginia State Prison, Pocahontas County Health Department, National Radio Astronomy Observatory, and West Virginia Conservation Agency.

The survey instrument addressed the following main topics: (a) agency roles and responsibilities, (b) water resources and management, and (c) the WRMP and its implementation. Most questions were multiple-choice; some allowed a write-in option. Each section provided at least one question that allowed open-ended answers. The final section collected general comments and contact information.

Respondents offered a variety of information about agency roles and responsibilities. Over half of the respondents stated "restoration and conservation" responsibilities to be a part of their agency's mission. Two-thirds of the respondents stated that water demand related to "fisheries and wildlife habitat" was a part their agency's mission; one respondent wrote in the responsibility "to develop a state water management plan by 2012," and that all aspects listed in the question were to be part of that plan.

Related to water resources and management, data most needed by respondents to help better manage water resources included water quality and water supply; these needs were closely followed by: impaired streams and impairment type, water demands, and education and/or capacity building. More specifically, actual data that could help better manage respondents' water resources included the following top responses: inventory of surface water resources, existing water quality, septic locations, and threatened or at-risk areas.

Related to water management concerns, respondents' top concern was hydraulic fracturing for natural gas. Other top concerns included the following: nonpoint source pollution from agriculture, mine-related concerns, wastewater treatment, development demands, and available data (e.g., stream gauges). The top challenge faced by respondents managing water resources was funding, followed by the challenge of education and public awareness.

Concerning the awareness of current planning, most respondents (80%) were aware of the state or county efforts to develop WRMPs. One respondent suggested that well drillers be additional stakeholders involved in the process. When asked what topics their agency can help with to implement the plan, respondents responded overwhelmingly with the following top responses: technical assistance, monitoring, best management practices (BMPs), and on-the-ground projects. Respondents also suggested a variety of specific data—and who houses it—to assist with this phase of the water planning effort, including the following:

- stream inventory data on streams on national forest lands (USFS);
- standards and specifications for installation of BMPs (USDA);
- fish population surveys and inventory of official trout waters (WVDNR);
- WVDEP's Watershed Assessment Branch's data (WVDEP);
- data on most of the listed concerns (WVDEP);
- National Wetlands Inventory, extent of karst, soil types, and the Tier 3 list of Outstanding National Resource Waters that receive the state's most stringent water quality protections (WVDNR); and
- withdrawal data (West Virginia State Prison).

Please see Appendix D for more information, results, and figures from the agency stakeholder survey.

2.4 Future stakeholder process

One potential method for developing the WRMP through a future stakeholder process is to define goals, objectives, and action items. These definitions could be developed by the stakeholders—or by an appointed technical committee—in a consensus-based process, which would help generate “buy-in” from the county and increase the likelihood of success. Table 1 illustrates an example method of gathering this information and implementing actions developed throughout the planning process. This method was implemented in the Rice County, Minnesota water resources plan (Bokman, 2003) and proved to be a successful step in developing and implementing the plan.

Table 1: Example goal, objective, and action-item table

Goal: Improve and protect surface water resources						
Objective #1: Identify current and potential problem areas						
Action item	Description	Focus area	Responsible party	Annual cost	Possible funding	Timeline
#1 Pollution source inventory						
#2 Monitoring plan						
Goal: Improve and protect groundwater resources						
Goal: Reduce sediment in streams						
Goal:						
Goal:						

Note: The goals, objectives, and action items in this table are merely examples and are not necessarily recommendations for Pocahontas County.

The first step in the process would be to set defined goals for the WRMP. For example, one goal could be to develop a water quality monitoring program (both surface and groundwater) for the county. This goal can have several objectives including establishing baseline water quality data; each objective could be broken down into action items such as purchasing monitoring equipment, identifying monitoring locations, writing a water quality monitoring plan, and recruiting volunteers for sampling efforts. All of these action items would be accompanied by a schedule and cost.

3. SURFACE WATER ASSESSMENT

This surface water assessment evaluates the county's surface water resources using readily available data and referencing published reports based on scientific study and review.

3.1 Surface water summary

Water resources play a crucial role in the county economy and are a significant resource to county residents and visitors. Pocahontas County is known as the birthplace of rivers; Figure 2 and Figure 9 illustrate this designation. The county boasts over 880 miles of streams, seven lakes and reservoirs, and the beginning of eight rivers within five basins: the Elk, Cheat, Tygart Valley, Gauley, and Greenbrier River basins. West Virginia contains 14 basins of this size and parts of 17 others. A basin includes all of the land area that drains to a point on a particular river.

This section contains an inventory of impaired streams (see Section 3.2) followed by an analysis of parameters exceeding water quality criteria, performed by Downstream Strategies using WVDEP's water quality data (see Section 3.3). This analysis indicates where problem areas exist from a water quality standpoint. In addition to the water quality analysis, total maximum daily load (TMDL) data and reports are summarized for each watershed (see Section 3.4); these summaries highlight key findings from WVDEP's TMDL reports.

Figure 2: Surface water resources

Towns US Census Bureau 2010
Major Watersheds Natural Resources Conservation Service 2004
County US Census Bureau 2010
Streams: National Hydrography Dataset (NHD), US Geological Survey 2004

3.2 Impaired streams of Pocahontas County

Impaired waterbodies are defined as rivers, streams, or other waterbodies that have been identified by state environmental agencies to have pollution levels that exceed ***water quality standards*** set to protect human health, public water supply, and fish and other aquatic life. Impaired waters are placed on the ***303(d) list***, triggering a ***TMDL*** study, which identifies the factors that contribute pollution to the waterbody. The TMDL is summarized in a report that identifies both point- and nonpoint sources of pollution and presents quantitative guidance to reduce pollutants to acceptable levels. Many streams and rivers in Pocahontas County are on the 303(d) list of impaired waterbodies, as shown in Figure 3 and Table 2.

TMDL studies were completed for the Greenbrier River in 2008, Cheat River in 2010, Tygart Valley River in 2001, Elk River in 2001, and the Gauley River in 2008.[1] A TMDL creates a framework for systematically improving local water quality and removing waterbodies from the 303(d) list. This framework can be refined with a watershed-based plan, which outlines specific steps to accomplish the clean-up goals and establishes a timeline to be followed.

Pocahontas County contains over 390 miles of impaired streams with five different types of impairments: aluminum, algae, fecal coliform, polychlorinated biphenyls (PCBs), and pH. State water quality standards for these pollutants are shown in Table 3.

There are many influences on water quality in Pocahontas County. Development, agriculture, steep slopes, precipitation patterns, soil types, and other characteristics all play a role. TMDL reports make a data-supported effort to tease apart these interconnected factors and determine the relative contribution and necessary reductions from pollution sources. TMDL reports can be downloaded from the WVDEP Web site (www.dep.wv.gov/WWE/watershed/TMDL/) and reviewed to understand WVDEP's methodology and to learn about the pollution issues and sources identified for each impaired waterbody. Pollution issues for specific watersheds are described in more detail in the following sections.

Impaired waterbody:
Federal law requires states to identify impaired waterbodies within their borders. Impaired waterbodies are lakes and river and stream sections that violate water quality standards more than 10% of the time (or in three samples if fewer than 20 samples are available). WVDEP identifies impaired waters by monitoring and assessing water quality. More information is available at www.dep.wv.gov/WWE/watershed/wqmonitoring/Pages/waterquality.aspx and in the 2010 303(d) list.

Water quality standards:
The State of West Virginia has established limits for a variety of pollutants in state waters. Specific criteria are set to protect designated uses including water contact recreation, public water supply, and fish and other aquatic life. Additionally, the State has policies to protect and maintain existing high quality waterbodies. Details are presented in Title 47, Series 2 of the Code of State Rules.

303(d) list:
The 303(d) list is a report to USEPA of impaired waterbodies. The list is revised and submitted by WVDEP in even years. The 2010 list can be downloaded from: www.dep.wv.gov/WWE/watershed/IR/Pages/303d_305b.aspx

TMDL:
A TMDL report is required for waterbodies on the 303(d) list. The TMDL identifies pollution sources and presents a plan to reduce pollutants to acceptable levels. WVDEP explains more about how it develops TMDL reports here: www.dep.wv.gov/WWE/watershed/TMDL/Pages/default.aspx

---

[1] The 2001 Tygart Valley River and Elk River TMDLs do not impact Pocahontas County and are not mentioned in Table 2.

Figure 3: Impaired streams

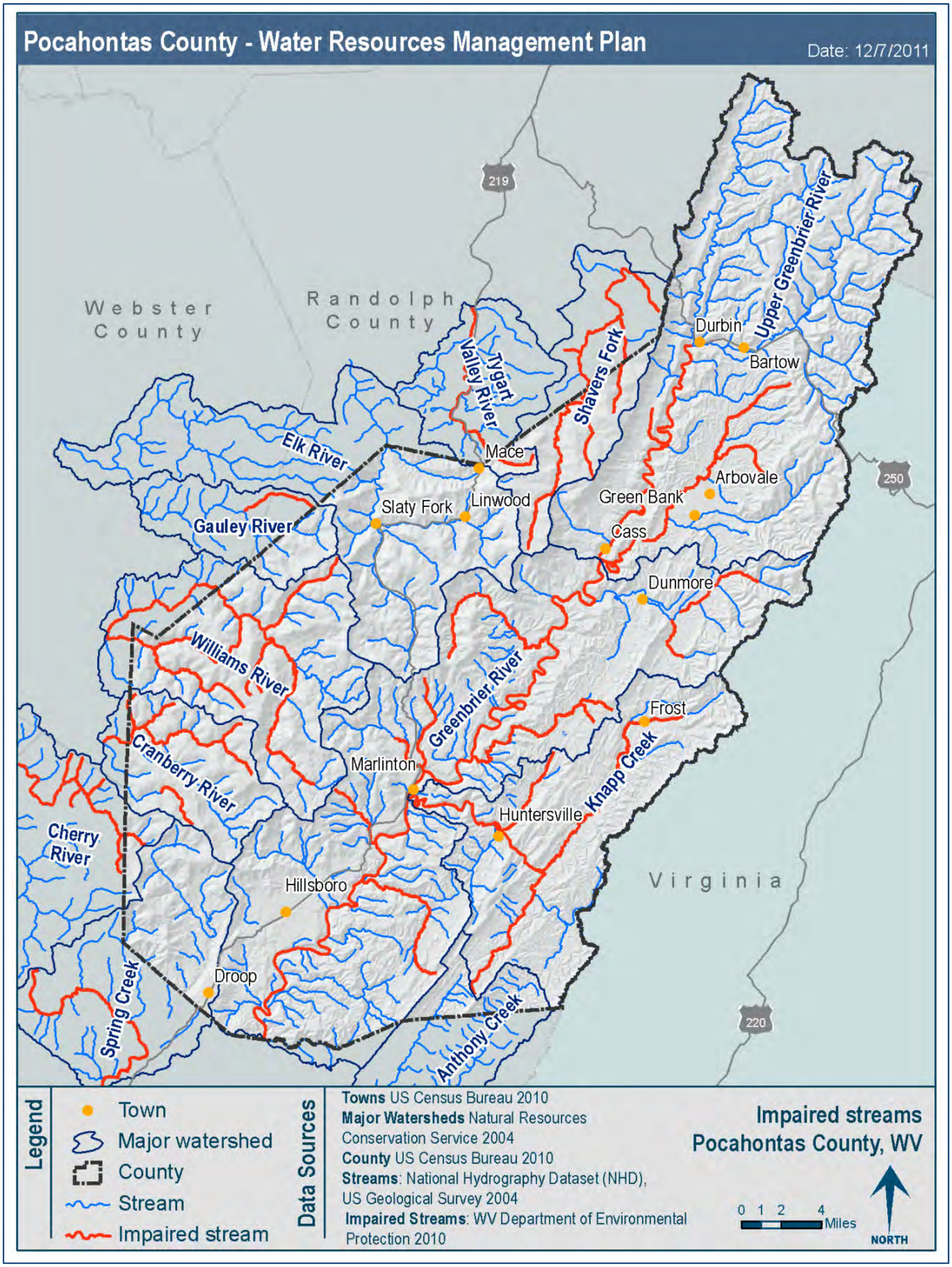


Table 2: Impaired streams in Pocahontas County

	Criterion affected	Stream name	Code	Reach description	TMDL
Cheat watershed	PCBs	Shavers Fork	MCS	Entire length	2019
	pH	First Fork	MCS-50	Entire length	2019
		Second Fork	MSC-54	Entire length	2019
		Shavers Fork	MCS	RM 40.6 (Bemis) to RM 68.6	2014
Gauley watershed	Aluminum (dissolved; trout)	Cranberry River	KGC	Entire length	2016
		Middle Fork Williams River	KGW-10	Entire length	2016
		North Fork/Cherry River	KG-34-H	Entire length	2021
		Sugar Creek	KGW-21	Entire length	2016
		Williams River	KGW	RM 3.0 to headwaters	2021
	pH	Beechy Run	KGW-10-C	Entire length	2021
		Birchlog Run	KGC-21	RM 6.8 to headwaters	2008
		Dogway Fork	KGC-19	Entire length	2008
		Kens Creek	KGW-18	Entire length	2008
		Left Fork/North Fork/Cranberry River	KGC-24-C	Entire length	2008
		Middle Fork/Williams River	KGW-10	RM 0.25 to headwaters	2008
		North Fork/Cranberry River	KGC-24	Entire length	2008
		Sugar Creek	KGW-21	Entire length	2008
		Tea Creek	KGW-20	Entire length	2008
		Tumbling Rock Run	KGC-22	Entire length	2008
		UNT/Sugar Creek RM 2.5	KGW-21-B	Entire length	2008
Greenbrier watershed	CNA	Greenbrier River	KNG	Mouth to RM 102.78 (Beaver Ck)	2022
	Fecal coliform	Allegheny Run	KNG-75	Entire length	2008
		Beaver Creek	KNG-47	Entire length	2008
		Browns Creek	KNG-53-D	Entire length	2008
		Buffalo Run	KNG-68-F	Mouth to RM 3.0	2008
		Cloverlick Creek	KNG-61	Entire length	2008
		Deer Creek	KNG-68	Entire length	2008
		Douthat Creek	KNG-53-H	Entire length	2008
		Galford Run	KNG-66-E	Mouth to RM 5.2	2008
		Greenbrier River	KNG	Entire length	2008
		Indian Draft	KNG-55-A	Entire length	2008
		Knapp Creek	KNG-53	Mouth to RM 26.3	2008
		Shock Run	KNG-66-D	Mouth to RM 2.6	2008
		Stony Creek	KNG-55	Mouth to RM 3.0	2008
		Swago Creek	KNG-49	Entire length	2008
		Thorny Creek	KNG-59	Entire length	2008
		UNT/Thorny Creek RM 9.27	KNG-59-E	Entire length	2008
Tygart	Fecal coliform	Tygart Valley River	MT	Entire length	2015

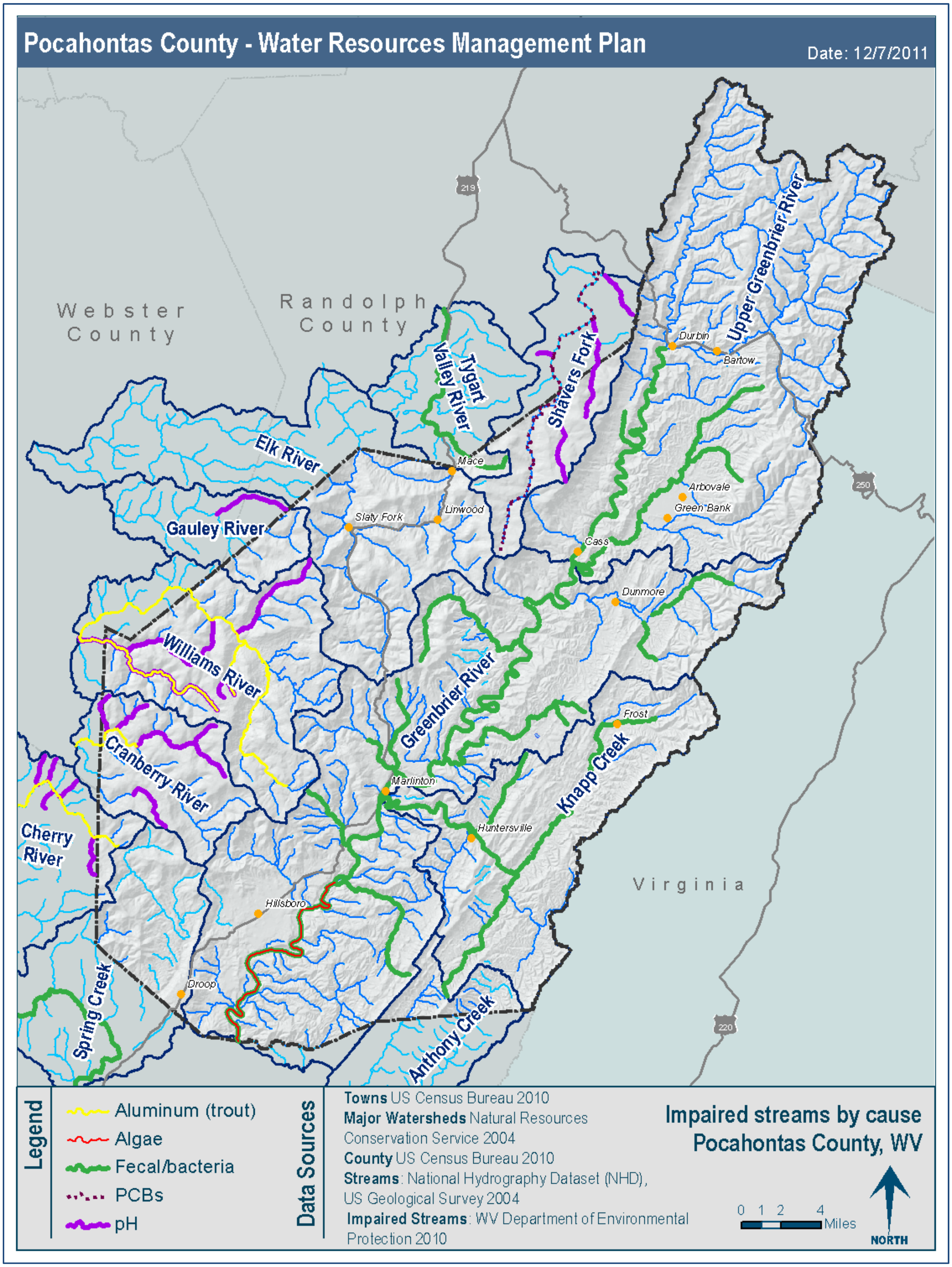
PCB=polychlorinated biphenyl. CNA=conditions not allowable. RM=river mile. UNT=unnamed tributary. Source: WVDEP (2010). Entire length indicates the river or stream is impaired from its mouth to the headwaters. Years in the TMDL column indicate actual year of publication for past years and goal year for future dates.

Table 3: Selected West Virginia water quality standards

	Aquatic life		Human health	
Parameter	**Category B1 (warm water fishery streams)**	**Category B2 (trout waters)**	**Category A (public water supply)**	**Category C (water contact recreation)**
Aluminum (dissolved)	Not to exceed 750 µg/L (chronic and acute)	Not to exceed 750 µg/L (acute) or 87 µg/L (chronic)	None	None
Biological impairment (CNA)	[N]o significant adverse impact to the…biological [component] of aquatic ecosystems shall be allowed.			
Fecal coliform	None	None	Not to exceed 400 cfu/100 mL	Not to exceed 400 cfu/100 mL
Iron (total)	Not to exceed 1.5 mg/L (chronic)	Not to exceed 0.5 mg/L (chronic)	Not to exceed 1.5 mg/L	None
PCBs	Not to exceed 14.0 ng/L	Not to exceed 14.0 ng/L	Not to exceed 0.044 ng/L	Not to exceed 0.045 ng/L
pH	No values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated.			

Source: 47 Code of State Rules Series 2. CNA= conditions not allowable. While there are no 303(d) listings for iron, the water quality analysis described in Section 3.3 finds exceedances of the iron standard.

Figure 4: Impaired streams by cause



3.3 Water quality analysis

Consistent with the impaired streams list, available water quality data exceed water quality criteria in non-trout waters for pH and fecal coliform. In trout waters, data exceed criteria for dissolved aluminum and total iron, in addition to pH and fecal coliform. A total of 200 sample sites were examined as part of this water quality analysis, shown in Figure 5. The sampling is part of the WVDEP Watershed Assessment Program (WAP). The dataset analyzed consists of data from 1996-2010—over 900 samples were tested for some combination of the following parameters:

- Acidity
- Aluminum
- Alkalinity
- Ammonia
- Calcium
- Chloride
- Conductivity
- Dissolved oxygen
- Fecal coliform
- Hardness
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nitrogen
- pH
- Phosphorus
- Potassium
- Selenium
- Sodium
- Sulfate
- Total dissolved solids
- Turbidity
- Zinc

All water quality sample results:

Results from these 900+ samples yielded almost 8,000 data points (meaning that, on average, each sample was tested for about nine water quality parameters). Of these samples, just over 200 exceed water quality criteria (Table 3). Figure 6 displays the location and count of exceedances across the county. While pH and fecal coliform comprise the bulk of water quality issues, there are a few trout streams that periodically exceed total iron and dissolved aluminum standards.

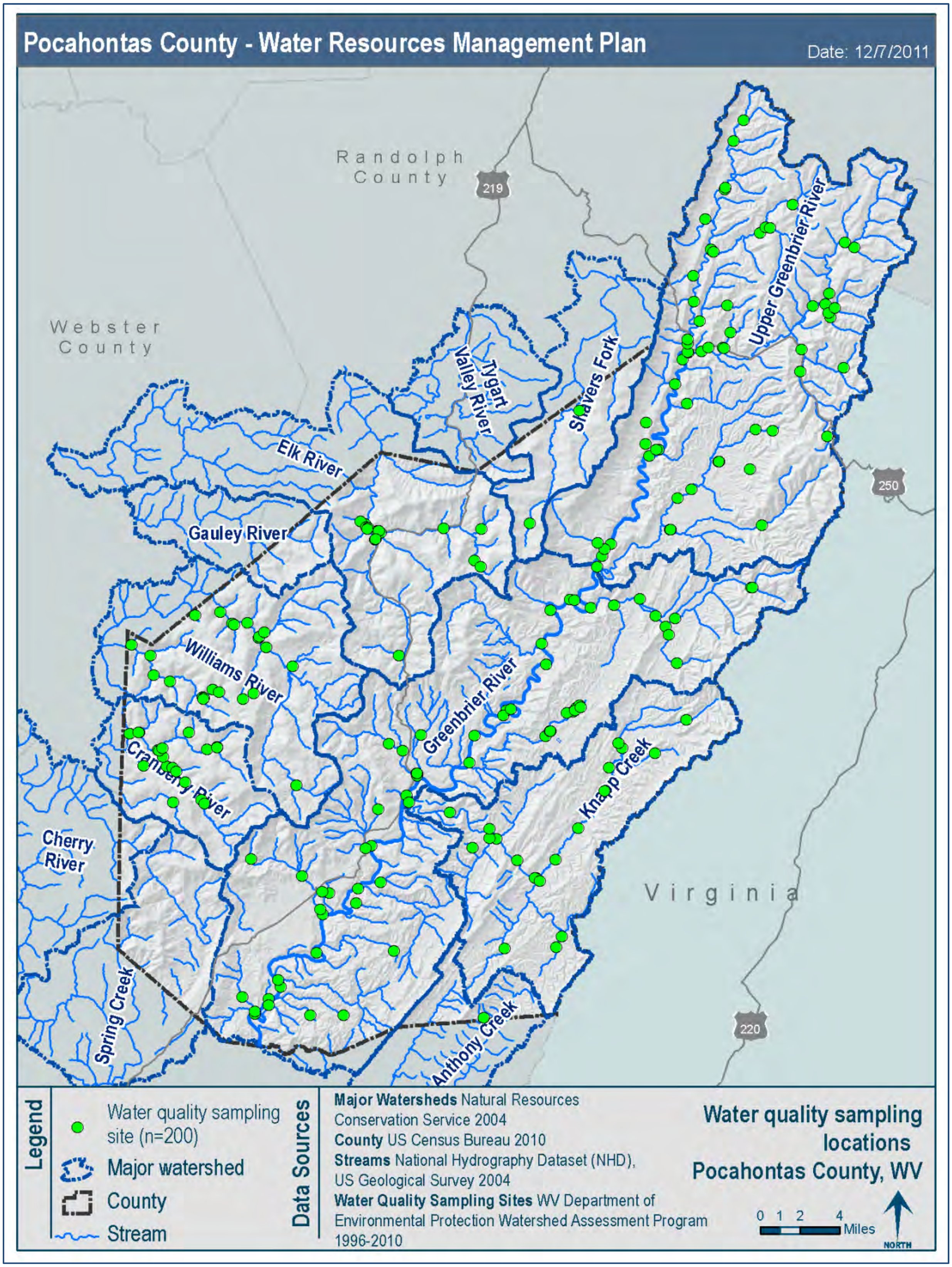
Water quality results for fecal coliform:

Twenty-nine of 88 locations sampled for fecal coliform in Pocahontas County have at least one fecal coliform exceedance (Figure 8), with sample results above 400 colony forming units (cfu)/100 mL (Table 3). Of the 12 locations with exceedances that have more than one sample date, the percent of samples exceeding the water quality criterion ranges from 13% to 31%. The average fecal coliform value of the samples with exceedances ranges from approximately 900 to 4,600 cfu/100 mL. Aside from a single exceedance in Slaty Fork of the Elk River, all fecal coliform exceedances in Pocahontas County were in the Greenbrier watershed.

Water quality results for pH:

Thirty-five of 106, or 33% of locations sampled for pH in Pocahontas County do not meet the state water quality criterion (Figure 7), with measurements falling below 6. No data in Pocahontas County show pH greater than 9. Most low pH measurements are in the Gauley River headwaters. Locations with low pH in other watersheds are isolated occurrences. pH is low in the Gauley headwaters—indicating acidic waters—because the soils and rocks in the area are unable to buffer the effects of acid rain (Tetra Tech, Inc., 2008). Average pH values of violating samples in Pocahontas County range from 3.4 at a Sugar Creek station to 5.95 at a station in the headwaters of the Greenbrier River. To mitigate the effect of acid rain, WVDNR installed three limestone dosing stations in the Gauley headwaters—one each on Sugar Creek (of the Williams River), North Fork (of the Cranberry), and Dogway Fork (of the Cranberry). Additionally, limestone fines are periodically trucked in and deposited in locations throughout the watershed. These stations raise the pH of these streams, and recent water quality sampling confirms this improvement, which has returned these streams to viable trout fisheries (water.epa.gov/polwaste/nps/success319/wv_sugardog.cfm).

Figure 5: Water sampling locations



Data Sources

Major Watersheds Natural Resources Conservation Service 2004
County US Census Bureau 2010
Streams National Hydrography Dataset (NHD), US Geological Survey 2004
Water Quality Sampling Sites WV Department of Environmental Protection Watershed Assessment Program 1996-2010

Figure 6: Water quality exceedances

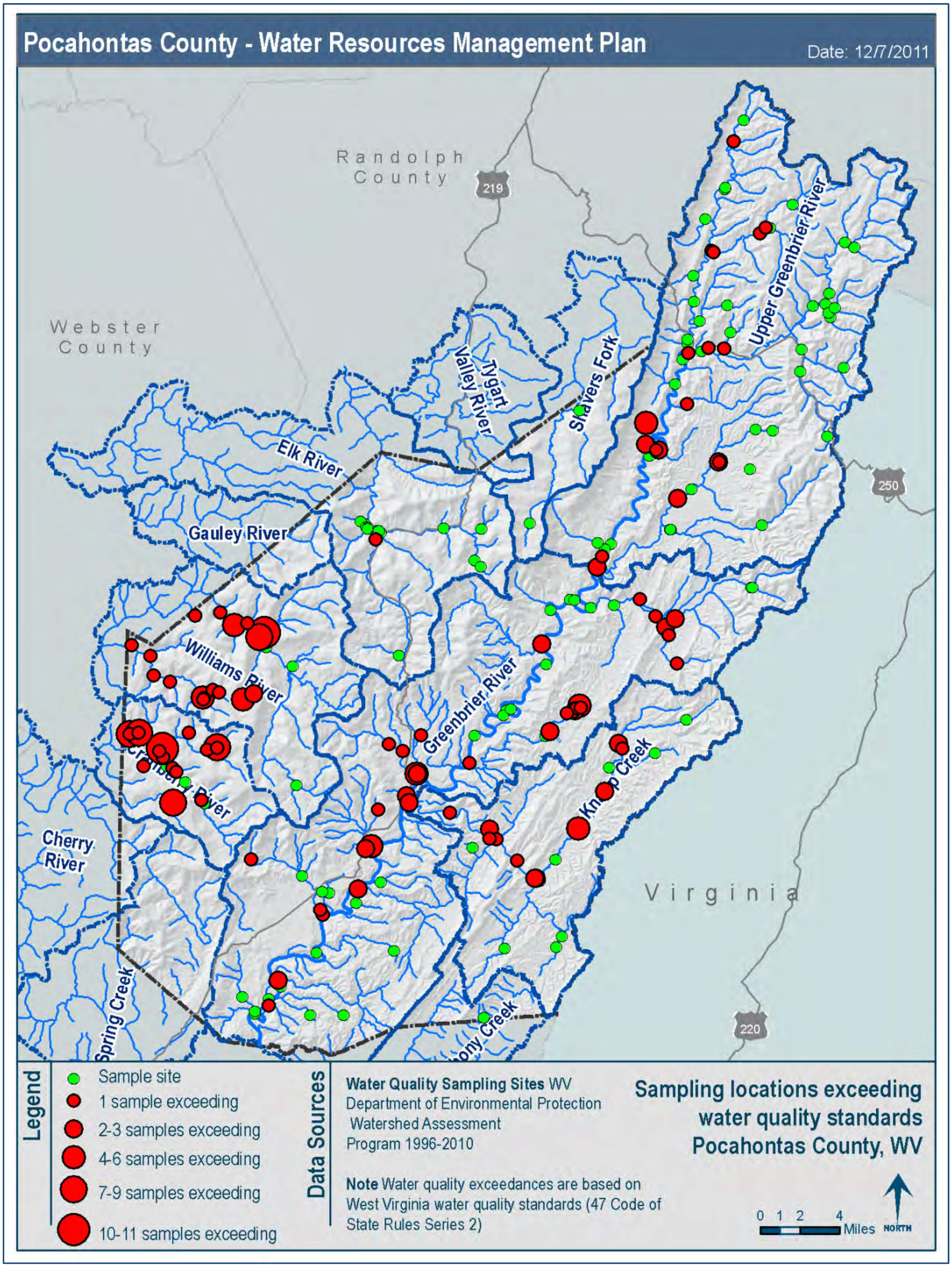


Figure 7: pH outside water quality standards

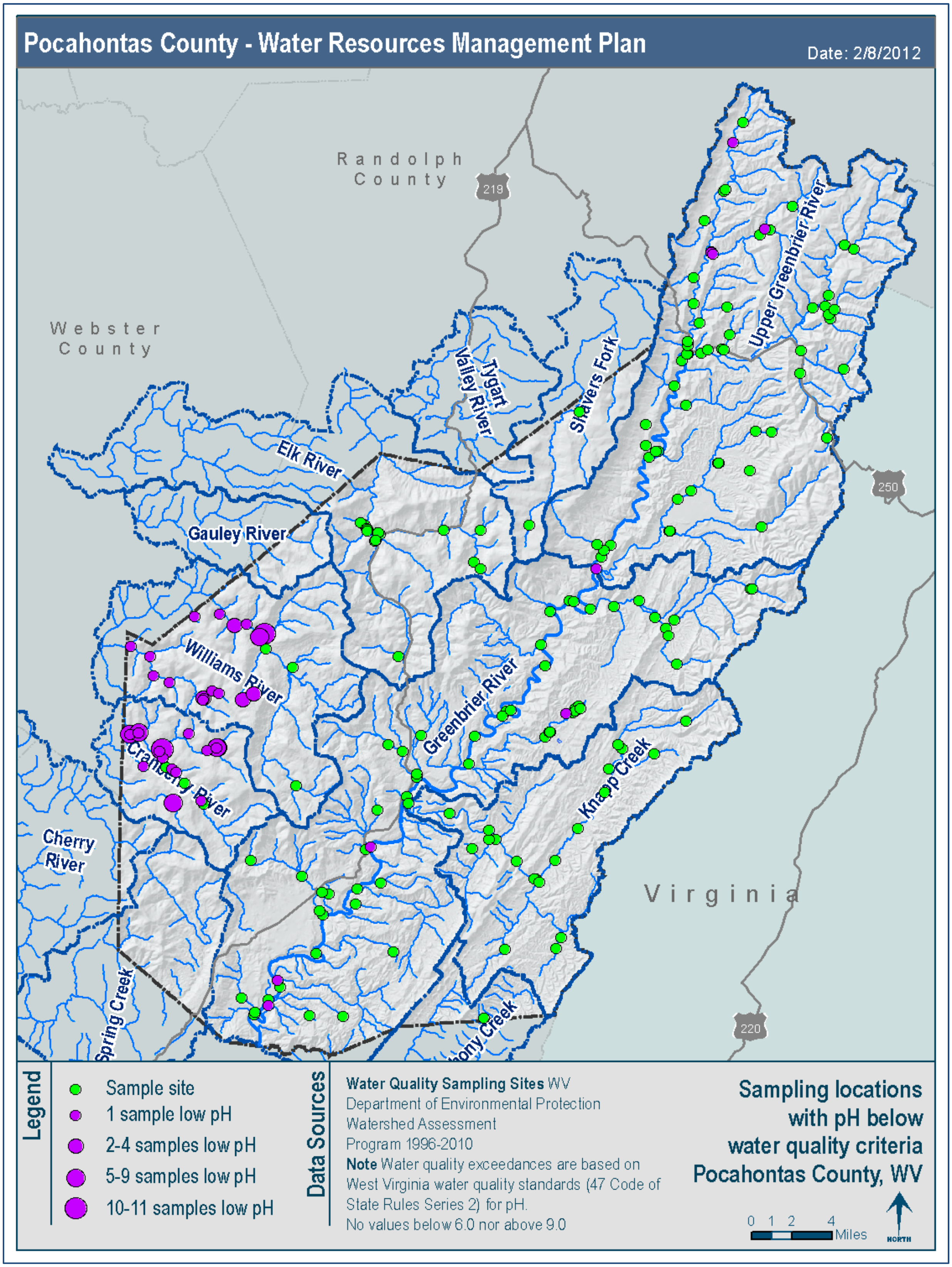
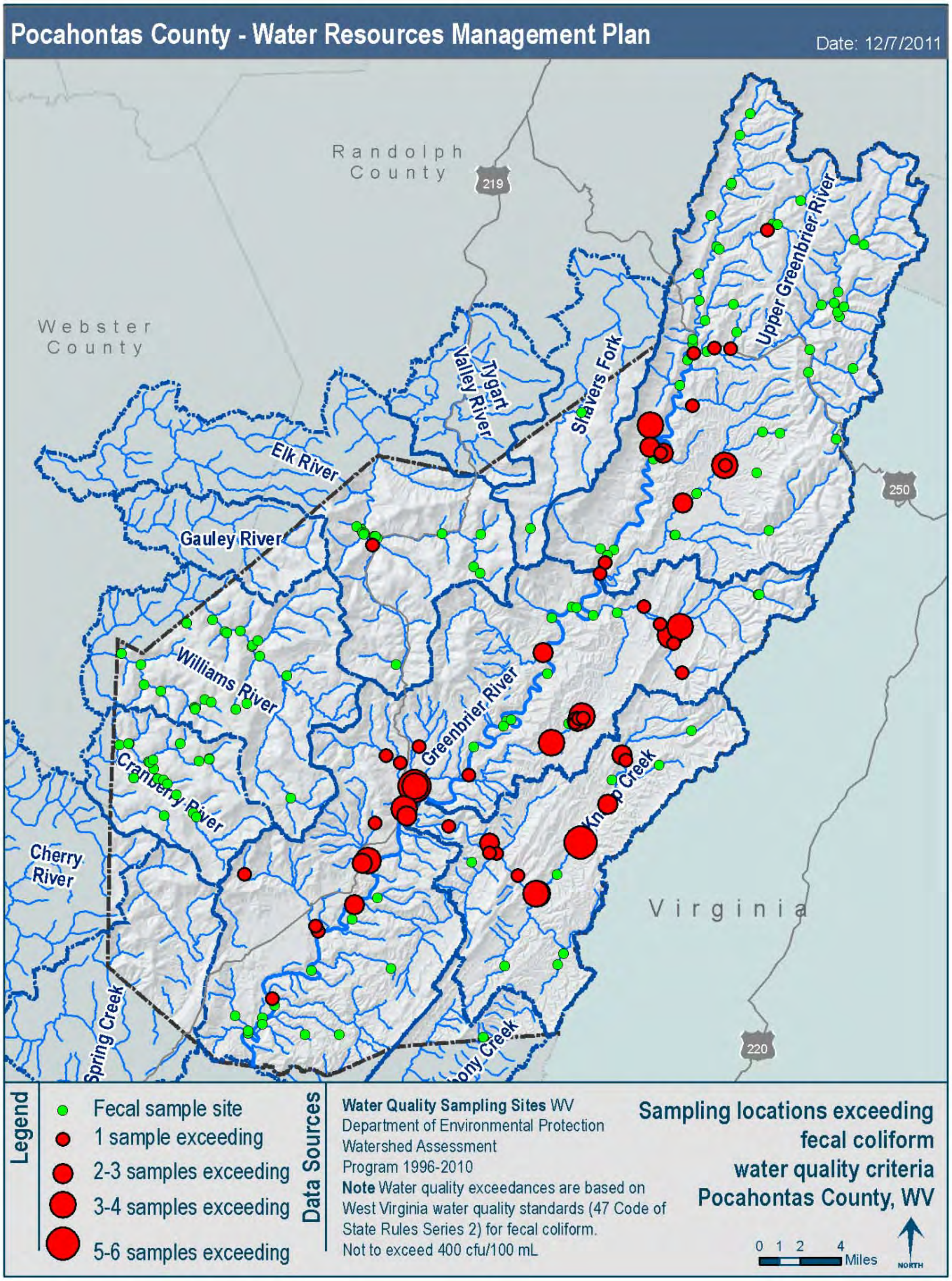


Figure 8: Fecal coliform exceedances



3.4 Watershed summaries

Eight rivers of five major watersheds, or basins, begin in Pocahontas County; all are part of the Mississippi drainage and ultimately flow to the Gulf of Mexico. A watershed consists of all of the small streams that feed a larger waterbody, as well as the land area they flow through. John Wesley Powell, second director of the US Geological Survey (USGS), is often quoted for his definition of a watershed: “that area of land, a bounded hydrologic (water) system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community" (USEPA, 2011).

In water resources management, watersheds are organized into management units and subdivided at various levels in order to understand the complexity and dynamics of the water resource. Watersheds can be divided at many different scales, ranging from areas that drain a single stream, like the creek that flows through your backyard, to areas that drain major rivers, like the Ohio River that drains parts of eleven states. For the purpose of this assessment, five watersheds were chosen to represent the major drainages of Pocahontas County. The Elk, Gauley, Tygart Valley, Cheat, and Greenbrier River basins are all watersheds with eight-digit ***hydrologic unit codes*** (HUCs).

Water does not follow political boundaries; therefore, streams that flow out of the county were included in this assessment and are shown in Figure 9. There are no streams in Pocahontas County that begin in another county. Each of the five major watersheds is unique and plays a role in shaping the characteristics of the county.

Hydrologic unit codes:
The hydrologic unit code system was developed by USGS as a way to catalog watersheds. The eight-digit HUCs for the five basins in Pocahontas County are shown below.

River basin	8-digit HUC
Cheat	05020004
Elk	05050007
Gauley	05050005
Greenbrier	05050003
Tygart Valley	05020001

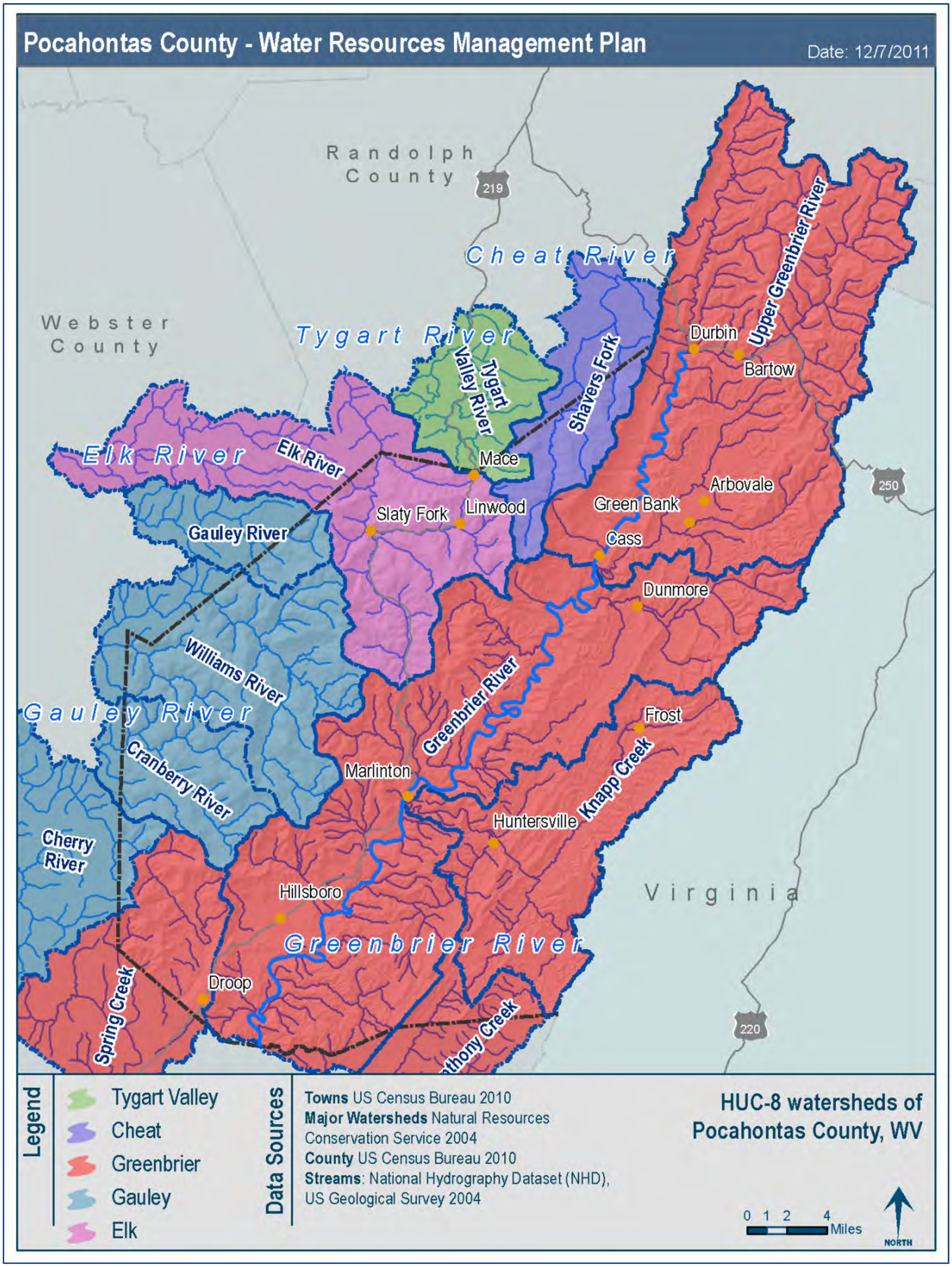
Notice that all five HUCs begin with “05.” “05” is the two-digit HUC for the Ohio River. All rain that falls in Pocahontas County eventually ends up in the Ohio River. The next two digits in the Cheat and Tygart Valley codes are “02” because these two rivers contribute to the larger basin of the Monongahela River—0502. Similarly, the four-digit HUC for the Kanawha River is 0505.

Smaller rivers have longer HUCs to place them within larger basins. The Williams, Cranberry, and Cherry Rivers are all in the Gauley River watershed, so all of their HUCs begin 05050005.

Link to more information:

water.usgs.gov/GIS/huc.html

Figure 9: County watersheds



3.4.1 *Cheat River watershed*

Shavers Fork, the largest Pocahontas County stream in the Cheat watershed, is impaired for pH and PCBs. The pH impairment is entirely downstream of the Pocahontas County line—from Bemis to the Cheat Bridge. The PCB impairment, however, is for the full length of Shavers Fork, including the approximately 12 miles flowing through Pocahontas County (WVDEP, 2010). First and Second Forks of Shavers Fork are also impaired for pH. None of the impairments in the Shavers Fork watershed were included in the 2010 Cheat River watershed TMDL. According to the TMDL, a single coal mine with a revoked permit (also known as a bond forfeiture site) and a single industrial wastewater permit are discharging iron into Shavers Fork, but no reductions are necessary. Shavers Fork is the only watershed in the Cheat TMDL that is in Pocahontas County. Despite the impairment listings, none of the water quality data examined for this report from the Cheat River watershed display any water quality exceedances.

TMDL report: Tetra Tech, Inc. (2011) Total maximum daily loads for selected streams in the Cheat River watershed, West Virginia. Prepared for WVDEP, Division of Water and Waste Management.

Link to report:
www.dep.wv.gov/WWE/watershed/TMDL/grpa/Documents/Cheat/Cheat%20Approved%202011/Cheat_Final_TMDL_Public_Report_1_20_11.pdf

3.4.2 *Tygart Valley River watershed*

Pocahontas County contains the highest Tygart Valley River headwaters, but less than 1% of Pocahontas County drains into the Tygart watershed. The Tygart Valley River is impaired for fecal coliform, but does not yet have a TMDL for this pollutant (WVDEP, 2010). The 2001 TMDL released for the Tygart to address acid mine drainage did not call for any reductions in the headwaters. All of the water quality issues exist outside of Pocahontas County and none of the examined water quality data for the Tygart Valley River watershed display any water quality exceedances in Pocahontas County.

TMDL report: Tetra Tech, Inc. (2001) Metals and pH TMDLs for the Tygart Valley River watershed, West Virginia. Prepared for USEPA, Region 3.

Link to report:
www.dep.wv.gov/WWE/watershed/TMDL/grpb/Documents/Tygart/3016_complete_tygart_tmdl.pdf

Water quality data:

Data presented in this section were collected and provided by WAP, within the Division of Water and Waste Management at WVDEP. WAP is responsible for data collection and analysis of West Virginia's surface waters.

Link to the WVDEP's water quality monitoring program:

www.dep.wv.gov/WWE/watershed/wqmonitoring/Pages/waterquality.aspx

Monitoring programs and strategies include:

Ambient water quality monitoring. Statewide, 26 stations on large rivers are monitored monthly or bi-monthly. None of these are in Pocahontas County.

Pre-TMDL development monitoring. When a TMDL study is initiated, additional data are collected to inform the TMDL.

Probabilistic monitoring. Randomly selected sites are monitored. Statistical analysis allows the data to be used to estimate water quality throughout a watershed.

Special studies. WVDEP collects additional data in locations with known and pending water quality issues. Recent examples include the Greenbrier River algae study and the Dunkard Creek fish kill study.

3.4.3 *Elk River watershed*

No impairments are documented in the Elk River watershed within Pocahontas County (WVDEP, 2010). Downstream of Sutton Lake, however, the Elk River is impaired for fecal coliform and iron. The 2001 TMDL released for the Elk River to address acid mine drainage did not call for any reductions in the headwaters. Similarly, there were no reductions called for in the headwaters in the 2011 TMDL draft report for aluminum, iron, selenium, and fecal coliform.

In 1997, a single location in Slaty Fork had a fecal coliform value of 633 cfu/100 mL, which exceeds the fecal coliform water quality standard.

TMDL reports: Tetra Tech, Inc. (2011) Draft report: total maximum daily loads for selected streams in the Elk River watershed, West Virginia. Prepared for WVDEP, Division of Water and Waste Management.

Tetra Tech, Inc. (2001) Metals and pH TMDLs for the Elk River watershed, West Virginia. Prepared for USEPA, Region 3.

Link to 2011 draft report:
www.dep.wv.gov/WWE/watershed/TMDL/grpb/Documents/Elk_TMDL_B2_2011/Preliminary_Draft_Elk_TMDL_Report_9-12-11.pdf

Link to 2001 report:
www.dep.wv.gov/WWE/watershed/TMDL/grpb/Documents/Elk/2972_WV_ElkRiver_TMDL.pdf

3.4.4 *Gauley River watershed*

The three tributaries to the Gauley River in Pocahontas County are the Cranberry, Cherry, and Williams Rivers. The Williams River and several of its tributaries are impaired for dissolved aluminum under the trout water criterion. The Cranberry River and the North Fork of the Cherry River are also impaired for dissolved aluminum under the trout water criterion.

Several headwater streams of the Gauley River are impaired for pH. All but four miles[2] of streams impaired for pH were addressed in the 2008 Gauley TMDL. These pH impairments are attributed to atmospheric deposition—acid rain (Tetra Tech, 2008). Because acid rain does not originate in the headwaters, no pH load reductions are assigned in the region. However, clean air legislation has the potential to reduce emissions in the surrounding region, abating the acid rain problems in the watershed.

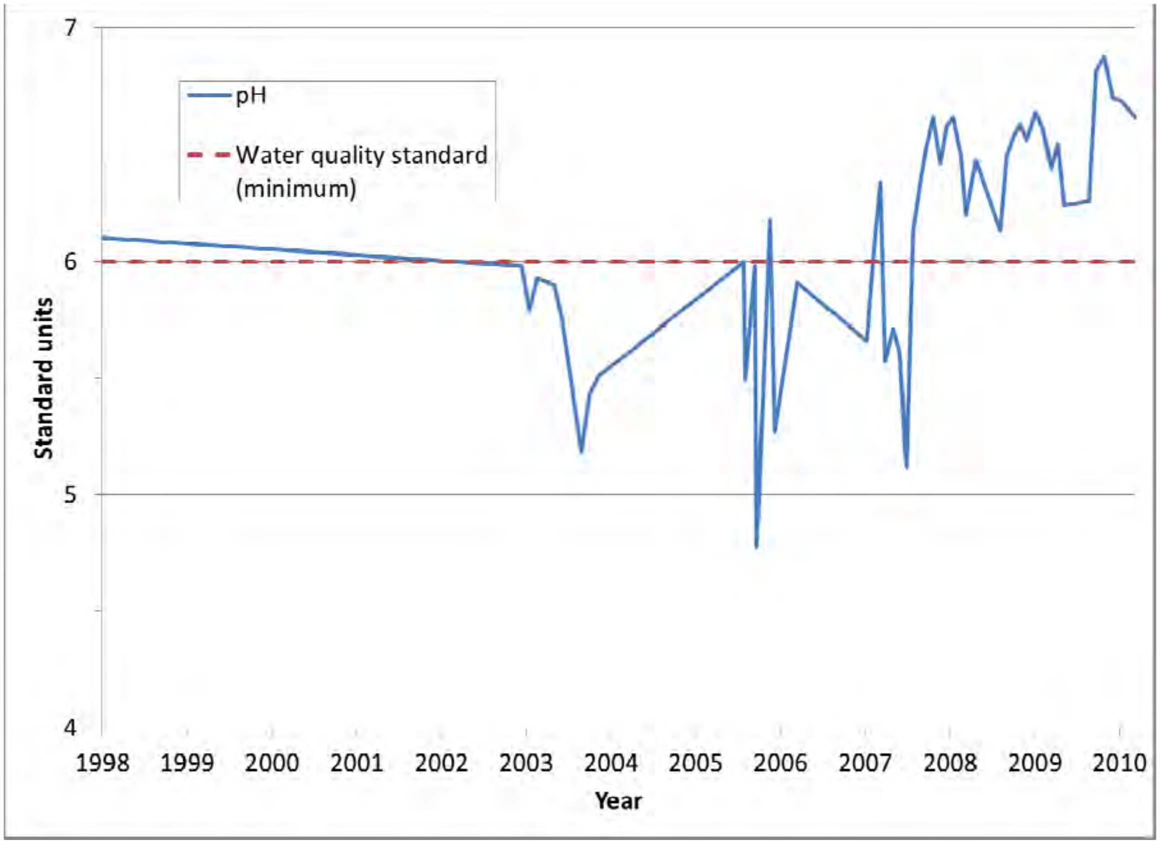
Of data collected between 1998 and 2010, 50% of samples in the Williams River watershed and 72% of samples in the Cranberry River watershed had pH lower than 6. However, the sample location with the most data, Tea Creek, displays an increasing trend in pH from the mid-2000s to the present, as shown in Figure 10.

Two trout streams in the Gauley River watershed exceeded the dissolved aluminum standard and are included on the 303(d) list—South Fork/Cranberry River and Tea Creek. South Fork/Cranberry River also exceeded the iron criterion in six of eight samples. No samples collected in the Gauley headwaters have exceeded the fecal coliform standard, also consistent with the 303(d) list.

---

[2] Beechy Run is 3.9 miles long and, while listed for pH since 2006, was not included in the 2008 TMDL.

Figure 10: pH trend on Tea Creek



<u>TMDL Report:</u> Tetra Tech, Inc. (2008) Total maximum daily loads for selected streams in the Gauley River watershed, West Virginia. Prepared for West Virginia Department of Environmental Protection, Division of Water and Waste Management.

Link to report: www.dep.wv.gov/WWE/watershed/TMDL/grpc/Documents/Gauley%202008/_Gauley_Final_TMDL_Report_03_27_08.pdf

3.4.5 *Greenbrier River watershed*

About three quarters of Pocahontas County is in the Greenbrier River watershed. The Greenbrier River and several of its tributaries are impaired for fecal coliform. Additionally, the lower sections of the Greenbrier—including the last 15 miles in Pocahontas County—have algae problems resulting in the biological impairment listing of “conditions not allowable,” or CNA. The fecal coliform impairment was addressed in a 2008 TMDL; a TMDL for the biological listing is scheduled to be complete by 2022 (WVDEP, 2010).

There are three municipal sewage treatment facilities in Pocahontas County that are within the Greeenbrier River watershed: Durbin, Hillsboro, and Marlinton. Of these, the combined sewer overflow at Marlinton is the only point source reduction listed in the fecal coliform TMDL.

Water quality data from 1999-2009 show seven of 48 samples in the Greenbrier River mainstem exceeded the fecal coliform standard. All seven of these exceedances were recorded in 2004. A similar ratio of samples taken in Greenbrier River tributaries—92 of 643—exceeded fecal coliform standards. Seventy of these 92 exceedances also occurred in 2004. Exceedances occurred throughout the watershed, but with a higher ratio in the southern portion of the watershed.

WVDEP conducted a study on the algae problem in the Greenbrier River (WVDEP, 2008). It concluded that low hardness combined with some minimum level of alkalinity in the presence of dissolved phosphorus, commonly discharged from sewage treatment facilities, facilitates the algae blooms.

While the only listed impairments of the Greenbrier watershed in Pocahontas County are fecal coliform and CNA-biological, water quality data show a few additional exceedances of water quality standards. Little River/West Fork/Greenbrier River is a trout stream that had one modest iron exceedance the only time it was sampled, in 1999. Little River/West Fork/Greenbrier River, along with two other trout streams—Deer Creek and West Fork/Greenbrier River—also had single low pH values out of a total of twelve samples for Little River, 23 samples for Deer Creek, and 27 samples for West Fork. Most of these samples were taken between 1999 and 2005. Additionally, six other sites in the Greenbrier River watershed recorded single instances of low pH, with the lowest value being 5.7, slightly below the standard of 6.

TMDL Report: Tetra Tech, Inc. (2008) Total maximum daily loads for selected streams in the Greenbrier River watershed, West Virginia. Prepared for West Virginia Department of Environmental Protection, Division of Water and Waste Management.

Link to report:
www.dep.wv.gov/WWE/watershed/TMDL/grpd/Documents/Greenbrier%202008/GB_Final_EPA_APPROVED TMDL Report 11 24 08.pdf

3.5 Water balance analysis

This portion of the study examines the water budget of the county, looking at the flow of water into and out of the county to determine long-term water balances for significant watersheds. These values can be used to help manage water supply and predict where there may be water shortages.

To characterize rainfall-runoff dynamics in Pocahontas County, frequency and water balance analyses were conducted on long-term stream gauging stations located within the county. Frequency analyses help understand the long-term variability of floods and low-flow periods and the general availability of surface water resources.

A water balance accounts for water coming into a watershed through precipitation and water leaving a watershed through runoff. The difference between these two measures is an approximation of change in storage, or water availability, in the watershed.

Precipitation has been measured by the National Oceanic and Atmospheric Administration (NOAA) at various locations throughout Pocahontas County. This report focuses on three stations: Buckeye, Marlinton, and Bartow (Figure 11). The Buckeye precipitation station is located near the Buckeye stream station.

Daily precipitation data: Downloaded for each station from the NOAA National Climate Database Center (www.ncdc.noaa.gov/oa/ncdc.html).

Data disclaimer: The data were then summed by year to calculate annual precipitation. The NOAA database is the most complete long-term dataset available. However, the sparse stations and gaps in records do not allow for a detailed evaluation across Pocahontas County; therefore, this analysis represents an estimate of conditions. Data were only used in years with nine or more months of records.

Each station has a varying number of records each year; we include annual values for years with nine or more months of records. For example, precipitation at the Buckeye station was only reported for October, November, and December 1995. As such, annual precipitation for 1995 is excluded from the analyses. The nine-month threshold is arbitrary, but maximizes usefulness of the data that have been collected. Including years with fewer months of data might skew the monthly average for those years, resulting in an inaccurate annual total; excluding all incomplete data years—even those with nine or more months of data—would reduce the number of data points for analysis.

Figure 11: Streamflow and precipitation gauging stations

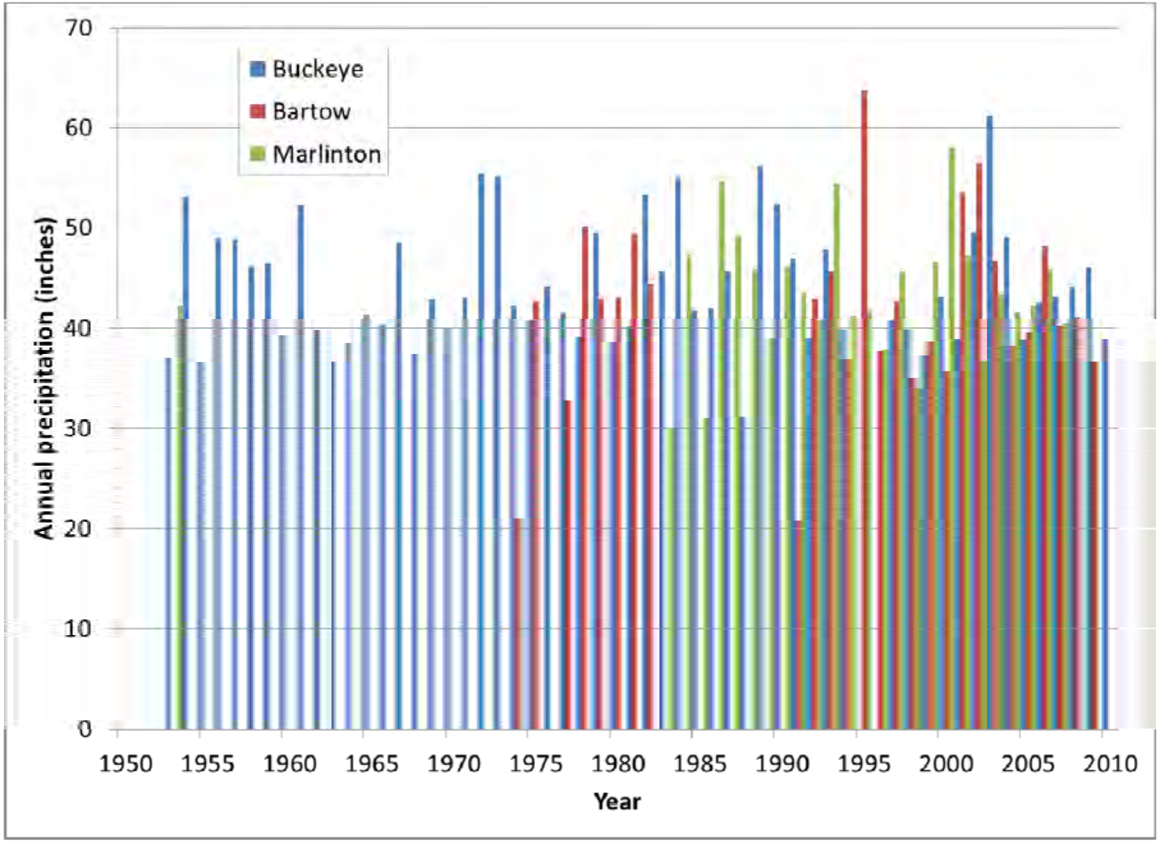
Data Sources

Towns US Census Bureau 2010
County US Census Bureau 2010
Streams: National Hydrography Dataset (NHD), US Geological Survey 2004
Stream Gauges: US Geological Survey 2012
Weather Stations: National Oceanic and Atmospheric Administration 1999

Annual precipitation from 1953 to 2010 for the Buckeye, Bartow, and Marlinton stations is shown in Figure 12. Buckeye had the most extensive and continuous record with only two years removed (1995 and 1996); 24 and 32 years were removed from the precipitation analysis for Bartow and Marlinton, respectively. Average, maximum, and minimum annual precipitation were determined to ascertain the average, wettest, and driest years, respectively. Standard deviations, which describe the dispersion of individual observations relative to the mean of all observations, were used to describe the annual variability in precipitation:

- Average annual precipitation across all three stations was 41 inches (standard deviation 3 inches).
- Average annual precipitation across all years for Buckeye was 44 inches (standard deviation 6 inches); Bartow 38 inches (standard deviation 13 inches); and Marlinton 42 inches (standard deviation 20 inches).
- The wettest year on record and amount of precipitation varied by station: Bartow had 64 inches in 1996; Buckeye, 61 inches in 2003; and Marlinton, 58 inches in 2003.
- The driest year on record varied as well; Bartow, 33 inches in 1978; Buckeye, 31 inches in 1988; and Marlinton, 30 inches in 1986.

Figure 12: Annual precipitation for the Greenbrier River watershed



The variations in annual precipitation reflect differences in location, topography, storm trajectory, and record length. For example, the Marlinton precipitation record has the greatest standard deviation, or variation from the annual average. This large variability likely reflects the large data gaps associated with this station. However, based on the relatively small variation in average annual precipitation between the three gauges, similarity in precipitation across these three stations is ascertained.

Data for the streamflow analyses came from several sources, including USGS monitoring stations. Only two USGS stations were identified within Pocahontas County, both on the Greenbrier River. One USGS gauge is at

Buckeye, which drains approximately 540 square miles. Streamflow has been measured here continuously from 1928 to the present—83 years. The second gauge on the Greenbrier River is located at Durbin, which drains approximately 133 square miles. Streamflow here has been measured continuously from 1943 to the present—68 years. The standard unit of reporting for streamflow by the USGS is stream discharge or volume per time, most often reported in cubic feet per second (cfs). Discharge—a volume per time—can be converted to runoff—a depth per time—by dividing by the watershed drainage area. Dividing streamflow by drainage area allows us to compare watersheds of different drainage areas. For example, 20 inches of runoff in a small watershed might yield an average discharge of 200 cfs, whereas 20 inches of runoff in a large watershed might yield an average discharge of 1,000 cfs. Comparing the discharges of the two watersheds would not yield meaningful information about the watersheds' relative runoff patterns.

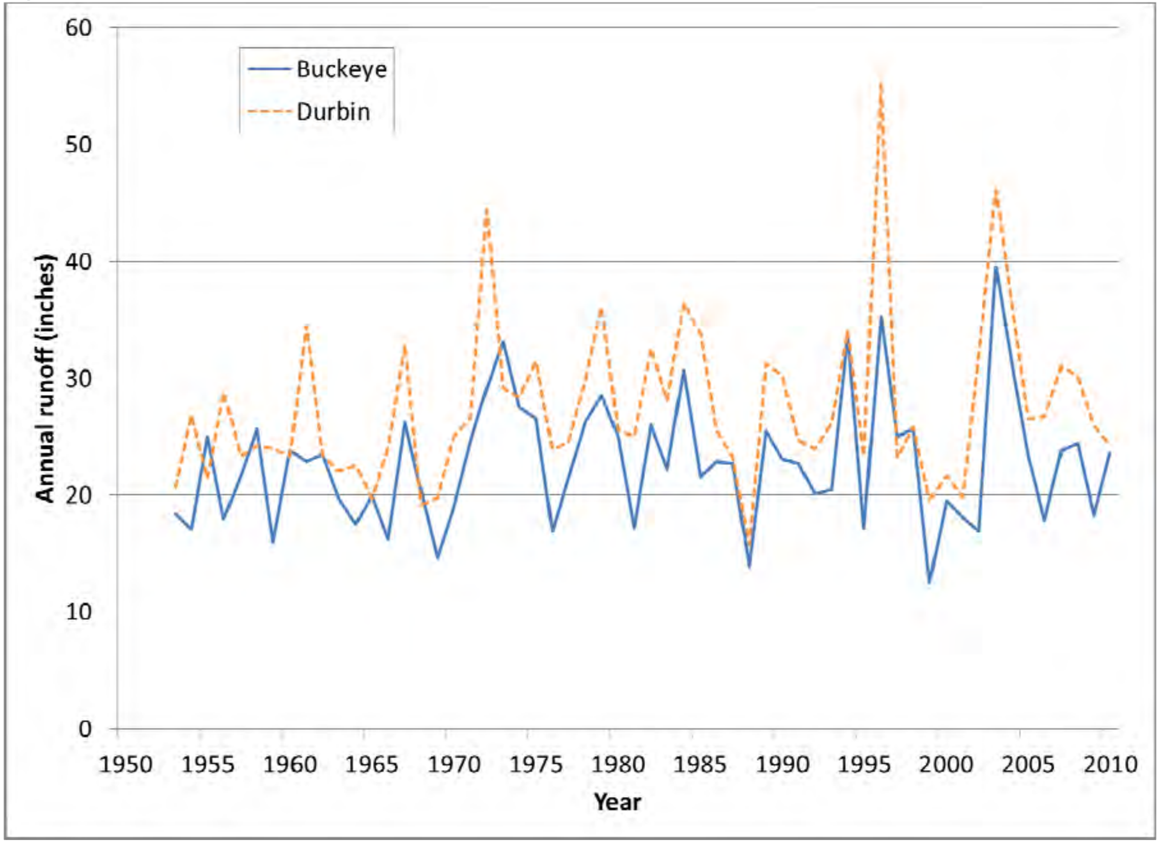
The conversion of stream discharge (Q) in cfs to runoff (R) in inches per year is shown in Equation 1.

Equation 1:

$$\boldsymbol{R\left(\frac{inches}{year}\right) = Q\left(\frac{feet^2}{second}\right) x \frac{1}{drainage\ area\ (ft^2)} x \frac{12\ inches}{1\ foot} x \frac{86,400\ seconds}{1\ day} x \frac{365\ days}{1\ year}}$$

The largest annual runoff—R—for the Greenbrier River at Buckeye and Durbin is 40 inches (2002) and 55 inches (1996), respectively (Figure 13).

Figure 13: Annual runoff for the Greenbrier River watershed



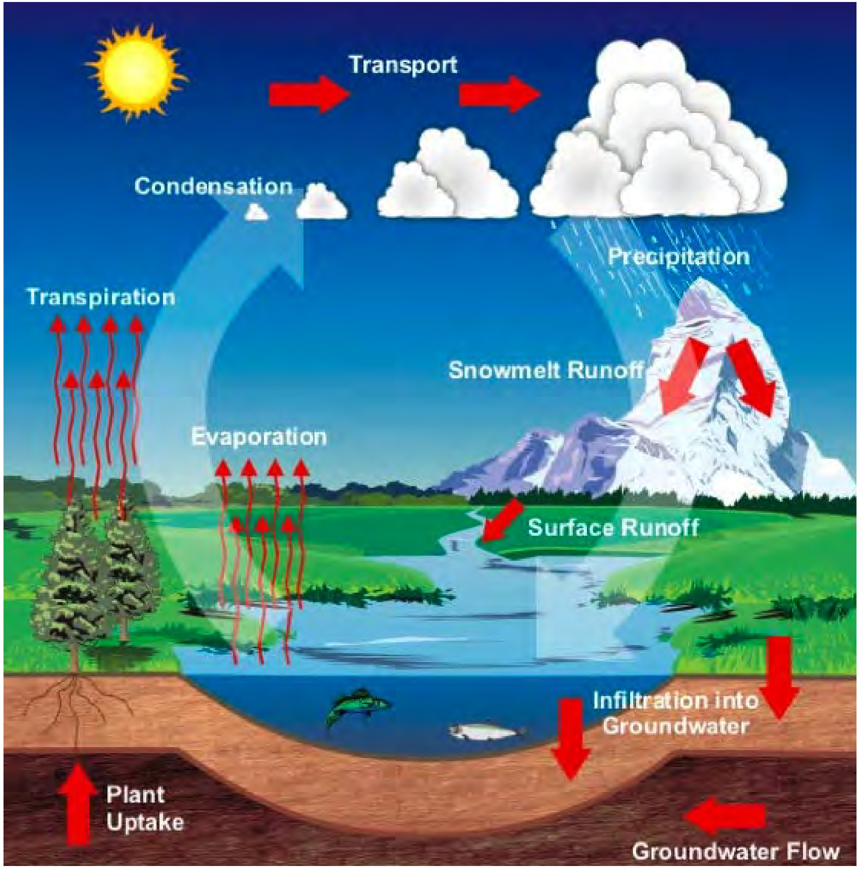
The conversion to a depth measurement also allows us to compare runoff to precipitation. By comparing runoff (in inches) to precipitation (in inches) we are able to estimate the proportion of runoff derived directly from precipitation. This is referred to as the runoff ratio (Equation 2).

Equation 2: $$\boldsymbol{Runoff\ ratio = \frac{runoff}{precipitation}}$$

The runoff ratio is indirectly related to land use, land cover, and other catchment attributes such as geology, soil types and depths, and topography. Ratios that approach one, generally the highest possible value, suggest that nearly all of the rainfall runs off directly into the streams, with little precipitation soaking into the soil. High ratios are expected in watersheds with large proportions of impervious surfaces and compacted soils that inhibit infiltration.

Conversely, ratios that approach zero imply that nearly all of the rainfall is stored within the catchment or lost or withdrawn. Lower ratios are expected in intact forested watersheds where a larger proportion of rainfall is stored in forest soils or lost through evaporation and plant uptake, collectively known as evapotranspiration (Figure 14).

Figure 14: The water cycle



Source: NOAA (2010).

Runoff ratios calculated for Buckeye can be used to approximate runoff ratios across Pocahontas County, although additional stream and rain gauges would be required to calculate actual ratios for different areas of the county. We use Buckeye for this analysis because this is the only location where a stream gauge and precipitation gauge are co-located, minimizing natural variation between measurements. Annual runoff ratios for Buckeye range from 32% to 85% and average 52% across all years (1953-2010), meaning that on average, for Buckeye, roughly half of the annual rainfall contributes to streamflow, with the remainder of precipitation soaking into the ground and contributing to aquifer recharge.

The availability of surface water resources is primarily a function of input (precipitation), outflow (evapotranspiration, consumption, etc.), and storage. Generally, less surface water will be available during dry years as compared to wet years. To assess the natural variation between precipitation, runoff, and surface water resources over time, annual precipitation and runoff are used to calculate change in storage for the Greenbrier River at Buckeye (Equation 3).

Equation 3: $$\boldsymbol{Storage\ (S) = precipitation\ (P) - runoff(R)}$$

Precipitation and runoff exhibit large natural variations year to year. For example, in 1988, annual precipitation and runoff were 31 and 14 inches respectively, whereas in 1989 annual precipitation and runoff were 56 and 26 inches respectively. Evaluating the potential impact of land-cover change and other influences on runoff is impossible unless year-to-year variations in precipitation and runoff are accounted for. One common approach is to standardize precipitation and runoff records to remove large natural variability. Standardization is used to rescale highly variable data around zero, which represents average conditions (Equation 4).

Equation 4: $$\boldsymbol{standardized\ P, R, or\ S = \frac{annual\ P, R, or\ S - average\ annual\ P, R, or\ S\ for\ all\ years}{standard\ deviation\ of\ P, R, or\ S\ for\ all\ years}}$$

The results for standardized precipitation, runoff, and storage are shown in Figure 15. The following percentages of occurrence represent how often precipitation, runoff, or storage fall above zero (a surplus); near zero (similar to the average); and below zero (a deficit) relative to the analysis period—1953-2010, excluding 1995 and 1996 (sample size = 56 years).

Precipitation trends are as follows:

- Standardized precipitation was significantly drier than the long-term average for 16 out of 56 years.
- Standardized precipitation was near zero 23 out of 56 years, meaning that about 41% of the years on record were similar to the long-term average.
- Standardized precipitation was significantly wetter than the long-term average for 17 out of 56 years.

Runoff trends are as follows:

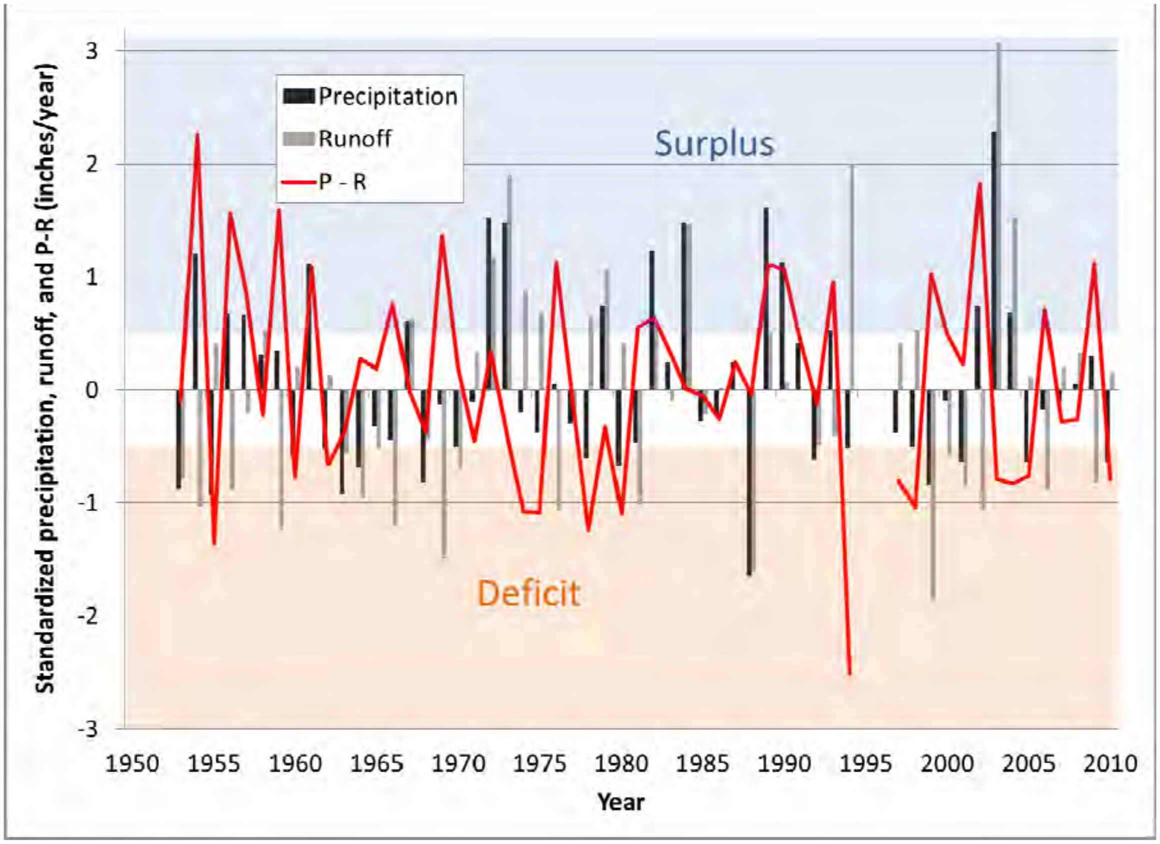
- Standardized runoff was significantly lower than the long-term average for 15 out of 56 years.
- Standardized runoff was near zero 22 out of 56 years, meaning that nearly 40% of the years on record were similar to the long-term average.
- Standardized runoff was significantly higher than the long-term average for 19 out of 56 years.

Storage trends are as follows:

- Standardized storage was significantly less than the long-term average—a deficit—for 17 out of 56 years.
- Standardized storage was near zero 25 out of 56 years, meaning that 45% of the years on record were similar to the long-term average.
- Standardized storage was significantly greater than the long-term average—a surplus—14 out of 56 years.

In each case, positive (water surplus) and negative (water deficit) values are balanced around the mean, suggesting that surface water resources in Pocahontas County are relatively stable under current land-use, climate, and land-cover characteristics. Figure 15 displays the standardized annual precipitation, runoff, and storage for the Greenbrier River at Buckeye. Negative values represent values smaller than the mean, whereas positive values represent values larger than the mean. Surface water experiences a deficit when runoff is greater than precipitation, yielding a value less than zero.

Figure 15: Surface water vulnerability analysis



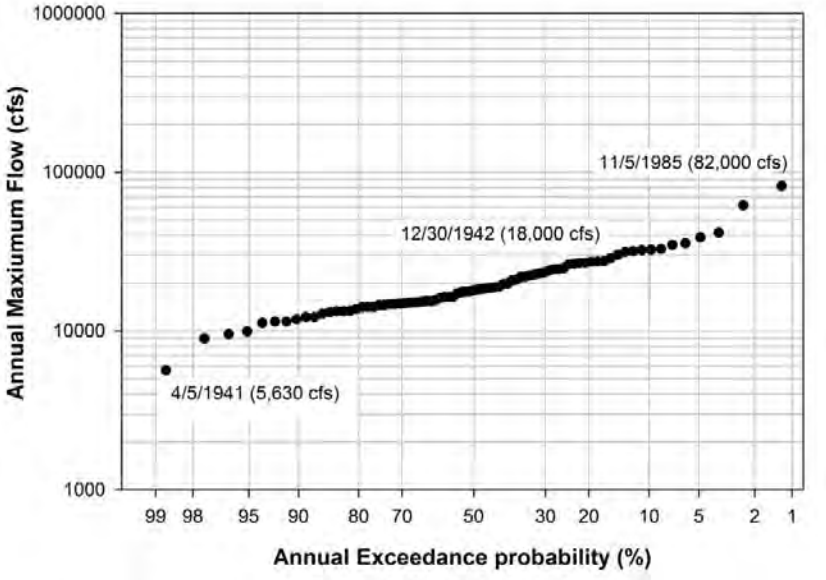
3.6 Flood frequency analysis

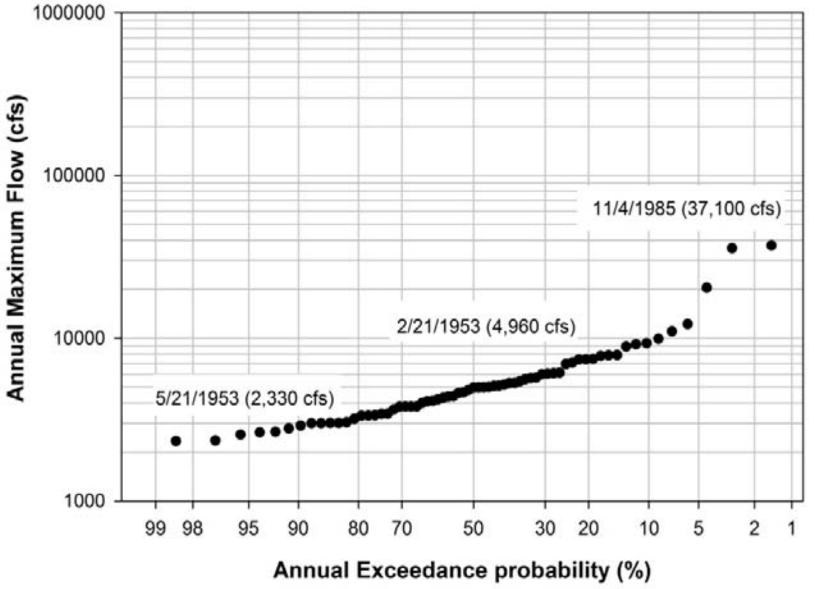
An analysis was conducted for gauged watersheds to determine flood magnitude and regime, as well as the effects of land-use change on flood frequency. Changes to the natural landscape such as urbanization (Hollis, 1975), mining (Ferrari et al., 2009), forest harvesting (Hewlett and Helvey, 1970), and agriculture (DeFries and Eshelman, 2004) can have a noticeable effect on the volume, magnitude, timing, and frequency of floods and low-flow events. Activities that alter or remove vegetation increase storm-flow volume by reducing the overall amount of water lost to the atmosphere through forest canopy interception and evapotranspiration, thereby increasing the volume of water delivered to a stream. Activities that reduce the infiltration capacity of soils—such as paving new roads, developing land for residential or commercial use, heavy grazing, surface mining, and using heavy machinery—can increase surface runoff by preventing precipitation from soaking into the ground.

Furthermore, roads and drainage infrastructure increase the connectivity of a watershed to the stream, resulting in reduced travel times of water and increased peak flow at the watershed outlet. Intact forests regulate storm runoff by returning water to the atmosphere through plant transpiration and interception or by temporarily storing runoff and releasing it over time. Additionally, runoff is a function of season (growing versus dormant), slope (steeper slope, more runoff), latitude (regional climate), and watershed size.

The largest flood events on record for the Greenbrier River at Buckeye and Durbin occurred in November 1985. Peakflow at Buckeye and Durbin were respectively 82,000 cfs and 37,100 cfs. Flood frequency analyses were conducted to determine the probability of a flood event, thus providing an idea of the likelihood of occurrence of a given magnitude storm. Figure 16 shows the flood frequency curves and the date and discharge of the minimum, median, and maximum annual peak flow for the Greenbrier River at Buckeye and at Durbin. The data indicate there is a very low probability a very large flood, such as the 1985 flood, will occur in any given year in the Greenbrier River watersheds analyzed.

Figure 16: Flood frequency curves for USGS gauging stations at Buckeye (top) and Durbin (bottom)

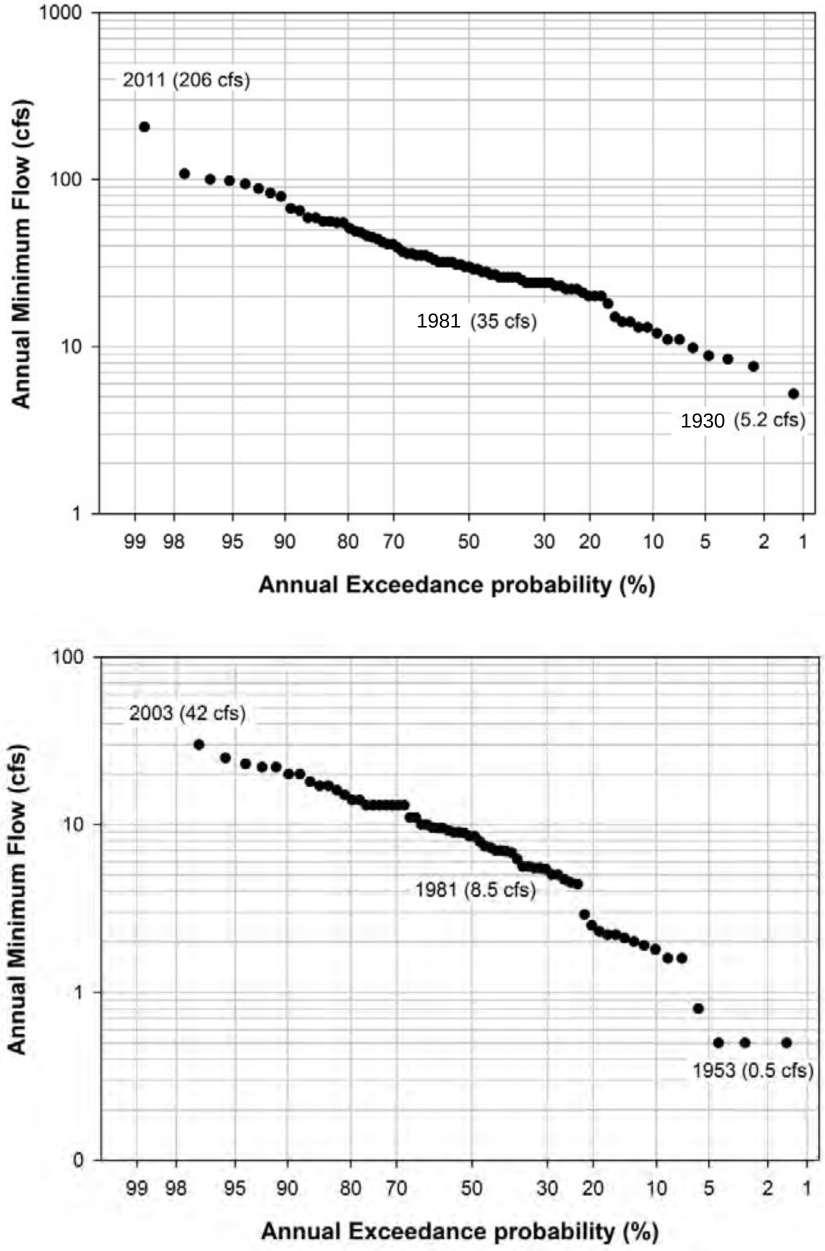




3.7 Low-flow frequency analysis

Similar to the flood frequency, low-flow frequency curves were estimated for the Buckeye and Durbin stations. These curves shed light on how frequently low flow can be expected. Low-flow analyses can help identify potential water availability conflicts between users, as well as effects of climate and land-cover change that could impact sensitive aquatic ecosystems. Figure 17 shows low-flow frequency curves and the year and discharge of the maximum, median, and minimum annual low flow for the Greenbrier River at Buckeye and Durbin. The lowest flow on record at Buckeye occurred in 1930: 5.2 cfs. At Durbin, the lowest flow occurred in 1953: 0.5 cfs. These low-flow events have a 1% chance of occurring any year. The median low-flow for both watersheds occurred in 1981, with a 50% or greater chance of occurring any given year.

Figure 17: Low-flow frequency curves for USGS gauging stations at Buckeye (top) and Durbin (bottom)



3.8 Surface water vulnerability

The vulnerability of surface water resources to consumptive use was estimated to identify future safe yields and areas of resource sensitivity.

To estimate surface water vulnerability, ***baseflow index (BFI)***, ***recharge rate***, precipitation, and discharge were calculated for individual small watersheds, known as ***catchments***, within Pocahontas County. These calculations were based on data gathered from USGS. Due to the variability in hydrologic conditions across Pocahontas County, BFI, recharge rate, precipitation, and discharge were normalized to produce relative indices. Relative indices were then categorized as below or above median values for each index. Catchments below the median are potentially vulnerable, whereas catchments above the median are less sensitive to water resources development.

Baseflow is derived from shallow groundwater tables. Baseflow provides water to streams even when it has not rained recently. As such, baseflow can be used as a surrogate for the amount of water available in the catchment. BFI, expressed as a percent, describes the proportion of total streamflow derived from baseflow. Therefore, a BFI that approaches 100% suggests that the majority of streamflow is derived from local groundwater systems; a lower BFI suggests that a larger proportion of streamflow is derived from rainfall.

Relative BFI values were consistently above the median BFI east and southeast of the Greenbrier River along the West Virginia/Virginia border (Figure 18). These catchments, shown in blue, are potentially less prone to fluctuations in streamflow caused by water resources development because streamflow is tempered by baseflow.

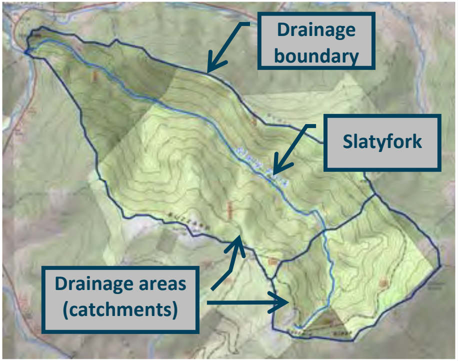
Relative BFI was consistently below median BFI along the western and northern border of Pocahontas County, indicating that these catchments, shown in red, are potentially vulnerable to extremes in weather and in water withdrawal.

The majority of Pocahontas County was categorized as median BFI, suggesting moderate groundwater contributions to streamflow. These catchments, shown in white, are located in and around the mainstem of the Greenbrier River in the northernmost portion of the county and along major watershed divides throughout the remainder of the county.

The distribution of relative BFI across Pocahontas County is primarily determined by the topographic characteristics of the region. Catchments with low relative BFI are typified by

Catchments

A catchment is defined as the land area that contributes runoff to a particular portion of a stream or waterbody. Catchments are defined by elevation. Shown below are the catchments that drain toward the Slatyfork River.



Link to data: nhd.usgs.gov/

Baseflow index

Baseflow is the component of streamflow that can be attributed to groundwater discharge into streams. A baseflow index was developed to compare relative baseflow across watersheds.

Link to data: water.usgs.gov/GIS/metadata/usgswrd/XML/nhd_bfi.xml

Recharge

While baseflow describes water flowing from groundwater to surface water, recharge describes flow that replenishes groundwater. This flow may be water from precipitation or from surface water in the form of losing streams.

Link to data: water.usgs.gov/GIS/metadata/usgswrd/XML/nhd_recharge.xml mountainous drainage patterns that combine steep slopes with relatively shallow soils and low catchment storage, and thus generate streamflow primarily through rainfall and runoff. Catchments close to large valleys—the white and blue catchments—generally have higher BFIs. Large valleys connect the local groundwater system to large regional groundwater systems, providing streamflow throughout the year, even in times absent of rainfall.

Recharge rate represents the mean annual recharge of groundwater. The majority of Pocahontas County is categorized as white (median) suggesting relatively stable groundwater resources for much of the county (Figure 19).

The distribution of relative recharge shows an opposite pattern to BFI. Relative recharge rates were consistently above the median in the western portion of the county, suggesting a resilient groundwater system, whereas the southeastern and northeastern portions of the county were consistently below the median, suggesting a potentially vulnerable groundwater system. Differences in recharge rates are primarily related to the spatial distribution of precipitation in Pocahontas County.

Precipitation and discharge were combined at the catchment level and normalized to produce an index that represents total surface water availability (Figure 20). Catchments receiving more precipitation and having greater discharge will produce more available surface water. The majority of Pocahontas County is categorized as having a median relative surface water index, suggesting that most of the county has relatively stable surface water reserves. Catchments that are above the median index are primarily located in the western and northern portions of the county. These areas receive more precipitation than the rest of the county due to the higher mountains in the west that create a rain shadow effect.

Blue areas directly adjacent to the mainstem of the Greenbrier River are primarily influenced by the accumulated runoff contributions in the large Greenbrier River valley. Catchments below the median index are primarily located in the contributing areas around the Greenbrier River and along the southeastern boundary of the county. There is a concentration of red catchments around the cities of Marlinton, Hillsboro, and Durbin.

Figure 18: Baseflow index

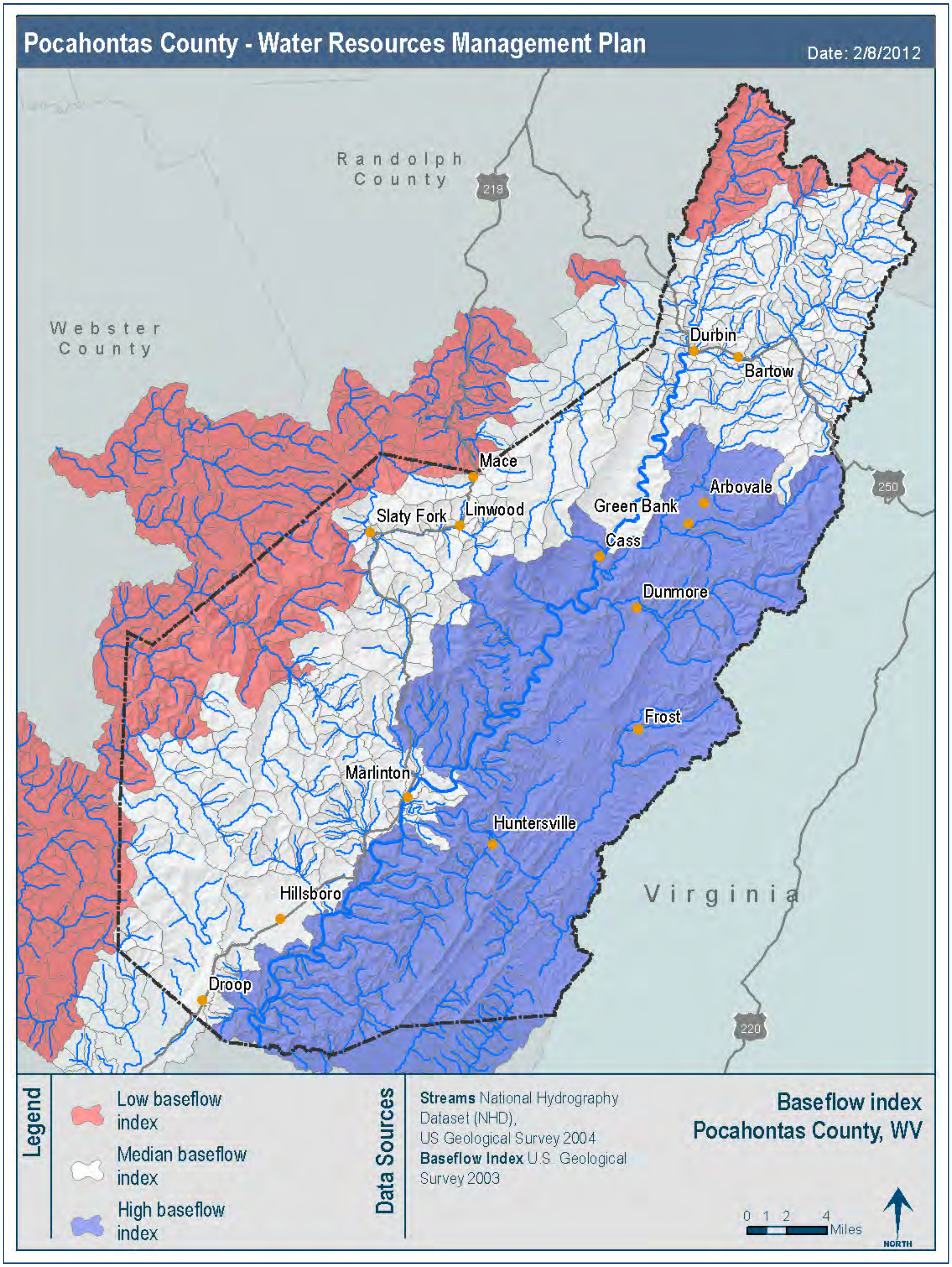


Figure 19: Groundwater recharge rate

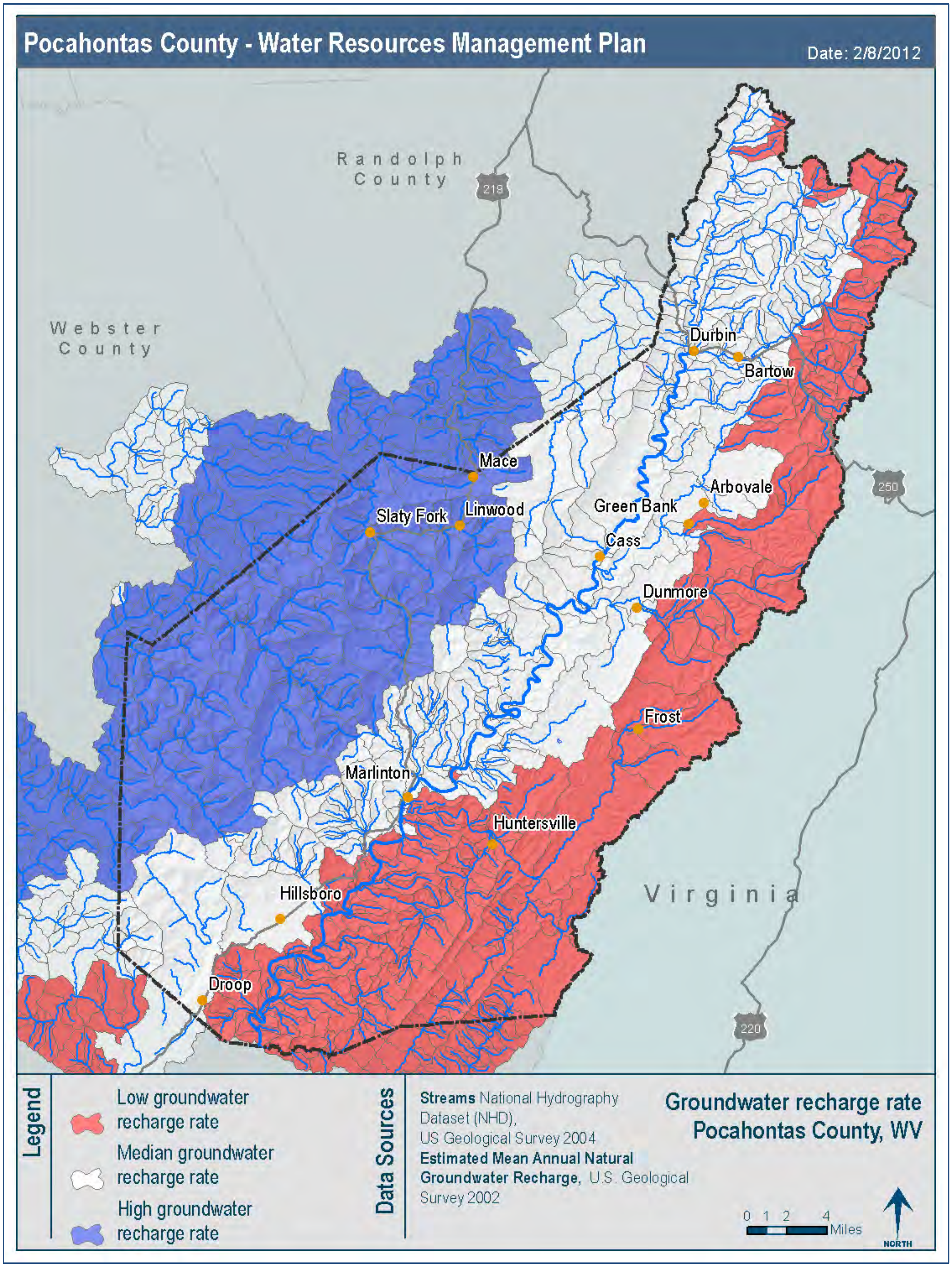
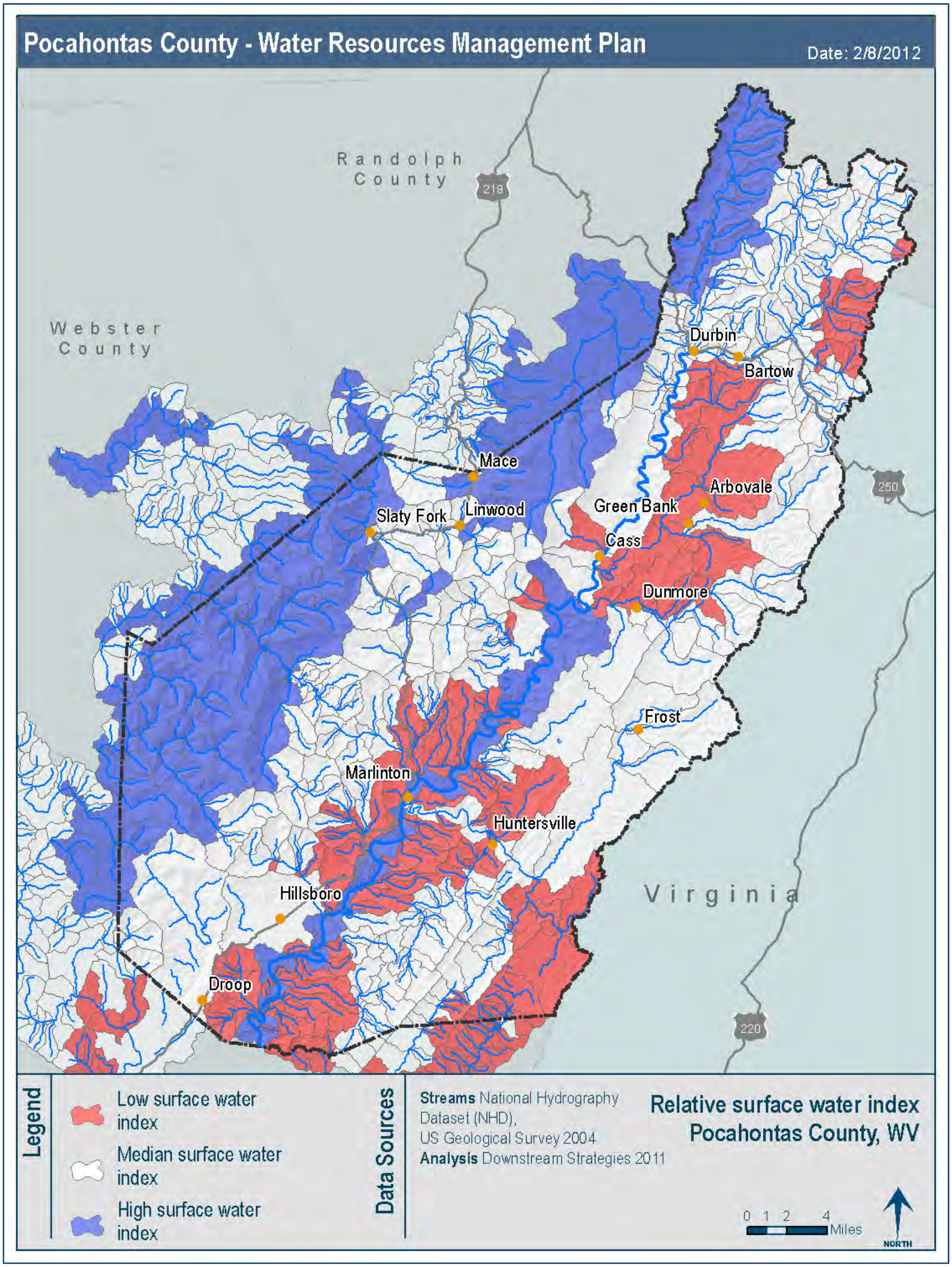


Figure 20: Surface water index



4. GROUNDWATER ASSESSMENT

The groundwater assessment evaluates the county's groundwater resources using readily available data.

4.1 Groundwater characterization

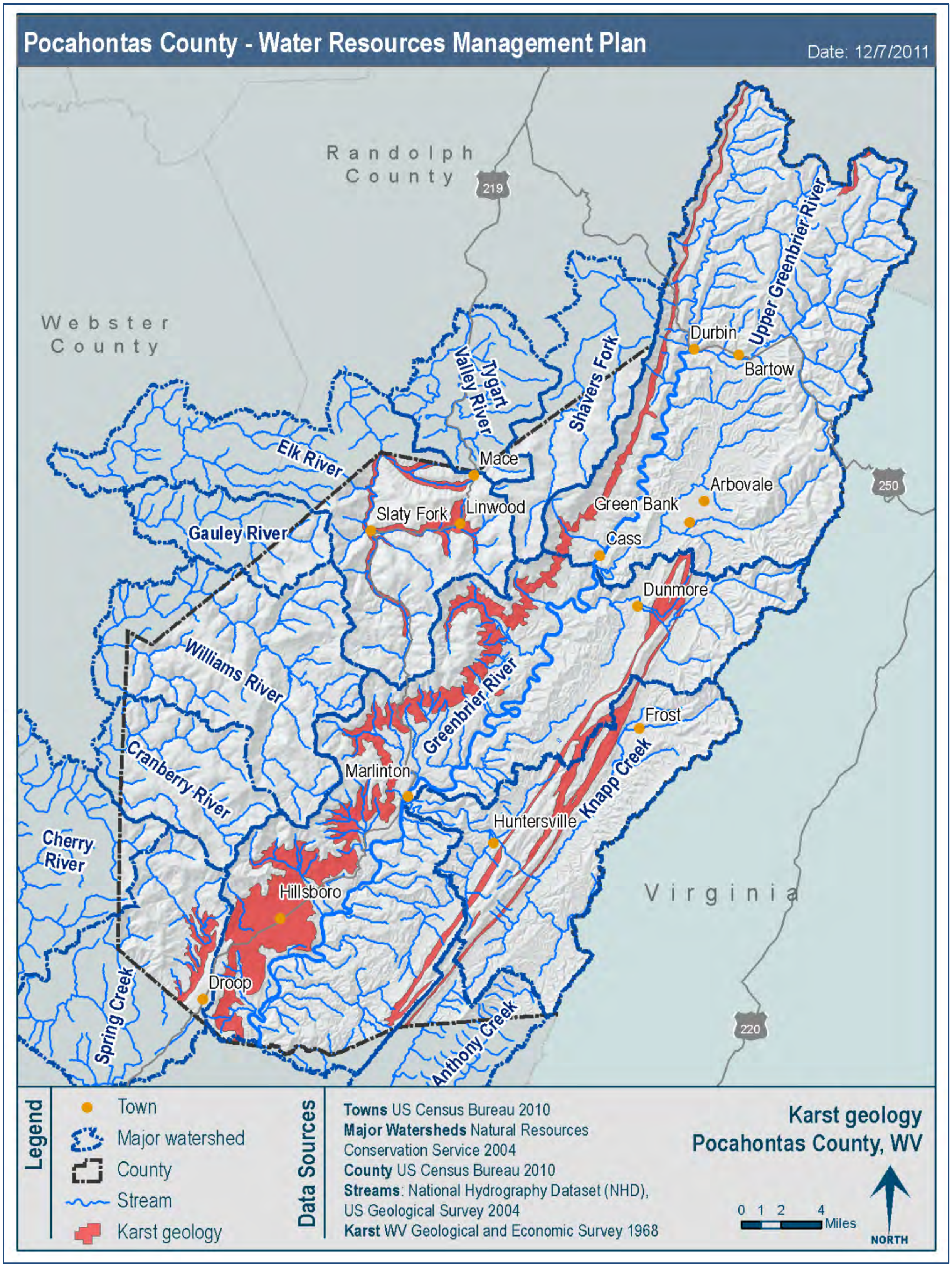
Pocahontas County does not collect public data for studying and interpreting groundwater basins (GWBs), aquifers, or flow patterns. This assessment used available data (detailed in Section 4.1.1) to develop a preliminary characterization of groundwater resources. The characterization of groundwater quantity, flow patterns, and quality will be expanded in future phases of the water resources plan; however, some key points can be interpreted from existing data, and future data needs can be determined.

4.1.1 *Groundwater data*

Data relevant to groundwater studies were collected from several private and public entities. Geological information was collected from the West Virginia Geological and Economic Survey (WVGES). These datasets contain anticlines, synclines, and fault data that are helpful in determining general groundwater flow patterns. Karst areas are delineated in Figure 21; these areas are important when considering groundwater conditions.

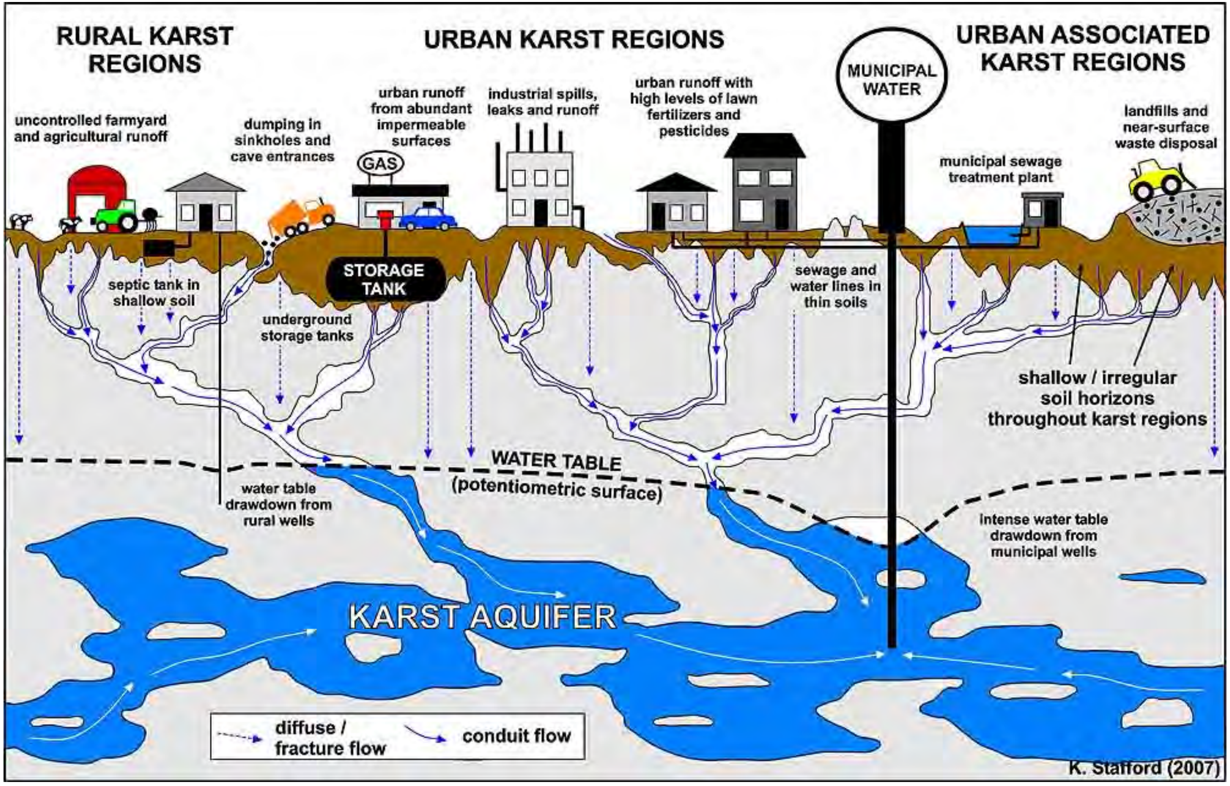
Karst is a type of landform, generally underlain by limestone, which allows unhindered subsurface water flow through channels and cave systems formed by the dissolution of limestone. This dissolution is caused by a weak carbonic acid found in water. When the acidic water flows into the subsurface through a fault or sinkhole, the acid dissolves the limestone. This can create extensive underground channels and massive cave systems. In fact, the highest waterfall in the state of West Virginia—approximately 180 feet—is found in a cave near Cass in Pocahontas County.

Figure 21: Karst geology



Pollution of all types can threaten any aquifer. Karst aquifers, illustrated in Figure 22, are especially vulnerable to pollution at the ground surface. Caves and other entrances can allow pollutants to reach county water tables, wells, and springs. This unfiltered pollution can move quickly and can contaminate aquifers and groundwater supply. Several towns in Pocahontas County and many private wells rely on groundwater as a drinking water supply; wells and groundwater in karst areas are particularly susceptible to pollution and contamination from various surface activities.

Figure 22: Karst environment illustration



Source: Stafford (2007).

An additional dataset was provided by the West Virginia Speleological Survey (WVASS) that helps improve the interpretation of subsurface conditions. WVASS collects and catalogues cave data from various individuals and entities that study caves in West Virginia and produces county bulletins that contain a large amount of karst information. For several reasons, including but not limited to public safety, protection of rare plant and animal species, and the delicate nature of caves, WVASS does not make its data public. A memorandum of understanding was established with WVASS; this gave the project team the ability to incorporate WVASS data into the GIS mapping system, with the understanding that specific cave locations would not be made available to the public. This information is critical in determining groundwater flow patterns. WVASS knows of 621 caves in Pocahontas County.

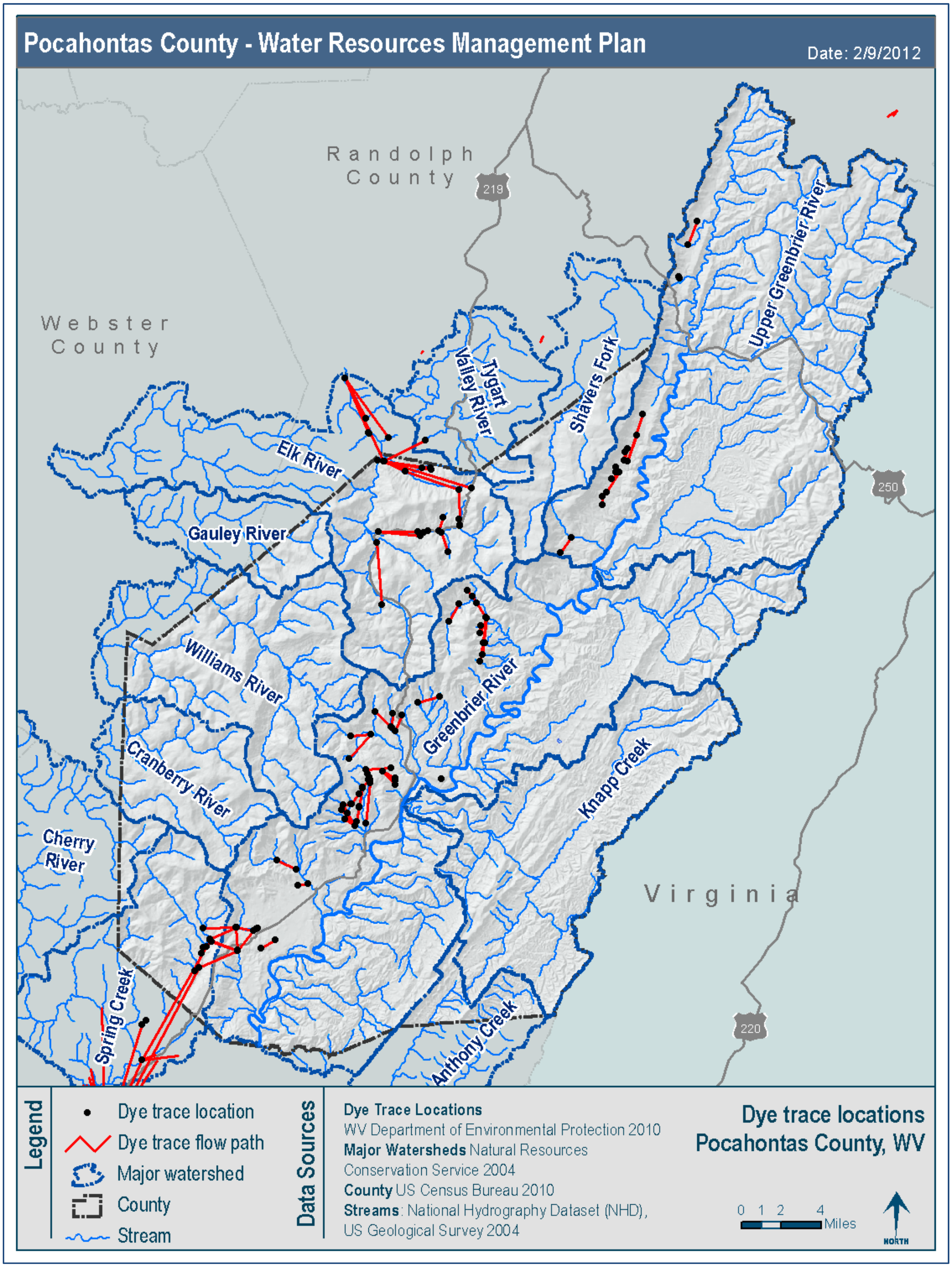
One method of determining groundwater flow is dye tracing. This technique uses fluorescent dye injected at one point (for example, a cave entrance) and traps placed at another entrance where it is expected the water may travel (for example, a spring). The traps are changed regularly if travel time is important for the study. Dye traces show that water sometimes flows several miles underground and potentially in several directions before coming back to the surface. Dye trace data are generally gathered by visually seeing the dye or analyzing the traps for presence or absence of dye. If injected dye flows through a dye trap, it will cling to charcoal in the trap, even if not visible to the naked eye.

Once it is certain that the dye has had ample time to travel through the traps, the traps are collected and analyzed at a laboratory using a fluorometer. The fluorometer analyzes the traps for fluorescence and can measure the intensity of the dye on the charcoal. For this study, WVDEP, USDA, and some individual citizens provided dye-trace data for a total of 43 traces (Figure 23).

It is normal for water to flow in various directions in a karst area, and it is generally controlled by minor or major fluctuations in the bedrock geology or faulting. These fluctuations include anticlines, or where bedrock forms a “dome,” and synclines, where bedrock forms a “basin” or a “bowl.” These structures, which act like hillsides, will cause groundwater to accumulate and flow generally toward the lowest point. If a flowpath intersects a fault, then the groundwater can change direction and find the easiest way downward. In karst areas, dye trace results are not dictated only by the folds, faults, and boundaries of any particular geologic unit; instead, they are influenced by the complexities introduced by caves and underground streams.

Rarely does water flow upwards, but it does happen, more often in karst areas through porous rock. This upward flow general occurs when pressures from below do not allow water to flow downward and the groundwater capacity becomes too great to hold additional water at the same level. Generally, this helps form springs on the surface for the groundwater to escape. While the data that exist are reliable, further dye traces are required to determine additional flow directions and basin boundaries.

Figure 23: Dye trace results



4.1.2 *Groundwater quantity*

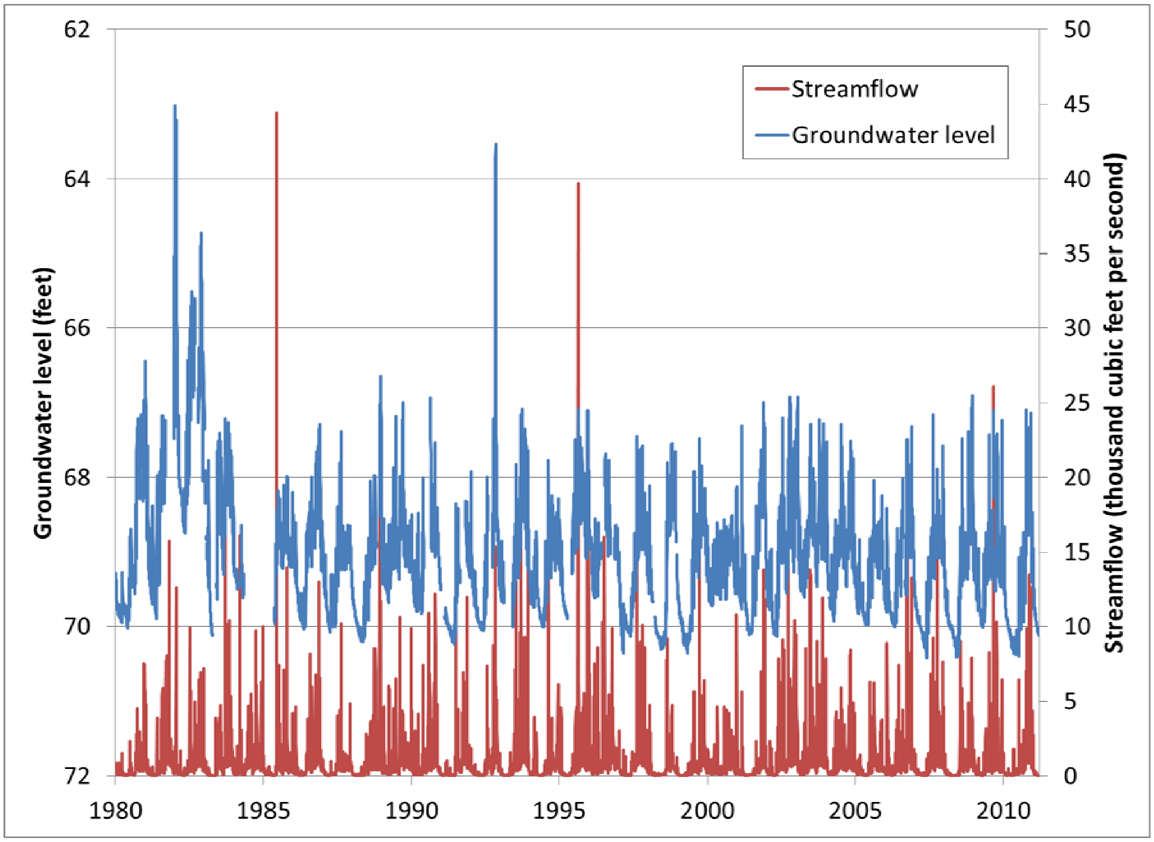
Limited groundwater quantity data were acquired as part of this preliminary study.

Water well data were collected from the Pocahontas County Health Department; these data, collected since 1984, report 1,851 wells drilled within the county to date (Henderson, 2011). Much of the data had minimal information regarding the rock unit or aquifer. In almost all cases, location was not reported, so field excursions will be required to determine exact locations.

Gas well data were provided by WVGES. These data will be critical in Phase 2 to help determine the qualities of any given aquifer based on information provided by the drillers, including but not limited to the geologic cross-section (to determine the aquifer), any drawdown or pumping data (to help establish recovery rates), and any water quality notes on the well report. Additional monitoring could be performed in order to help establish a baseline dataset.

A single monitoring well is used to show flow patterns and groundwater levels. This well has been maintained during the past 40 years by USGS. The dataset, while limited, can help illustrate correlations between groundwater and surface water levels, shown in Figure 24. Water quality data were collected from this well three times in 1984 and 1985, but this is too small of a dataset from which to draw conclusions.

Figure 24: Groundwater level on Droop Mountain and flow in the Greenbrier River at Buckeye



Future phases of this project can study drawdown rates and groundwater levels throughout the county. Water levels in the USGS monitoring well on Droop Mountain depicted in Figure 24 generally correlate with surface water flows and seasonal cycles. While there are anomalies that prompt further study, characterization of additional wells would help illuminate water availability, including seasonal and longer-term fluctuations.

Data that show approximate consumption of groundwater resources suggest that the population centers of Pocahontas County are responsible for the greatest water consumption. Besides the population centers, the Route 92 corridor and the Route 219 corridor comprise additional zones of groundwater consumption for the county. A majority of the precipitation that recharges groundwater falls in the western portion of the county—the portion of the county that withdraws the least water. The potential groundwater consumption for the county was derived by estimating the number of wells per catchment and assuming 150 gallons per day per household (NRCS and WVCA, 2004). An estimate of 3,482 households in Pocahontas County (US Census Bureau, 2011a) was used to arrive at a groundwater consumption estimate. Assuming one well per household, an estimated 522,300 gallons of groundwater are consumed each day for domestic usage. In addition to household wells, consumption rates for large quantity consumers are listed in Table 4. These data were integrated into the consumption equation, bringing the total consumption to over 800,000 gallons of groundwater per day in Pocahontas County; Figure 25 displays the results of this analysis.

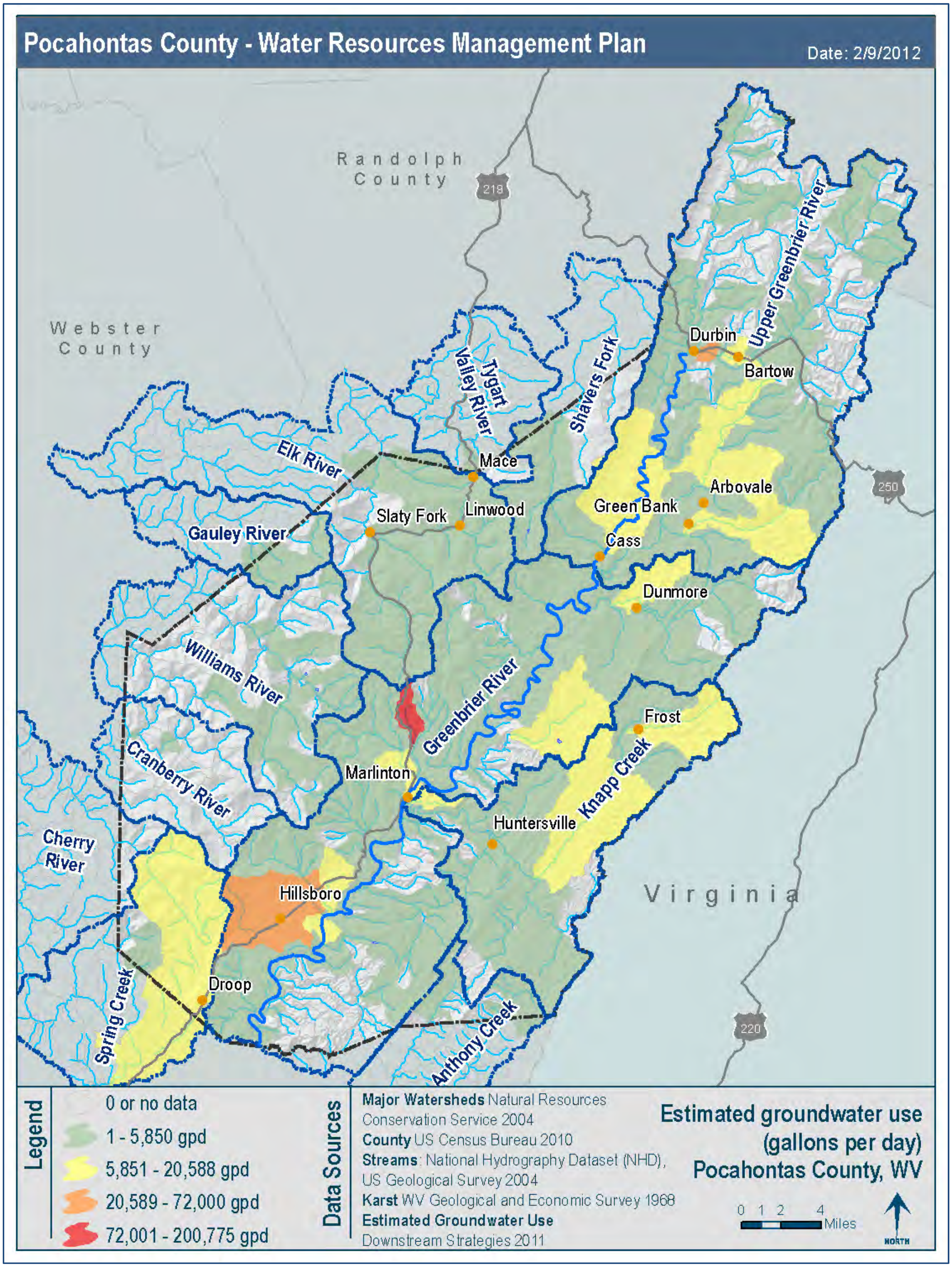
Table 4: Large quantity water consumers

Consumer entity	Consumption type	Gallons per day	Source
Groundwater			
Town of Hillsboro	Household/commercial	13,276	Wells
Durbin, Bartow, and Frank	Household/commercial	67,000	Spring #2
Edray Fish Hatchery	Raising fish/drinking	216,000 - 3,600,000	Upper Spring (McLaughlin Spring)
Surface water			
Town of Marlinton	Household/commercial	206,504	Knapps Creek
Denmar Prison	Drinking/domestic	62,929	Greenbrier River

Source: Barkley (2011), Driscol (2011), Rigsby (2011), Tate (2011), Williams (2011).

Based on a USGS study, potential well yield was determined for the Greenbrier River basin (USGS, 1984). Figure 26 suggests that more productive water wells are in the valleys and not high on the mountains. Also note that the areas that consume the most water are in areas that do not have the greatest recharge. If demand grows, groundwater levels will decline. Areas of the greatest consumption of groundwater include Marlinton and Hillsboro.

Figure 25: Estimated groundwater use



Pocahontas County - Water Resources Management Plan

Date: 2/9/2012

Estimated groundwater use (gallons per day) Pocahontas County, WV

Data Sources

Major Watersheds Natural Resources Conservation Service 2004

County US Census Bureau 2010

Streams: National Hydrography Dataset (NHD), US Geological Survey 2004

Karst WV Geological and Economic Survey 1968

Estimated Groundwater Use Downstream Strategies 2011

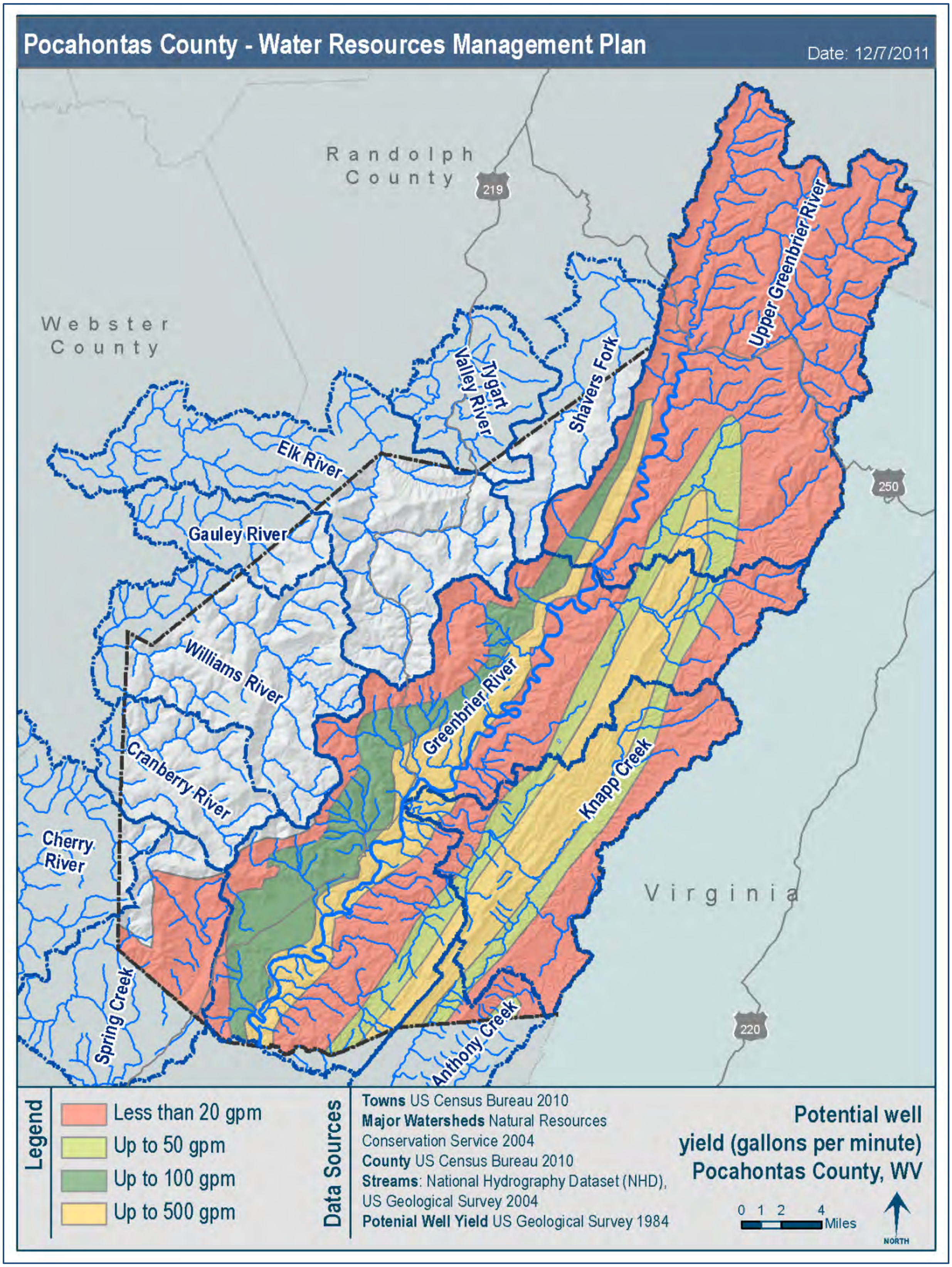


Figure 26: Estimated groundwater yield

4.1.3 *Groundwater quality*

Water quality could only be studied at the one USGS monitoring location mentioned above, but generalizations were made from water quality analyses performed in the 1960s and 1970s on 113 wells.

Hardness, manganese, and iron are all noted as high near the karst basins west of the 219 corridor from the Greenbrier County line to beyond Marlinton, with an additional zone near the Slatyfork/Snowshoe area. Hardness levels are highest in areas primarily underlain by limestone, including karst basins. Hardness tends to be the result of minerals that have dissolved from the rock and entered the groundwater. Iron or manganese presence in rocks is sometimes revealed through color staining.

Groundwater quality and characteristics are affected by rock type. Groundwater in karst basins is likely to have relatively high contamination due to rapid flow through karst, with limited natural filtration. Groundwater age and depth of circulation provide insightful information about the connectedness of surface water and groundwater. Groundwater age is the amount of time that has elapsed since the groundwater was last in direct contact with the open atmosphere. In general, older groundwater tends to have fewer contaminants, and younger groundwater tends to have more contaminants. Karst areas, which allow groundwater to find easy travel routes, generally have younger groundwater because as water flows through, it is replenished with water from the surface.

There are several methods for ascertaining the age of groundwater. Once determined, groundwater age can be used to define groundwater contributing areas, confirm groundwater flow, and estimate contamination travel time. Groundwater age can be established by chemical analyses, but can more simply be estimated with dye and tracer tests if flow is rapid.

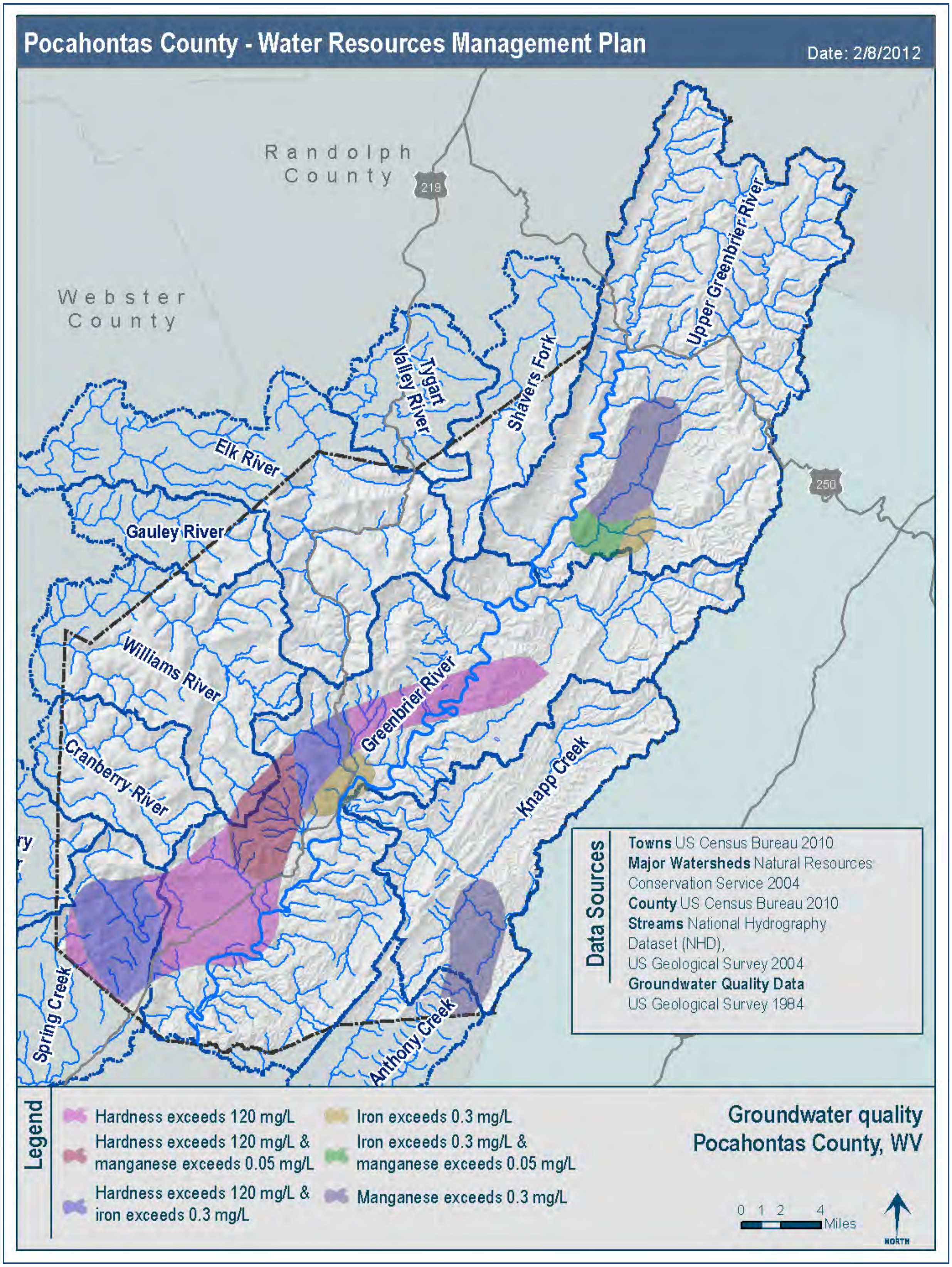
A USGS study released in 2000 characterized groundwater quality conditions in the Appalachian Plateau region of the Kanawha River basin (Sheets and Kozar, 2000). The study found that, locally, the only factor that correlates with groundwater age is topography. Generally, water from hilltop wells was younger, having a median age of 10 years, while valley well water was much older, with a median age of 42 years. Based on the same USGS report, groundwater in the Appalachian Plateau generally meets USEPA water quality standards, even though some parameters do exceed these standards at some sites. Constituents were reported higher in the karst regions, illustrating the direct connection between surface and groundwater.

Figure 27 shows high iron around Greenbank and Marlinton. Iron levels above 0.3 mg/L exceed secondary drinking water standards. Iron in excess of secondary standards can cause aesthetic issues and may easily stain clothes and produce a metallic taste. If concentrations are high enough, water system piping and fixtures may also become clogged. If high levels of iron are found in a well, a driller may drill deeper, because iron levels tend to decrease with depth.

Figure 27 also shows high manganese is small areas of the county. Manganese, if found in extremely high levels for a sustained amount of time, could become a health risk, especially to children.

Water hardness is often high in and around limestone because the limestone slowly dissolves, adding minerals to the groundwater.

Figure 27: Groundwater quality data



4.2 Groundwater basin delineations and flow direction

As part of Phase 1, several GWBs were delineated based on available datasets. Additional data will be required to effectively map all the GWBs and aquifers in Pocahontas County. The well data already collected—some from stakeholders—provides useful information about aquifers and will be important for future development in Pocahontas County. Additional dye tracing will be required to better delineate the GWBs, including those already delineated in this report. Sometimes, GWBs in karst breach topographic boundaries, and even overlie each other, adding more complexities that will require further testing.

Groundwater generally, but not always, flows downhill, following the dip of any particular rock bed. Often, water will flow down toward the middle of a large fold in rock layers—just as water flows to the center of a bowl. When the rock has a great number of fractures or a fault, water can travel in unexpected directions. Water can follow the strike (parallel to the fold axis), as it does along the flank of the Browns Mountain Anticline parallel to Route 92 in eastern Pocahontas County. Water can sometimes flow up-slope, if the rock layer is completely submerged in water, and appear in a spring or rise. Karst can sometimes cause water to travel beneath and through a mountain, as in Mingo, West Virginia. For this report, dye-trace data were collected from multiple sources and digitized. These data enabled the delineation of basin boundaries (Figure 28 through Figure 32).

Dye traces have been concentrated around dense cave areas, where direct access to the groundwater is possible. These better-studied karst basins tend to be west of the Greenbrier River in the US 219 corridor, with most data being collected from around Hillsboro (Figure 28) and Marlinton (Figure 29), where some of the larger cave systems exist. These same basins also illustrate some of the complexities of karst as seen by the arrows that point in several directions, especially in GWB-1 and GWB-2. GWB-1 and GWB-2 have enough good cave and karst data to allow for numerous dye traces to better characterize those areas. Marlinton has some good data, but obvious gaps exist around GWB-18, GWB-19, and GWB-20. These boundaries are especially generalized due to lack of data and a complicated karst environment.

Some additional data have been collected south of Snowshoe and along the Elk River (Figure 30). Basins near the Snowshoe/Slatyfork area are especially sensitive to development, in addition to being popular for recreation, and thus warrant further data collection.

The least-studied karst GWBs are GWB-11 through GWB-15, including the karst areas from Cass northward (Figure 31 and Figure 32). These areas will need considerably more data to accurately delineate GWBs. Additional information is also needed along Stomping Creek. GWB-11 dye trace data are minimal, perhaps due to the caves in that area requiring more technical skill to navigate.

Groundwater flow directions represented in the GWB maps are based on limited data; when additional data are collected, different conditions may be revealed. The information in this report is simply a starting point using available data. Primary groundwater flow direction arrows are generalized and do not represent the more localized fluctuations in groundwater flow, which can only be further illuminated through a more detailed study with additional dye tracings and surface- and groundwater mapping.

Figure 28: Groundwater basin map 1

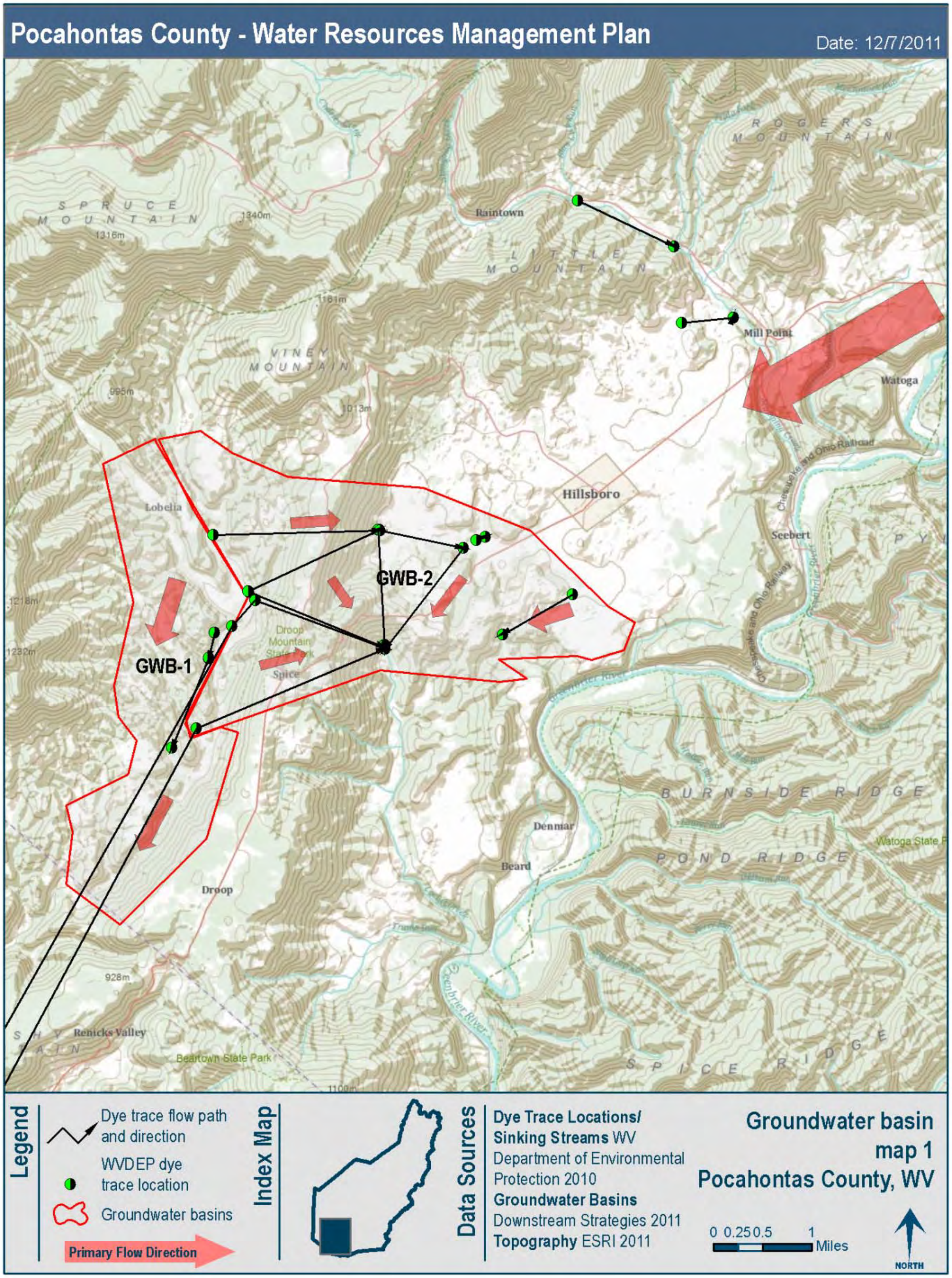


Figure 29: Groundwater basin map 2

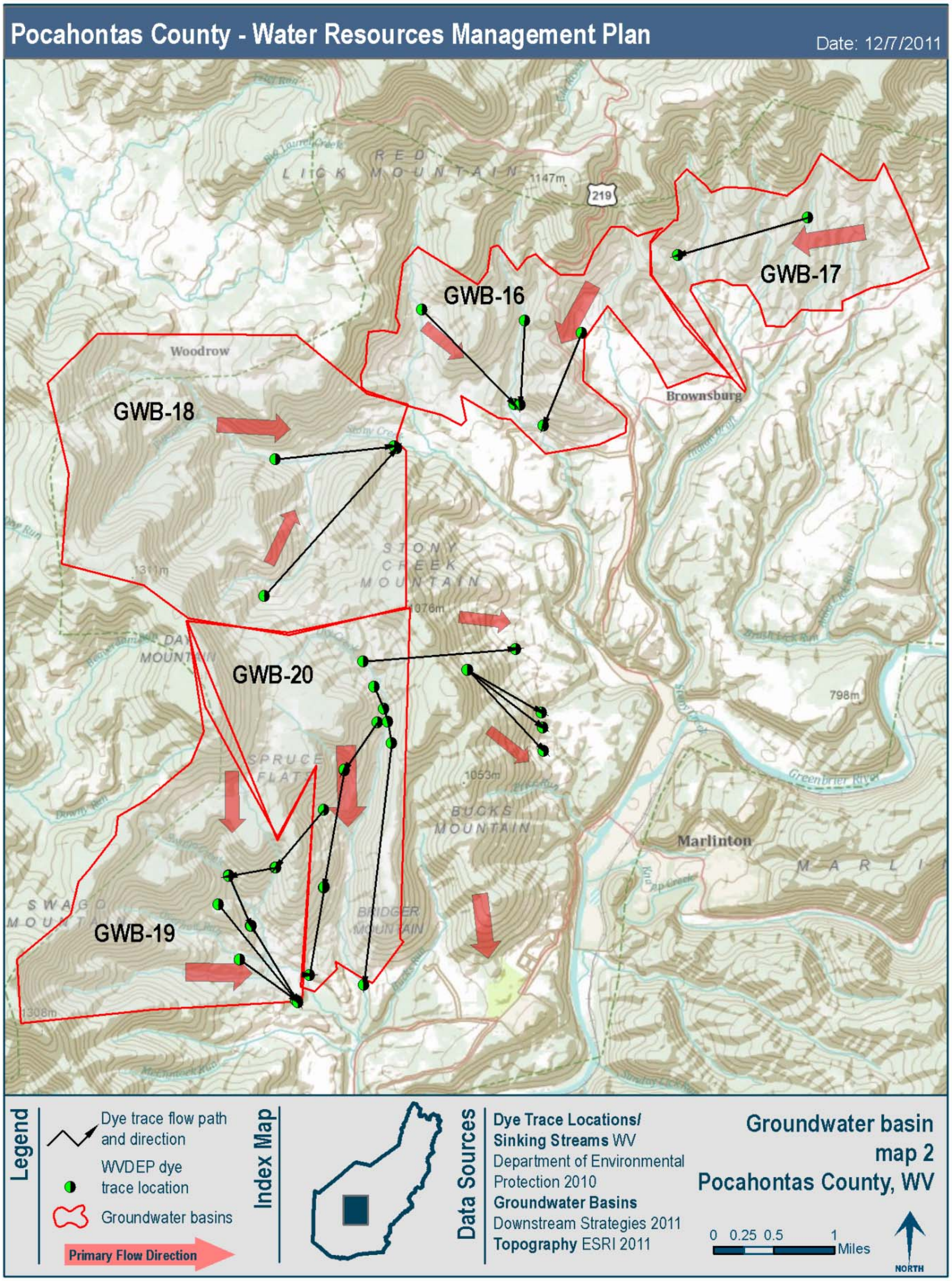


Figure 30: Groundwater basin map 3

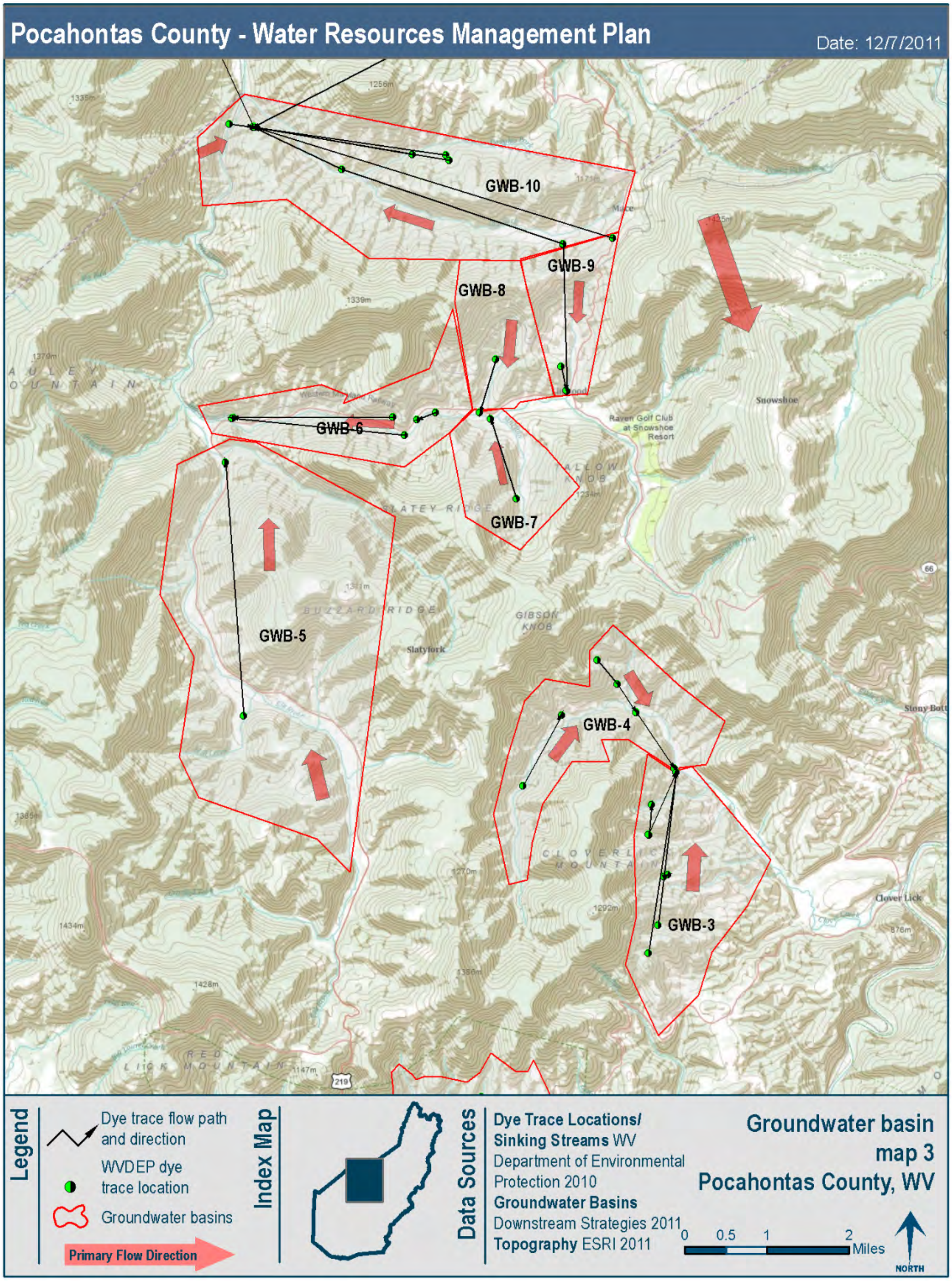


Figure 31: Groundwater basin map 4

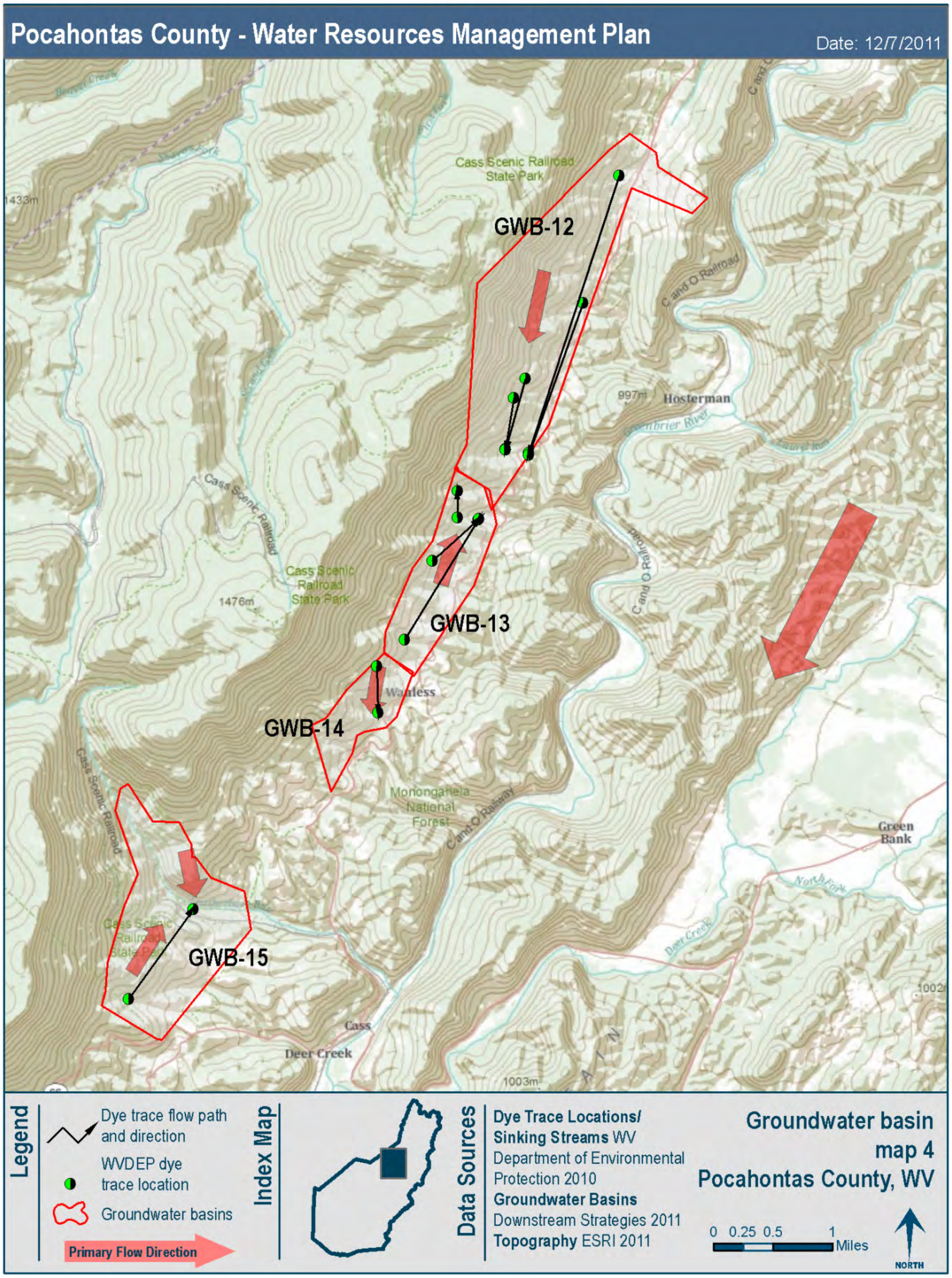
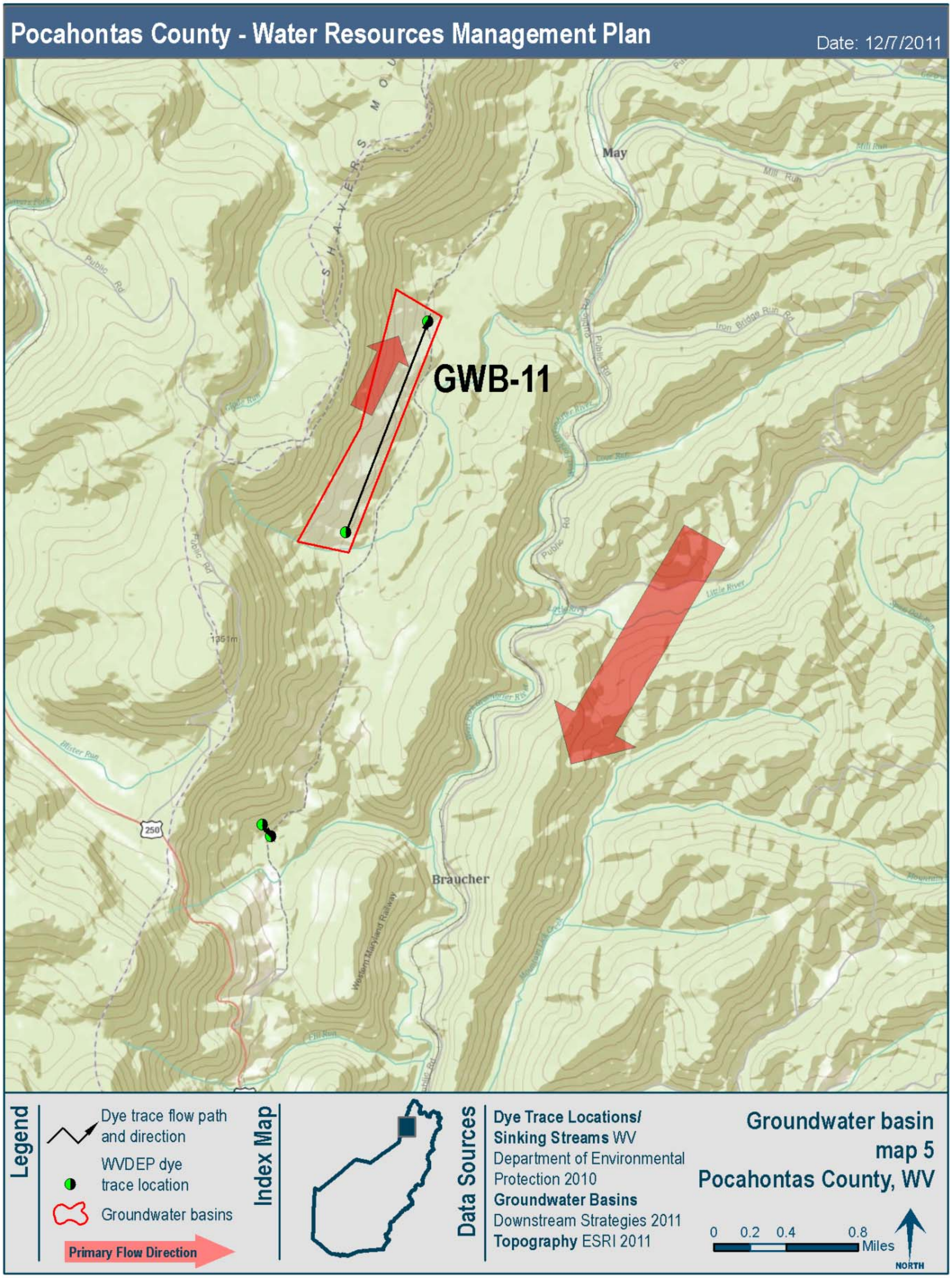


Figure 32: Groundwater basin map 5



4.3 Groundwater vulnerability

All karst areas should be identified as sensitive and especially susceptible to a number of issues, including but not limited to excessive dewatering, contamination, and subsidence. Contaminants can travel very fast in karst regions and via unpredictable flow paths. Because of this, it is imperative that extra precaution be taken when undertaking any activity in a karst area to be sure that one is not negatively affecting another's water supply.

The Elk River is an example of a very sensitive karst area. Even though an area may be considered a karst area, there are typically boundaries to these sensitive areas corresponding to boundaries in rock type. Oftentimes setbacks are established to better protect the karst area from activities on adjacent land. Future phases of this work will examine areas vulnerable to groundwater pollution and over-consumption employing a methodology that was used in the Elk Headwaters to develop several data layers, including groundwater risk, hazards, and overall vulnerability.

5. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report is to examine the available data, perform preliminary analyses, and summarize findings. The report presents baseline information that can be used to develop recommendations for content to be included in the WRMP. While it has been noted that stakeholders desire a more locally based evaluation of water resources in the county, data presented in this report are mostly from federal and state agencies. The point of the WRMP is to develop a road map to implement a locally driven water resources management structure. The plan will provide the framework within which to assess state and federal conclusions and determine the validity of those studies. The WRMP will also outline a method for understanding water quality and quantity, using enhanced datasets and "on-the ground" observations made by county stakeholders.

Generally, water resources in Pocahontas County are clean and abundant, especially when compared to other counties in West Virginia. Water pollution issues do exist in the county and actions could be taken to understand and remediate possible pollution sources. Water in Pocahontas County is currently an abundant resource, without significant consumption pressure. Future work should consider this report's analysis showing that some areas are more sensitive than others to consumption pressure, for both surface and groundwater. Finally, Pocahontas County has a very complex subsurface environment, due the concentration of caves and karst. This complexity creates many flow paths for groundwater, resulting in a close connection to activities on the land surface.

Pocahontas County has a plethora of water resources, resources that help to drive the local economy and provide a high quality of life for residents. Filling data gaps is the first step toward the goal of sustainably managing these resources and meeting the needs of county residents.

5.1 Stakeholders

Stakeholders have expressed concerns that WVDEP is developing a statewide WRMP without significant input from county residents. WRTF was created to lead the planning effort and develop a county-wide WRMP, an effort that shall be aligned with the perspectives and direction of county residents. Baseline information is now understood—and presented in this report—that should help facilitate an organized and concise vision of the plan. The plan will be a living document that could be updated on a periodic basis to reflect developments in data, perceptions, and pressures. But the first version of the plan must be constructed so it will be implemented quickly and sustainably. Recommendations include:

1) Create a planning matrix that outlines the completed plan. This outline would be agreed on by WRTF and a timeline would be created for each objective. In addition to a timeline, data gaps and actions would be assigned to each metric. This task could take place as part of Phase 2.
2) Using Table 1 on page 9, work through a stakeholder process to determine specific objectives, tasks, and costs associated with the implementation of the plan.

5.2 Surface water

As in most of West Virginia, there is little hydrologic or climate data in Pocahontas County. Many of the analyses conducted for this report are cursory in nature and represent a preliminary assessment of surface water resources. In order to fully characterize the state of the county's surface water resources and potential impacts of land-cover changes, climate change, and future natural resources extraction, a more robust network of streamflow, water quality, and climate stations should be established within the county. We outline four specific, interrelated objectives that should be undertaken to overcome the limitations of the current assessment:

1) **Establish permanent, long-term streamflow, water quality, and climate stations in benchmark watersheds**. The lack of hydrologic data makes a thorough and accurate characterization of surface water resources very difficult. We recommend establishing additional precipitation and stream gauging stations at selected locations throughout the county. A system and plan for maintenance of these gauges should also be developed. Gauging locations should be established in watersheds with representative land cover and in those at the extreme ends of land-cover variation (benchmark watersheds) so a comprehensive assessment of current and future surface water resources can be conducted. The locations and number of stations would be determined in future phases of the planning process.
2) **Conduct studies to characterize surface water and runoff generation in Pocahontas County**. Detailed studies should be conducted to characterize how water moves through selected watersheds within the county. Process studies using stable isotopes, geochemistry, and tracers should be conducted in conjunction with streamflow gauging stations located in benchmark watersheds to gain a thorough understanding of watershed hydrology. Process studies should be designed to answer how different land cover and activities affect runoff and flood generation, to define rainfall-runoff relationships, to quantify how long water stays in a watershed (residence time), and to define dominant sources of water (groundwater, surface water, riparian water) within the watershed.
3) **Evaluate threats to Pocahontas County water resources.** Pointed studies are needed to evaluate the impacts on streamflow and water quality of (i) land-cover changes, (ii) climate change, and (iii) water use. These disturbances represent the greatest potential threats to surface water resources in Pocahontas County.
4) **Conduct pointed studies to evaluate the impacts of Marcellus Shale development in Pocahontas County on surface and groundwater resources.** Natural gas extraction issues were listed as a concern by 86% of agency survey respondents and 62% of community survey respondents—more than any other single concern in both cases. Research should aim to understand how Marcellus Shale development will impact water quantity and quality. Water quantity may be impacted by water withdrawals for hydraulic fracturing operations and by community water use pressures. Water quality can be impacted in two ways. Reduced streamflow resulting from water withdrawals for hydraulic fracturing operations can impact water temperature, dissolved oxygen, and stream chemistry. In addition, surface and ground water contamination associated with brines (produced water) from Marcellus operations, which are sometimes disposed of through land application or on roads as deicer, can further impact water quality. One potential threat associated with Marcellus Shale operations is that of drinking water wells becoming contaminated with methane. A recent study in New York and Pennsylvania showed that methane concentrations in drinking water wells in active gas extraction areas (one or more gas wells within 1 kilometer) increased with proximity to the nearest gas wells (Osborne et al., 2011). With the high number of households in Pocahontas County dependent on drinking water wells, baseline information is needed prior to the development of Marcellus Shale extraction in the area.

5.3 Groundwater

Looking ahead toward further study of groundwater quantity and quality, one must consider several of the following concepts. First, a complete and thorough dye tracing schedule would complement the data that already exist by delineating GWBs in the karst areas and determining how quickly local aquifers recharge. In an ideal world, every cave system that has flowing water should be traced to its corresponding spring. It is impractical to dye trace every cave in Pocahontas County; efforts should begin with the largest cave systems in the areas most likely to be impacted. Karst basins in the vicinities of Hillsboro, Marlinton, Slatyfork, and Cass would be the top priorities. Once GWBs are established, then work can begin to determine what parts of the county may be able to better accommodate development. This information may also help determine what type of development is consistent with protecting sensitive GWBs.

In non-karst areas, analysis of well data will help determine the location of aquifers, the direction of underground water flow, and the quantity of available groundwater. These data would build on what various agencies and individuals, including USGS, have already published and shared for this report. The single existing USGS groundwater monitoring well has been tested only three times, all in the mid-1980s. Many of the contaminants tested did not exceed standards. It would be valuable to study this well again, using the data from the 1980s as a baseline, and to set up monitoring wells in other parts of the county. Newer data would better illustrate the current groundwater quality and how it changes seasonally and over time.

For future gas-well drilling considerations, it will be important to study water quantity in addition to any near-surface issues that the karst and its associated aquifers may present. It is not possible to make assumptions about these issues until more data are collected and the available well data are incorporated into GIS.

This water resources assessment is the first step in developing and implementing a long-term county-wide WRMP. Once completed, the WRMP will help plan for a sustainable water future by balancing the needs of agriculture, business, industry, and tourism as well as those of the environment and individual citizens of Pocahontas County.

APPENDIX A: REFERENCES

Bokman M. 2004. Rice County Water Resource Management Plan. Prepared with the Rice County Water Resource Management Advisory Committee. Adopted Mar 30, 2004.

Cardwell DH, Erwin RB, Woodward HP. 1968 (slightly revised 1986). Geologic map of West Virginia. West Virginia Geological and Economic Survey. Scale 1:250k.

Barkley R. 2011. Treasurer and Secretary, Public Service District. Interview with author Condon.

Bosch JM, Hewlett JD. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. Journal of Hydrology, 55(1), 3-23.

DeFries R, Eshleman KN. 2004. Land-use change and hydrologic processes: a major focus for the future. Hydrological Processes, 18, DOI: 10.1002/hyp.5584.

Driscol D. 2011. Mayor, Town of Marlinton. Interview with author Condon.

Ferrari JR, Lookingbill TR, McCormick B, Townsend PA, Eshleman KN. 2009. Surface mining and reclamation effects on flood response of watersheds in the central Appalachian Plateau region. Water Resources Research, 45(W04407), DOI: 10.1029/2008WR007109.

Fry J, Xian G, Jin S, Dewitz J, Homer C, Yang L, Barnes C, Herold N, Wickham J. 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States. Multi-Resolution Land Characteristics Consortium. *PE&RS*, Vol. 77(9):858-864.

Henderson D. 2011. Pocahontas County Sanitarian. Interview with author Condon.

Hewlett JD, Helvey JD. 1970. Effects of forest clear-felling on the storm hydrograph. Water Resources Research, 6(3), 768-782.

Hollis GE. 1975. The Effect of Urbanization on Floods of Different Recurrence Interval. Water Resources Research, 11(3), DOI: 10.1029/WR1011i1003p00431.

National Oceanic and Atmospheric Administration (NOAA). 2010. The water cycle. www.srh.noaa.gov/crp/?n=education-watercycle Accessed Feb 3, 2012.

Natural Resource Analysis Center (NRAC). 2002. Public lands/land stewardship (WV GAP). GIS shapefile.

Natural Resources Conservation Service and WV Conservation Agency (NRCS and WVCA). 2004. Hardy County water resources assessment. Prepared for the Hardy County Commission.

Osborn SG, Vengosh A, Warner NR, Jackson RB. 2011. Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. Proc Natl Acad Sci USA 108:8172–8176.

Pocahontas County Convention and Visitors Bureau. 2012. Quick county facts. http://www.pocahontascountywv.com/quick_county_facts.aspx?m=1 Accessed Feb 5, 2012.

Rigsby M. 2011. Water Operator, Denmar Prison. Interview with author Condon.

Sheets CJ; Kozar MD. 2000. Ground-water quality in the Appalachian Plateaus, Kanawha River basin, West Virginia. Water-Resources Investigations Report 99-4269. US Geological Survey.

Stafford K. 2007. Karst groundwater hazards placemat. National Cave and Karst Research Institute.

Tate M. 2011. Water Operator, Town of Hillsboro. Interview with author Condon.

US Census Bureau (USCB). 2011a. 2010 Census.

___________. 2011b. County business patterns. http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl Accessed Feb 5, 2012.

US Department of Agriculture (USDA). 2009. 2007 Census of agriculture. Vol 1, Ch 2: County level data. http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/West_Virginia/st54_2_001_001.pdf Accessed Feb 5, 2012.

___________. 1998. Soil Survey of Pocahontas County, West Virginia. Natural Resources Conservation Service.

US Environmental Protection Agency (USEPA). 2011. What is a watershed? http://water.epa.gov/type/watersheds/whatis.cfm Accessed Feb 9, 2012.

US Geological Survey (USGS). 2011. Geologic units in Pocahontas County, West Virginia. tin.er.usgs.gov/geology/state/fips-unit.php?code=f54075 Accessed Dec 9, 2011.

___________. 2003. Digital elevation models (USGS 3-meter).

___________.1984. Ground-water hydrology of the Upper New River basin, West Virginia. Compiled by RA Shultz. Map report. Scale: 1:250,000.

West Virginia Department of Environmental Protection (WVDEP). 2010. 2010 West Virginia integrated water quality monitoring and assessment report. Submitted to USEPA. Department of Water and Waste Management.

West Virginia Division of Natural Resources (WVDNR). 2006. West Virginia physiographic regions.

Williams J. 2011. Manager, Edray Fish Hatchery. Interview with author Condon.

APPENDIX B: PROJECT TEAM

ABOUT DOWNSTREAM STRATEGIES

Downstream Strategies offers environmental consulting services that combine sound interdisciplinary skills with a core belief in the importance of protecting the environment and linking economic development with natural resource stewardship. We have considerable background in environmental science and policy, GIS, field monitoring, watershed planning, chemistry, permitting, and acid mine drainage treatment design. Our skills also include environmental economics and survey design and execution. We have an established track record of managing successful projects from inception to completion. Downstream Strategies has more than 14 years of experience building capacity for sustainability through projects in our three main program areas—water, energy, and land—via our unique toolkit, which includes GIS and stakeholder involvement and participation.

ABOUT THE AUTHORS

Fritz Boettner, M.S., Environmental Management, Principal, Downstream Strategies
Mr. Boettner has ten years of professional experience in a wide array of environmental consulting activities. He has managed complex environmental projects, including organizing resources, outlining project scopes, and developing and working within project budgets. He has worked on several watershed plans across West Virginia, including one for the Muddy Creek watershed. He also has experience in applying GIS and computer visualization to a variety of projects at the local, regional, and national levels.

Anne Hereford, M.S., Geological Sciences, Environmental Scientist, Downstream Strategies
Ms. Hereford has authored watershed plans and natural resource assessments and has a strong background in environmental science. Her diverse experience includes work in GIS development, permit research, data analysis, water monitoring, aqueous geochemical modeling, and science education.

Nicolas Zegre, Ph.D., Forest Hydrology, Forest Hydrologist, West Virginia University
Dr. Zegre has thirteen years of professional experience in environmental sciences, with expertise in watershed and forest hydrology, water and natural resources management, land-use and climate change, hydrologic behavior change detection, hydrologic modeling, and statistics. He has conducted and participated in research, modeling, field and laboratory experimentation, and consultation at the national and international levels for state and federal agencies, nonprofits, and private industry.

Jeff Bray, B.S., Geology, Geologist, Maxwelton GeoSolutions
Mr. Bray is consulting on this project as a karst geologist and specialist. He has worked as a karst geologist in the Greenbrier Valley and beyond primarily through his geophysical consulting firm, Maxwelton GeoSolutions. He was trained in geology at Radford University and WVU. He has spent considerable time studying the karst geology in West Virginia over the past 17 years and has lived in the Greenbrier Valley for eight years. In addition, Mr. Bray has a great deal of experience working with government entities and the public on planning through his involvement in several endeavors at local levels in his home county, usually helping to identify BMPs for development on karst.

Lynmarie Knight, Pocahontas County Water Resources Coordinator
Ms. Knight's background is in Biology and Environmental Education. She has experience teaching watershed education and stream monitoring techniques to students and educators. She began working on this project in December 2009 as a contracted grant writer and served as an AmeriCorps VISTA for the WRTF from February 2010 through February 2011. In addition to fundraising, Ms. Knight has contributed to WRTF's organizational development, community outreach and education, research, and community organizing.

Clay Condon, Water Resources Task Force AmeriCorps VISTA
Mr. Condon was born and raised on an organic farm in Pocahontas County. He is working on this project as a capacity builder focusing on volunteer organizing and community outreach and education. He studied Geography at WVU and participated in a year-long study abroad program in Seoul, South Korea, where he had the opportunity to travel to Southeast Asia and see first-hand some of the developing world's intertwined poverty and resource management issues.

Sera Zegre, M.S., Natural Resource Social Science, Project Manager, Downstream Strategies
Mrs. Zegre is a social scientist with a background in public land management, natural resource policy and law, and asset-based community planning. She offers expertise in issues related to communities and natural resources, including: community visioning and planning, education and interpretation, outdoor recreation and tourism, social science research, environmental behavior, natural resource economics, and brownfields/community redevelopment.

Roy Martin, Ph.D., Wildlife and Fisheries, Aquatic Ecologist, Downstream Strategies
Dr. Martin has extensive academic and applied experience in natural resources science and management. Specifically, his expertise is in the application of current field techniques, statistics, and GIS to the study and management of natural resources, with an emphasis on aquatic resources. His work has been presented in peer-reviewed journals and at professional and academic workshops and conferences.

APPENDIX C: DATA DELIVERABLES

C.1 Water Quality Database

A Microsoft Access database is delivered to WRTF as part of this initial water resource assessment. This dataset includes all water quality sampling results and locations of sampling stations.

C.2 Geodatabase

An ESRI GIS geodatabase is delivered to WRTF as part of this initial water resource assessment. The database includes previously developed datasets, as well as datasets created for this project. Table 5 lists all the geo-datasets that were used in the assessment project for mapping or analysis purposes. Proper metadata is embedded in the geodatabase for all data layers that were either created or otherwise not gathered from the public domain. The table organization below mirrors the organization of the ESRI geodatabase scheme; this table provides a general description of each dataset.

Table 5: GIS data layer summary

Layer name	Description	Feature class layer descriptions in geodatabase
Analysis	Results from various analysis and summaries developed during the water resource assessment	• Catchments with all relevant water quality information tied to the drainage area, for both trout and non-trout streams • TMDL subwatersheds with load allocations calculated • Catchments with all many statistics calculated per catchment, which include: o Land-use o Calculated groundwater consumption o Wells per catchment o Recharge rate, both surface and groundwater o Baseflow information o Climatic conditions • Water quality sample locations for the study area • Digitized well yield estimates for parts of Pocahontas County
Basemap	Cartographic representations of relevant Pocahontas County features	• County boundary • Roads • HUC 12 watersheds • Populated places with annotation • Structures
Geology/karst	Geologic features of Pocahontas County, including karst and cave data provided by various institutions	• Geology of the county • Karst formations • WVASS Cave locations (CONFIDENTIAL) • 8-Rivers dye trace locations • Interpreted groundwater basins (part of this study and mapped in the report) • Pocahontas county oil and gas wells • WVDEP Sinking streams • WVDEP dye trace locations
Hydrology	Surface water data used for both cartography and analysis	• WVDEP high resolution stream datasets, reaches • WVDEP 2010 303(d)-listed stream • NHD 1-100k catchments • NHD 1-100k flowlines (streams) • NRCS HUC-12 watershed boundaries • Watershed annotation • Stream gauge locations
Recreation	Public lands	• Monongahela National Forest boundary • State forest boundaries • State park boundaries • Wilderness boundaries
Social	Demographic and economic datasets	• Block population (point locations) • Block population (polygons) • Business and public administrative water users • County parcels (2010) • County structures
Wastewater	Datasets relevant to the wastewater situation in Pocahontas County	• Septic failure: Scoring based on WV DEP methodology using soils data based on permeability, depth to groundwater, drainage • Priority parcels for septic inventory and evaluation • WVDEP water service areas (polygons)
Other	Tables and other datasets without a specific category	• TMDL wasteload allocations • Impaired streams by mile summary • Land-use dataset – raster 2001 • Elevation dataset – raster 2001 • Hillshade dataset – raster 2001 • Water quality data and relationship with sample locations

APPENDIX D: STAKEHOLDER SURVEY SUMMARIES

D.1 Agency Survey Results

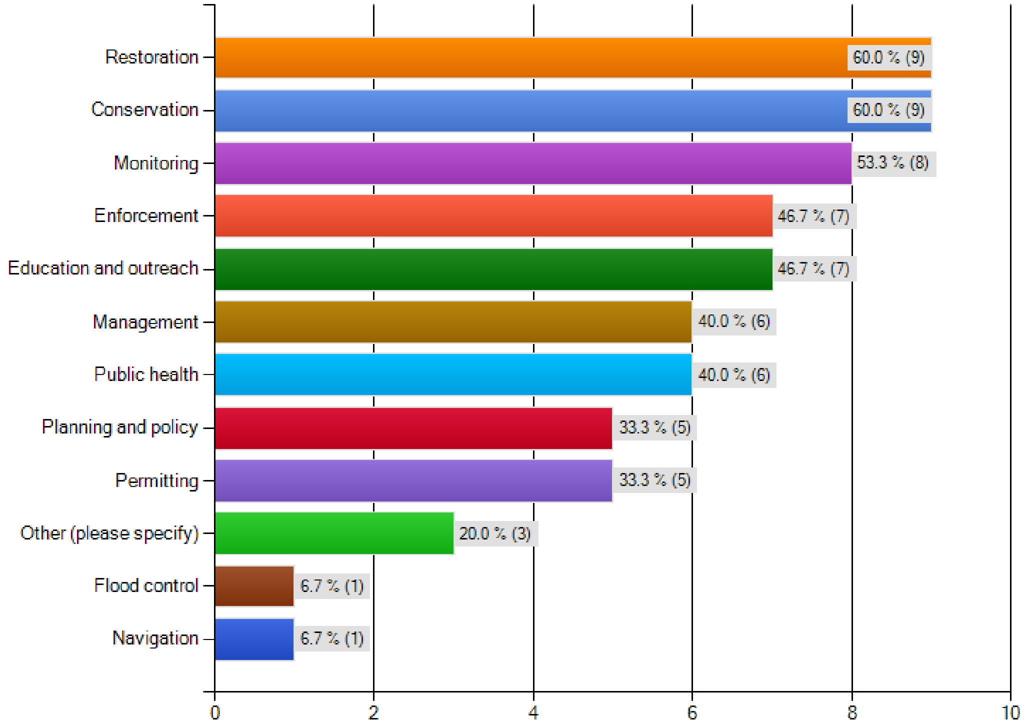
D.1.1 Project narrative on survey

Project purpose: This survey will focus on water quality and quantity of surface and groundwater resources in Pocahontas County, West Virginia. We are conducting this survey to understand water resources and management from the perspective of those with responsibilities related to water resource management. Results will be presented at an agency stakeholder meeting, and inform the development of the Pocahontas County Water Resources Management Plan. Your input is important.

D.1.2 Agencies represented

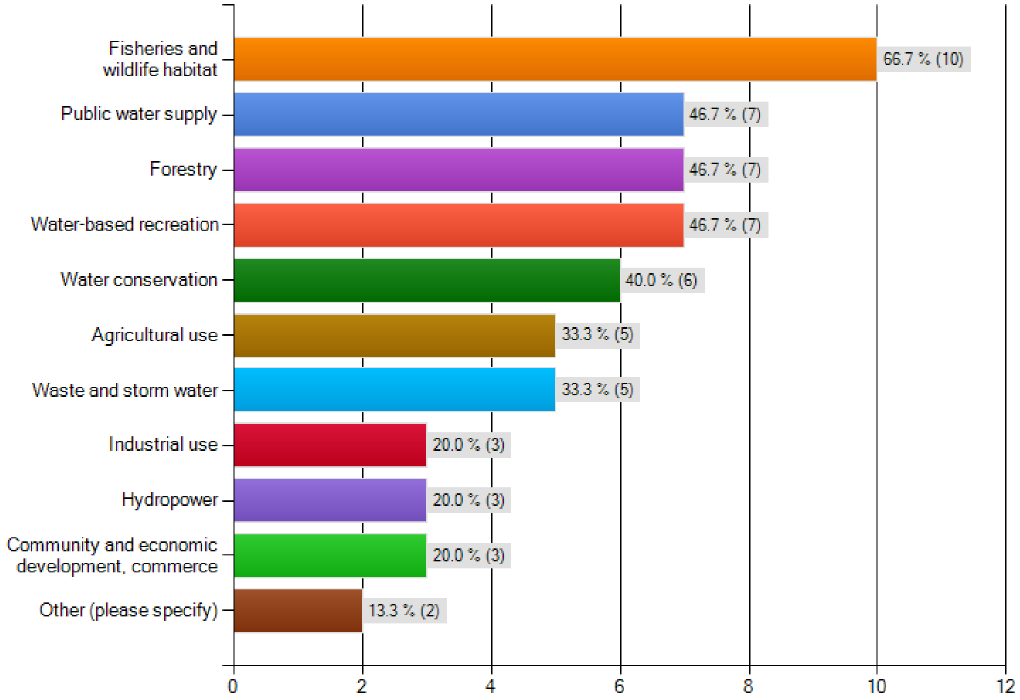
- USFS
- WVDEP
- WVDNR
- West Virginia Department of Health and Human Services
- USDA
- West Virginia State Prison
- Pocahontas County Health Department
- National Radio Astronomy Observatory
- West Virginia Conservation Agency

What are your organization's water resource responsibilities (Check all that apply)



Note N=15,Other: (1) monitor public water supplies at Droop Mtn, & Beartown State Parks only, (2) Develop a statewide water management plan, and (3) This is just for my section. I assume you have asked others in the DEP to complete the survey because most of these areas are under some section of DEP.

Which of the following water demands is part of your organization's mission? (Check all that apply)



Note N=15, Other: (1) Individual Water Supply, and (2) My section is to develop a state water management plan by 2013, and all of these aspects are referenced someway in the legislation detailing plan contents.

Additional comments:

- The Environmental Engineering of the WV Bureau for Public Health has primacy for the EPA's Safe Drinking Water Act. We also permit water and sewer projects, and certify water and wastewater operators.
- I work for the Nonpoint Source Program so our goal is to improve water quality by working with groups to address nonpoint pollution.

D.1.3 Water Resources Management plan

The Pocahontas County Commission's Water Resources Task Force has kicked off efforts to develop a county-wide Water Resources Management Plan. This plan will meet the requirements of the West Virginia Department of Environmental Protection, and be included in the statewide water resources management plan. The county's plan will be developed in phases; this survey is part of Phase 1: to assess water resources and identify information gaps. More information will be provided at the end of this survey.

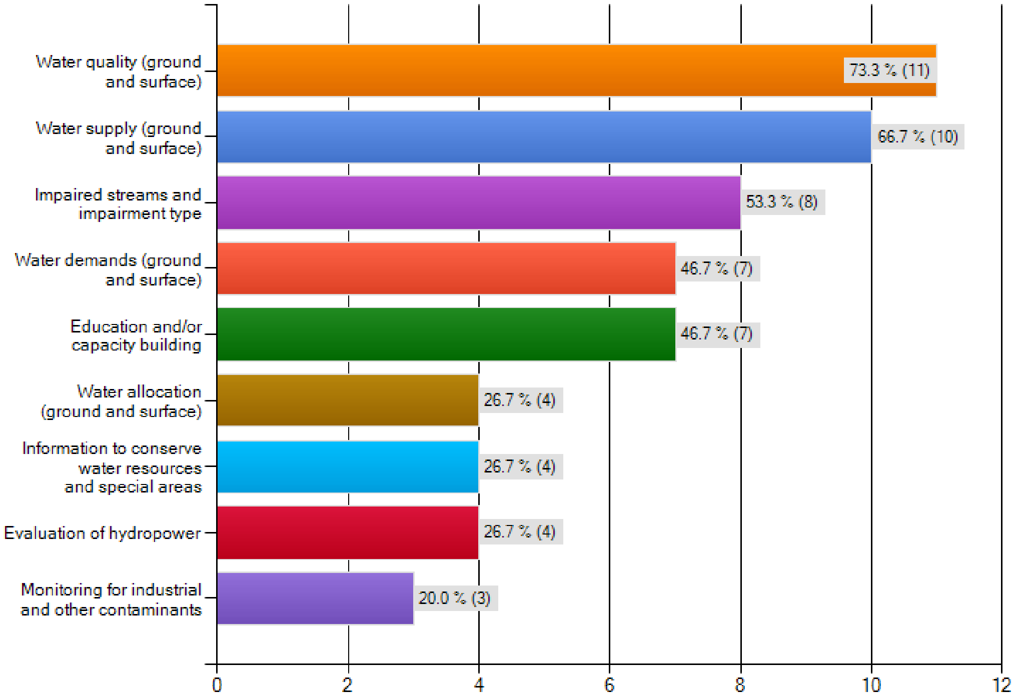
Before this survey, were you aware of state or county efforts to develop Water Resource Management Plans?

- Yes 80% (12)
- No 20% (3)

Explanations:

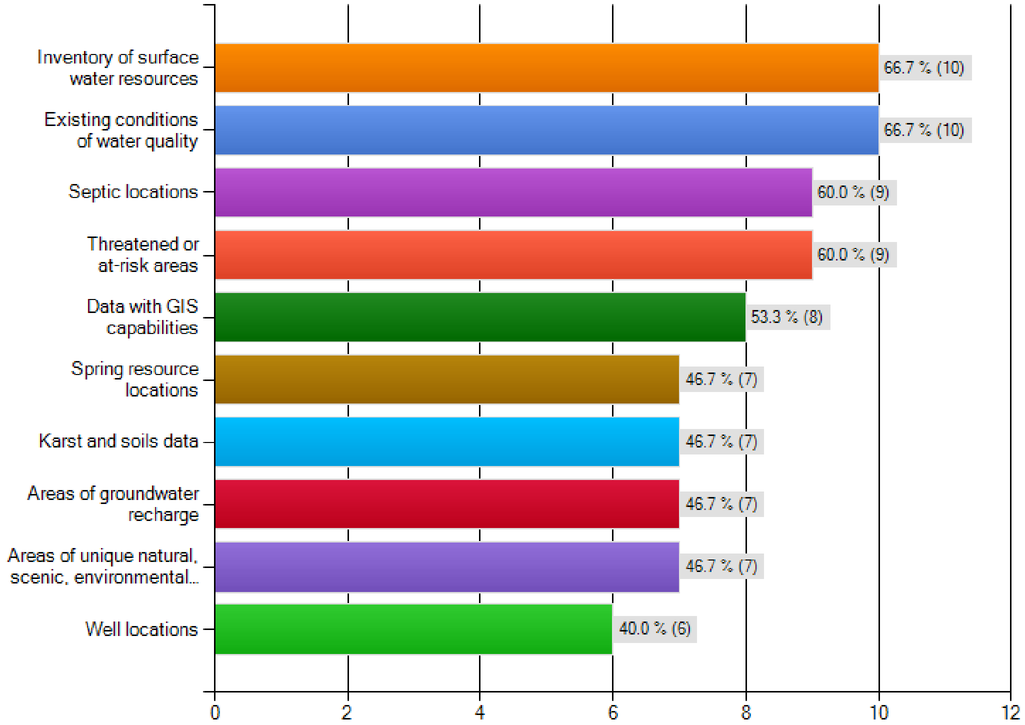
- roadside watershed signs
- I have attended many meetings of source water associations. Most recently I have been involved in coordinating with the River Alert Information Network (RAIN) in a cooperative effort with Pennsylvania.
- I attended several meetings and I have had several meetings with project coordinators.
- I am the manager for the section charged with development of the state plan.

What general information could better manage your water resources? (Check all that apply)



Note: N=15, "Other" was an option without any response.

What data could help better manage your water resources? (Check all that apply)



Note: N=15, "Other" was an option without any response.

Additional comments:

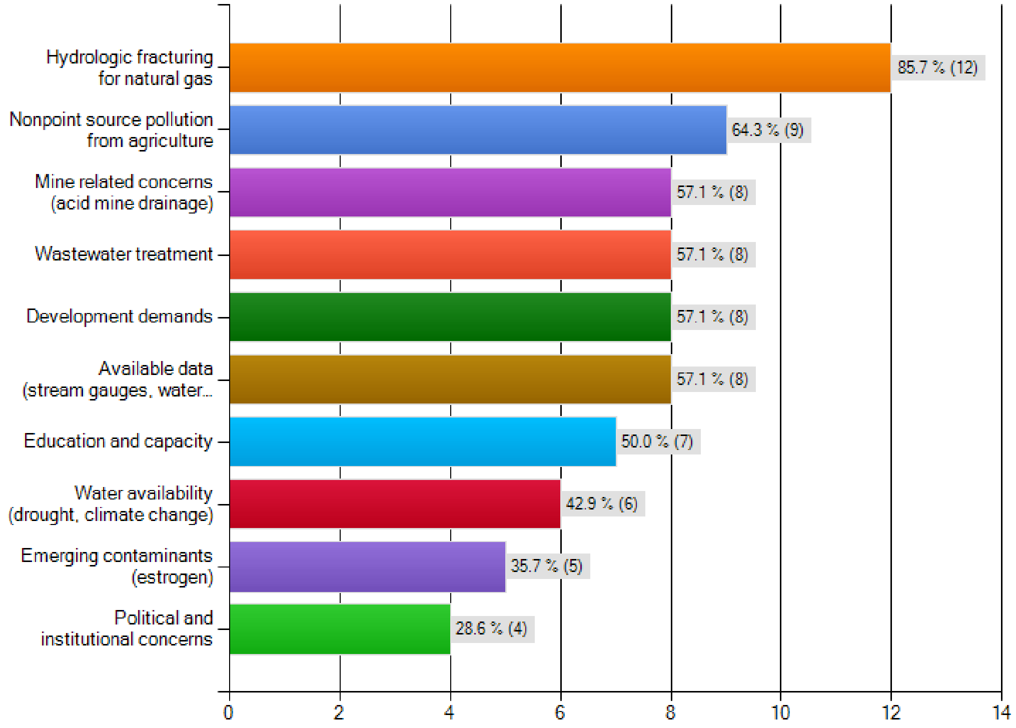
- USGS has compiled well log data for many years at the park (Droop Mtn.) but is not readily accessible.

Additional stakeholders you think should be involved in the process:

- Well drillers

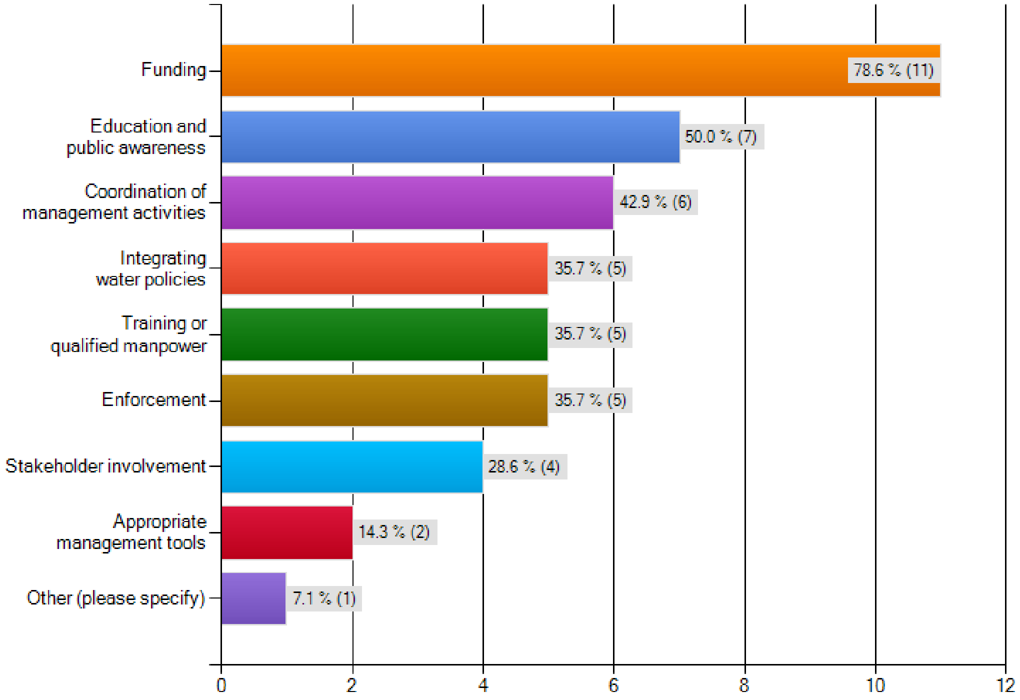
D.1.4 Water Resources and Management

What are your water management areas of concern? (Check all that apply)



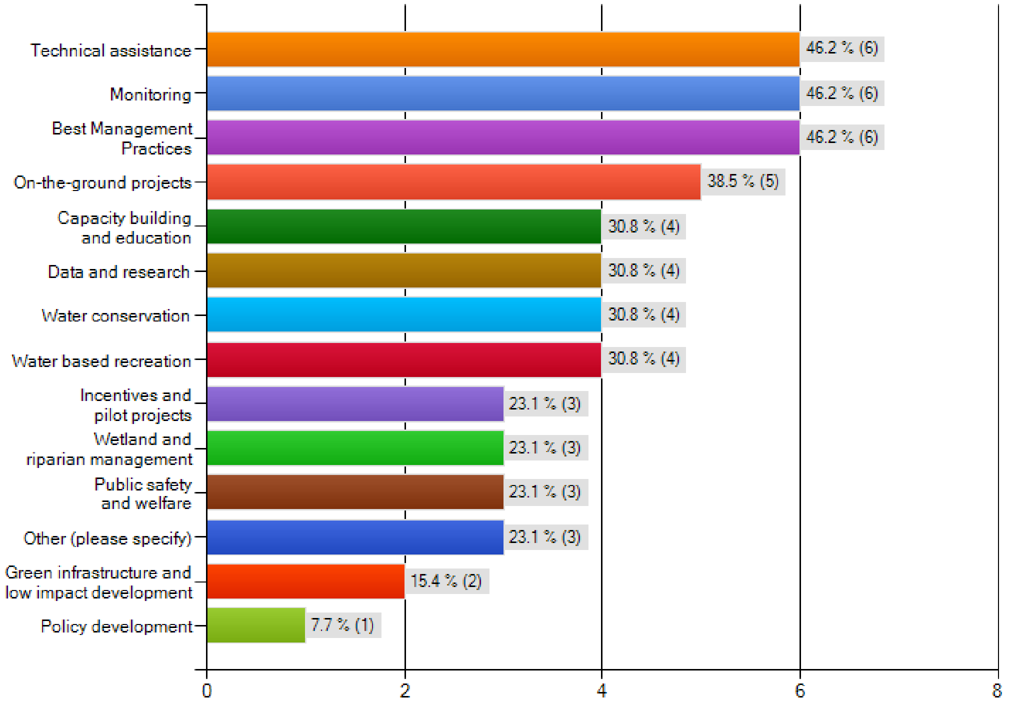
Note: N=14, “Other” was an option without any response.

What are some of the challenges your agency faces when managing water resources? (Check all that apply)



Note: N=14, “Other” = Marginal groundwater availability

With what topics can your agency help to implement the Water Resource Management Plan in Pocahontas County? (Check all that apply)



Note: N=13, "Other" includes the following: (1) Quality Testing + Monitoring, (2) Some of our GPS information is considered to be confidential and is not available to the general public, (3) Do not have the authority to commit agency resources.

Stakeholder data that may assist with this phase of the water planning effort.

- We have GPS data on file which relates to the public water supplies, but this information is considered to be confidential and is not provided to the general public (WV Department of Health and Human Services)
- Stream inventory data on many of the streams on NF lands (USFS)
- Standards and Specifications of installation of BMPs (USDA)
- Fish population surveys (WVDNR)
- WVDEP's Watershed Assessment Branches data (WVDEP)
- We have data on most of your listed concerns (WVDEP)
- Most of our data is available through public sources. For example National Wetlands Inventory, Karst, soil types, Tier 3 list, B2 trout waters, water quality data (WVDEP). We do not have any data on water withdraw. (WVDNR)
- Withdrawal Data (WV State Prison)

D.1.5 Water Resources Management Plan Implementation

Suggestions or additional comments: (none)

Contacts:

Name	Email	Phone
Sam Lammie	slammie@fs.fed.us	304-636-1800 x207
Craig R. Cobb	Craig.R.Cobb@wv.gov	304-457-2296
Rondi Fischer	rfischer@fs.fed.us	304-799-4334 x17
Susan Davis	susan.davis@wv.usda.gov	304-799-4317
James A. Walker	James.A.Walker@wv.gov	304-924-6211
David Henderson R.S.	davidchenderson@wv.gov	304-799-4154
Jennifer DuPree	jennifer.s.dupree@wv.gov	304-465-1911
Michael Stratton	michael.i.stratton@wv.gov	304-926-0499 x1280
Mike McMunigal	jmcmunigal@wvca.us	304-645-6172 x117
Mark Riggsby	Lovanne.k.Riggsby@wv.gov	304-653-4201 x290

D.2 Community Survey Responses

D.2.1 Additional Information regarding survey dissemination and community meetings

WRTF disseminated a community survey throughout Pocahontas County between June 24 and October 24, 2011. This survey was distributed as an insert in *The Pocahontas Times* on Thursday, August 18, 2011. In order to collect the surveys distributed in the newspaper, collection boxes were set up at all of the public libraries in the county and at one or more gas stations and/or grocery stores in each major community within the county. A link to the online version of the community survey was posted to Facebook page on June 24, 2011 and to the WRTF Google group page on July 11, 2011.

In addition, WRTF set up a booth at the Hillsboro Little Levels Heritage Fair, Durbin Days, Pioneer Days, The Road Kill Cook Off, and Huntersville Traditions Days on June 24, July 8 and 9, July 16, Sept 24 and October 4, 2011 respectively. The purpose of this outreach presence was to obtain additional surveys and inform the community about the WRTF and WRMP.

The incorporated municipalities of Hillsboro, Durbin, Green Bank and Marlinton were canvassed by Clay Condon and/or Lynmarie Knight on September 29, September 27, October 4, and October 31 respectively. The purpose of the canvassing initiative was to inform citizens of the WRTF and obtain more community survey responses.

Community Meetings were held at all of the public libraries within the county and surveys were made available at these meetings. The dates and times of the community meetings were as follows:

Hillsboro Public Library: 9/27/2011 6:30pm-9:00pm

Durbin Public Library: 9/29/20011 6:30pm- 9:00pm

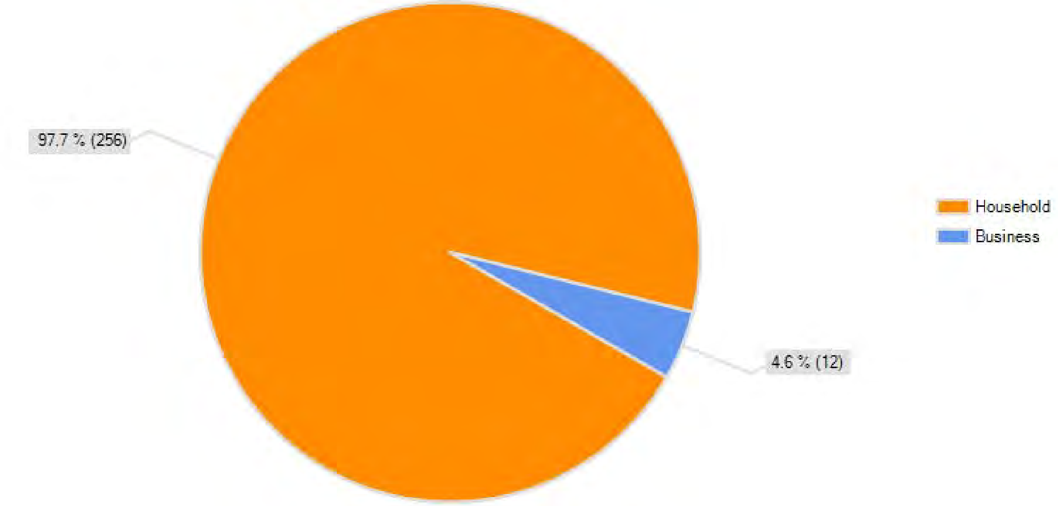
Greenbank Public Library: 10/04/11 6:30pm-9:00pm

Linwood Public Library (Snowshoe): 10/06/11 6:30pm-9:00pm

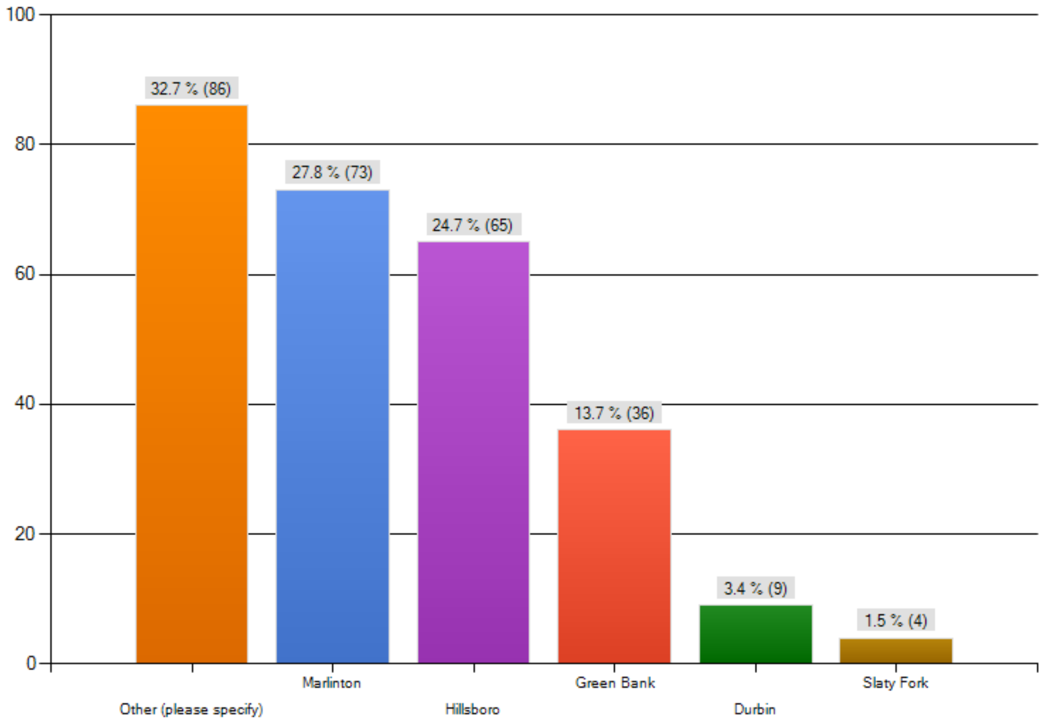
McClintic Public Library (Marlinton): 10/12/11 6:30pm-9:00pm

D.2.2 Summary of Community Survey Responses

Are you completing this survey for a household or business?

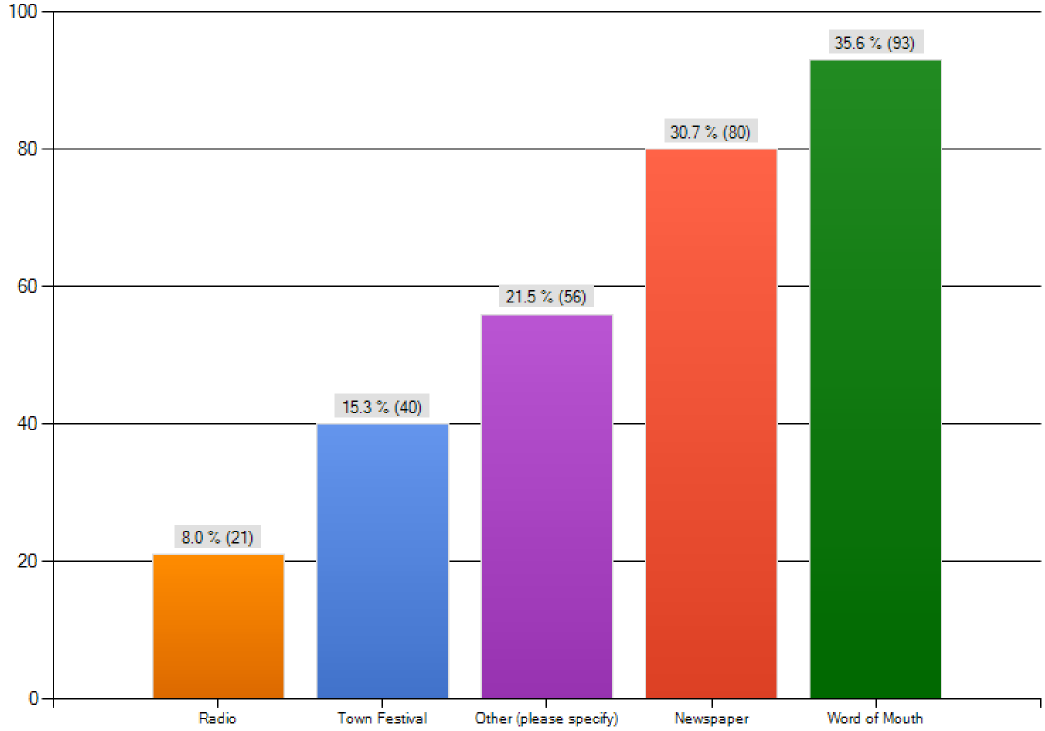


Where is your household or business located?

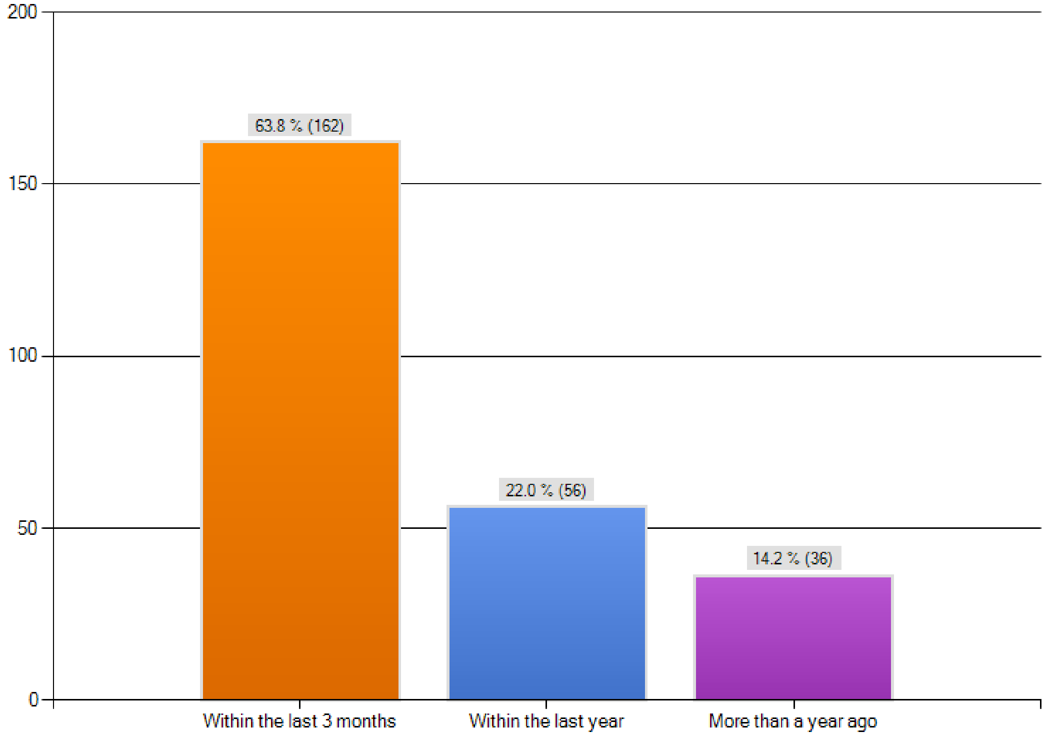


Other = not in an incorporated town

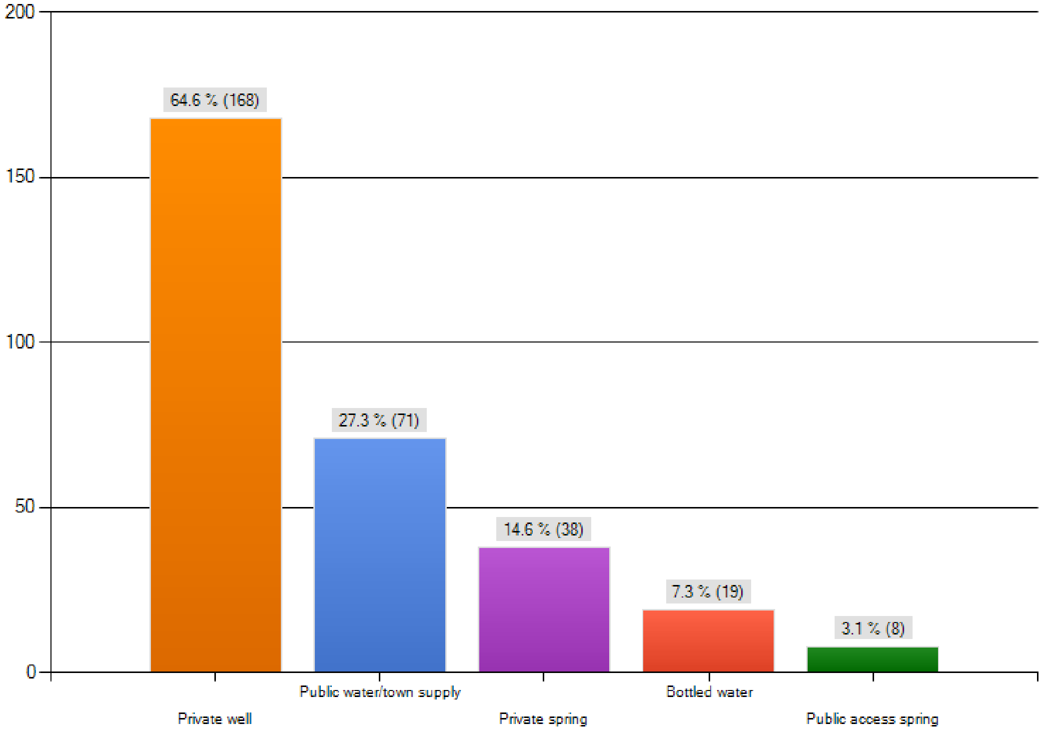
How did you hear about the Water Resources Task Force?



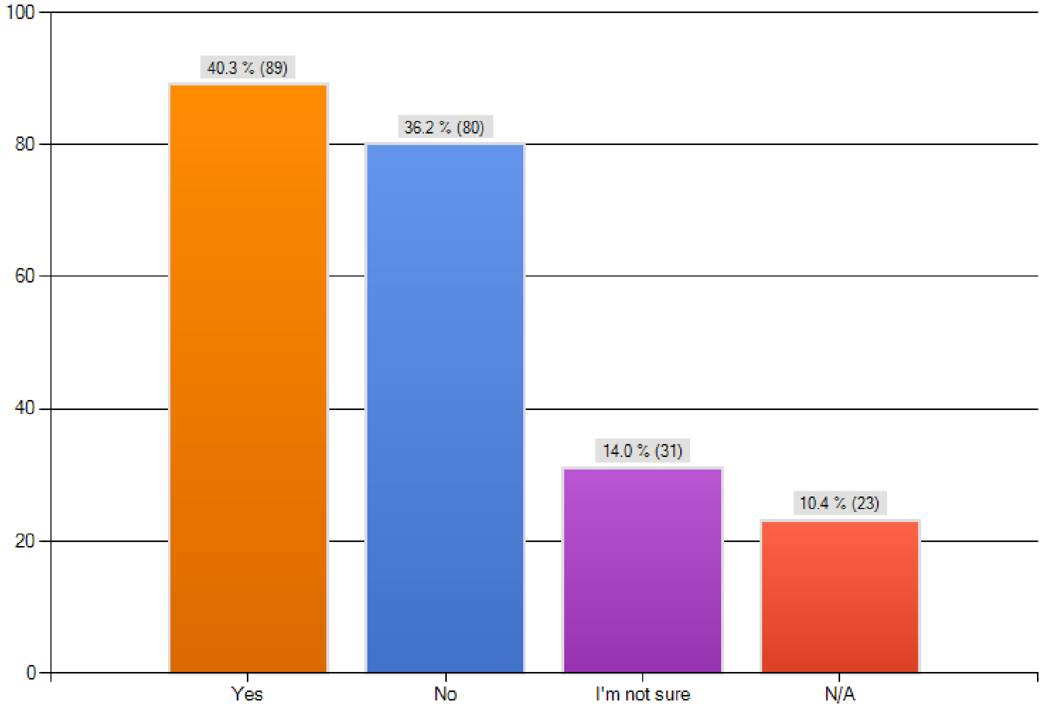
When did you hear about the Water Resources Task Force?



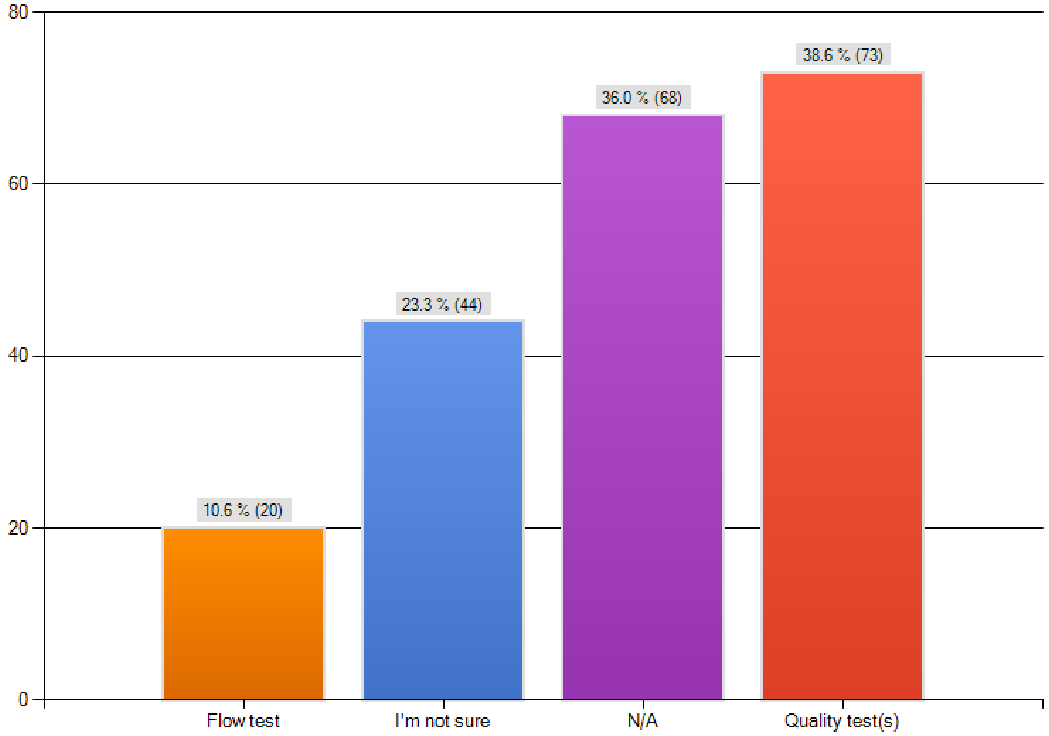
What type of water supply do you use? Please check all that apply.



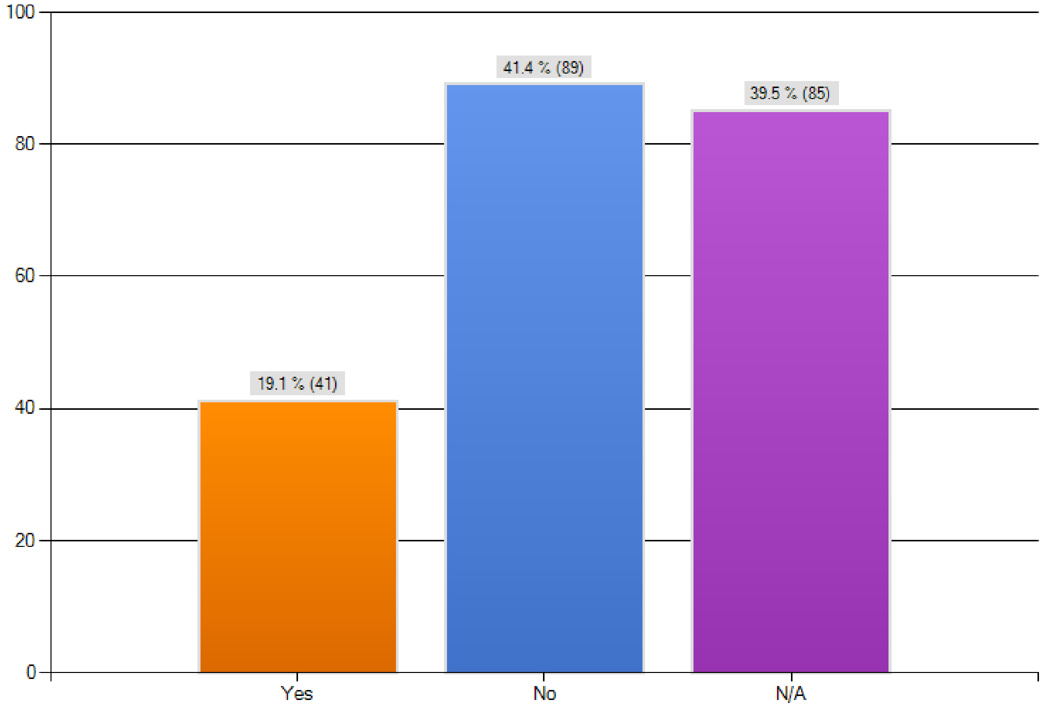
If you use a private well or spring, have you ever had any testing done on your water supply?



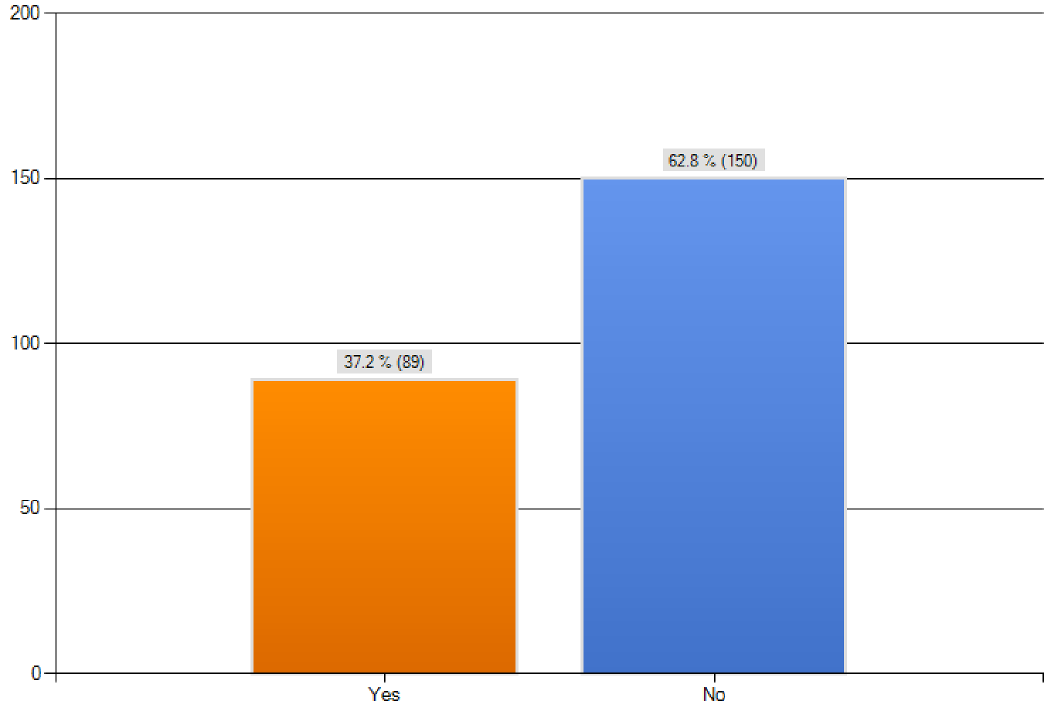
If your water supply has been tested, what type of tests were performed?



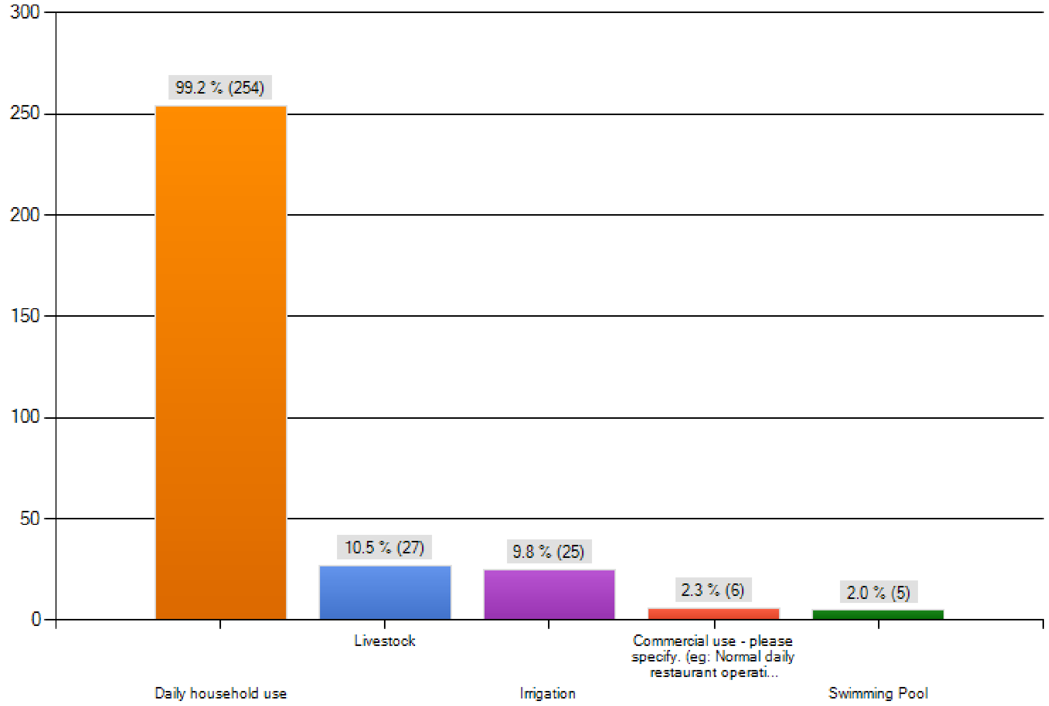
Do you have any data on your private water supply you would be willing to share with us?



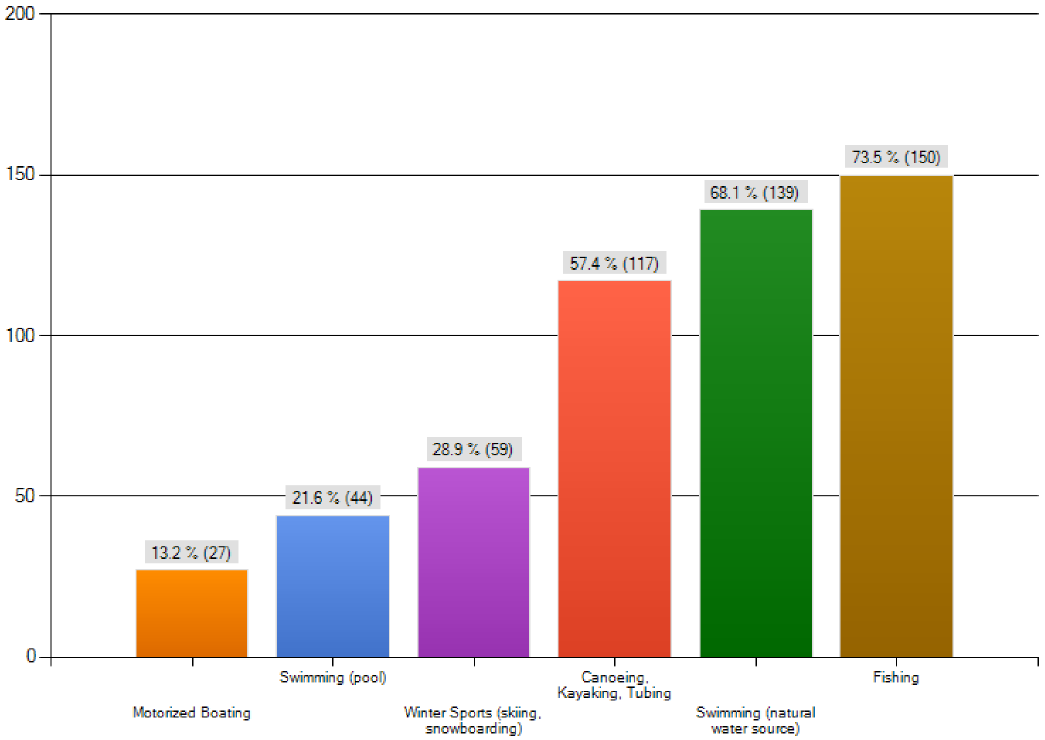
Are there any issues with your water supply you're aware of? Do you have any concerns regarding your water supply?



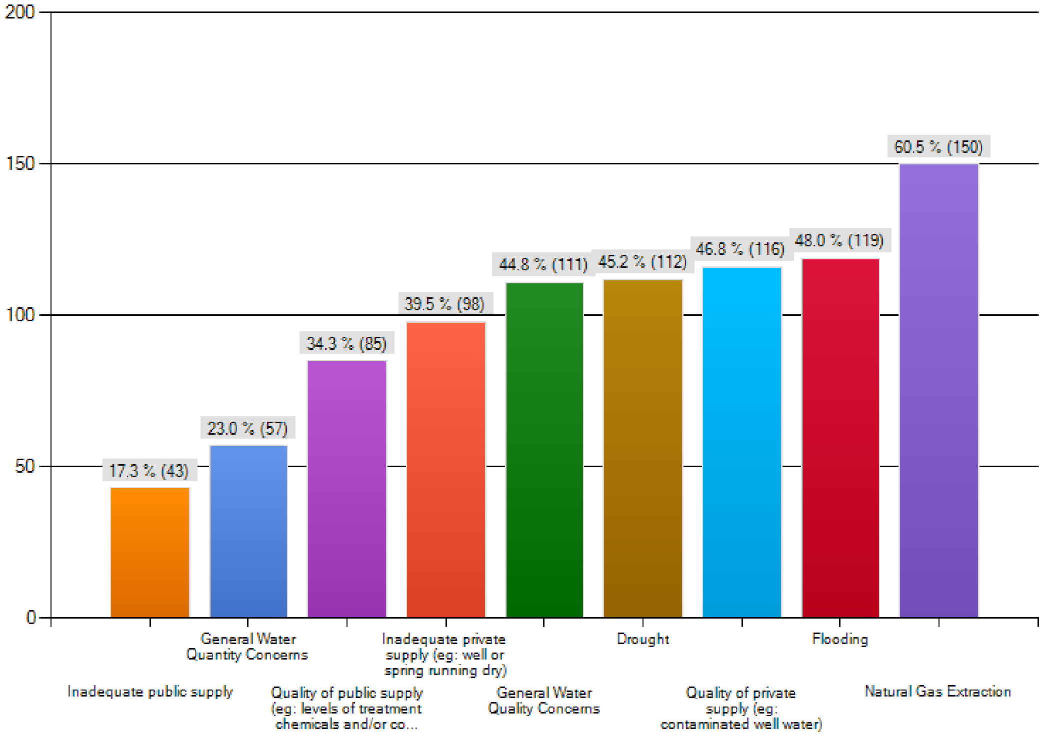
What are your primary uses of water?



How do you use water for recreation? Please check all that apply.



What concerns do you have regarding Water Resources in Pocahontas County?



Do you think it is valuable to study/understand our Water Resources?