2005 Progress Report

December 30, 2005

Implementation of the Water Resources Protection Act

West Virginia Code, Article 22-26

Stephanie R. Timmermeyer
Cabinet Secretary

Revised: January 18, 2006

West Virginia Department of Environmental Protection
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Notes for the January 18, 2006 Revised Edition

After the initial report was delivered to the West Virginia Legislature's Joint Legislative Oversight Commission on State Water Resources, errors were discovered that necessitated issuance of this revised edition of the *2005 Progress Report: Implementation of the Water Resources Protection Act.* The following changes have been made to the report:

Appendix C – Inventory of West Virginia Lakes

Some federally controlled lakes were inadvertently omitted from the original report. The table in Appendix C was replaced with a new table that includes the missing data. This changed the totals reported in Table 1 on page 5 of the report. Table 1 was corrected to reflect the new totals.

Appendix A – Copy of the Act

An earlier version of SB 163, the Water Resources Protection Act, was mistakenly downloaded from the West Virginia Legislature's web site. Appendix A has been corrected, and now contains the enrolled version of the Act.

IMPLEMENTATION OF
THE WATER RESOURCES PROTECTION ACT
WEST VIRGINIA CODE, ARTICLE 22-26

2005 PROGRESS REPORT

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Abbreviations and Acronyms

Act	Water Resources Protection Act
ASIWPCA	Association of State and Interstate Water Pollution Control Administrators
BBER	WVU's Bureau of Business and Economic Research
CBER	MU's Center for Business and Economic Research
CEGAS	Center for Environmental, Geotechnical, and Applied Sciences
CVI	Canaan Valley Institute
DOT	Department of Transportation
DNR	Division of Natural Resources
GED	Gallons per Employee per Day
GW	Ground Water
HUC	Hydrological Unit Code
ICPRB	Interstate Commission on the Potomac River Basin
IMS	Information Management System
MGD	Million Gallons per Day
MOU	Memorandum of Understanding
MU	Marshall University
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NWS	National Weather Service
O&M	Operation and Maintenance
PDSI	Palmer Drought Severity Index
PSD	Public Service District
RTI	Nick J. Rahall, II Appalachian Transportation Institute
SB	Senate Bill
SDS	Spatial Data Standard
SWAP	Source Water Assessment and Protection Program
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WRI	West Virginia Water Research Institute

WRPA	Water Resource Protection Act
WVBEP	West Virginia Bureau of Employment Programs
WVBPH	West Virginia Bureau of Public Health
WVDA	Department of Agriculture
WVDEP	West Virginia Department of Environmental Protection
WVGES	West Virginia Geologic and Economic Survey
WVDHSEM	West Virginia Department of Homeland Security and Emergency Management
WVU	West Virginia University
7Q10	Low Flow for a Stream for Seven Consecutive Days During a Ten Year Period

Acknowledgements

Without the assistance of numerous individuals within the Department of Environmental Protection (DEP), other state and federal agencies, academia, and the private sector, compilation of this report would not have been possible.

The DEP would like to thank the following groups for their assistance: West Virginia Legislature's Joint Legislative Oversight Commission on State Water Resources, the various offices within the Department of Environmental Protection, Bureau for Public Health, WV Geological and Economic Survey, Public Service Commission, Department of Natural Resources, Department of Agriculture, Office of Emergency Services, U.S. Geological Survey, WV Chamber of Commerce, WV Rural Water Association, WV Conservation Agency, WV Development Office, WV Farm Bureau, WV Manufacturer's Association, WV Coal Association, and the Independent Oil & Gas Association of West Virginia.

Special thanks to the Water Research Institute at West Virginia University and the Rahall Transportation Institute, Center for Environmental, Geotechnical, and Applied Science, Center for Business and Economic Research at Marshall University, for contributing to the research necessary for this report. Special thanks also to the U.S. Geological Survey for providing data utilized in this report, and the West Virginia Geological and Economic Survey for providing input into the survey design. In addition, the DEP extends special thanks to the DEP's Information Technology Office for developing the on-line survey and associated databases. The DEP would also like to recognize the West Virginia Coal Association for developing a survey preparation guideline document for the coal industry.

Finally, the DEP would like to thank all of the survey participants, including the draft survey (beta) testers: Arch Coal, WV-American Water Company, Appalachian Electric Power, Union Williams Public Service District, and Bright Industries.

Executive Summary

The 2005 report is a compilation of findings to date on the major tasks set out in the Water Resources Protection Act. West Virginia University's Water Research Institute and Marshall University's Center for Environmental, Geotechnical, and Applied Sciences as well as its Center for Business and Economic Research have co-authored this report.

This report concentrates on existing data, data accuracy, and data deficiencies. The main conclusion to be drawn from this report is that while some of the major elements will be answered, the majority will not be completely resolved due to lack of data. However, the State has taken a major step forward in answering these questions. If the WV Legislature deems it necessary to create a program to analyze water availability, it will need to know what direction to take in order to gather the data necessary to answer these questions. As noted in the ASIWPCA survey results, other states have had programs in place from 3 – 100 years. Others are still trying to implement a program. West Virginia has taken the necessary first step to quantify its water resources so that it can begin gathering the data necessary to make decisions on water availability.

The following constitutes recommendations on what actions need to be taken during the upcoming year:

- West Virginia University and Marshall University have stated that for continued support on the Water Resources Protection Act, they have budgetary needs of $108,000 and $155,000, respectively. These funds will ensure continued research and support, and operation and maintenance of the data warehouse at the Nick J. Rahall II Appalachian Transportation Institute.

- The primary problem with the existing data is the lack of long-term information from which to draw any meaningful conclusions. Although the following information will not result in a complete understanding of the ground water resources of the state, it is essential for any future understanding of this important state resource. The DEP recommends that the state move toward making long-term commitments for both ground water and stream gauge monitoring:

    - The United States Geologic Survey (USGS) recently lost federal funding for nine ground water monitoring wells. According to USGS, a one-time expenditure of $9,200 for installation of gauges and telemetry radios for two wells and a yearly expenditure of $36,000 for the operation of all nine wells is needed.

    - In addition, the USGS will lose federal funding for stream gauges in 2006/07. Continued stream gauge monitoring and the installation of new stream gauges are needed to gather the necessary data on surface water availability. The USGS estimates the cost to be $181,000.

Introduction

The Water Resources Protection Act ("Act" or "WRPA"), W.Va. Code §§22-26-1 *et seq*., enacted March 13, 2004, authorized the establishment of a Joint Legislative Oversight Commission on State Water Resources. The West Virginia Department of Environmental Protection (DEP), the implementing agency for the Act, is required to submit a yearly progress report to the Commission (§22-26-5(b)). This report summarizes the DEP's actions taken to implement the Act from January 1st through December 30th 2005. A copy of the Act can be found in Appendix A.

Major Tasks

The Act addresses water use in West Virginia, and focuses on three major tasks: 1) preparation and implementation of a survey of persons who withdraw and/or consume more than 750,000 gallons of water in any calendar month for the calendar years 2003, 2004, or 2005; 2) preparation of a final report, due December 31, 2006, that must address nine major topics related to water use, including recommendations from the DEP for additional actions that should be taken to implement a water quantity management strategy, if needed; and 3) implementation of a registration program for large water users beginning in 2006.

Data Collection

The questions posed in the WRPA may only be answered with accurate and complete data. During 2005, the DEP concentrated on acquiring the requisite data from other state and federal agencies, and with the 2003-2004 Water Use Survey. The DEP expended a large number of personnel hours to contact or otherwise determine which of the original 1,600 facilities were subject to the requirement to complete the survey. In addition, a significant amount of time was expended by the DEP to convert data from the Department of Health's Sanitary Surveys into an electronic format. Data was also collected from the United States Geological Survey, the Ohio Department of Natural Resources, and the West Virginia Department of Agriculture.

West Virginia University and Marshall University

West Virginia University (WVU) and Marshall University (MU) were specifically authorized to enter into interagency agreements with DEP to assist with implementation of the Act. During 2005, a Memorandum of Understanding (MOU) was executed between the DEP, MU, and WVU. The MOU specifically includes the MU Center for Environmental, Geotechnical and Applied Science (CEGAS), and WVU's West Virginia Water Research Institute (WRI). Though not specifically mentioned in the MOU, additional assistance has been supplied by MU's Center for Business and Economic Research (CBER) and the Nick J. Rahall, II Appalachian Transportation Institute (RTI).

West Virginia University has assisted in preparation of the following report sections: Historic and Current Conditions That Indicate Low Flow and Flood/Drought Conditions, An

Evaluation of Current or Potential In-Stream or Off-Stream Uses that Contribute to or are Likely to Exacerbate Natural Flow Conditions to the Detriment of the Water Source, and Practices to Reduce Water Withdrawals.

Marshall University has assisted in preparation of the report section on Potential Growth Areas Where Competition for Water Resources May Be Expected, assisted with GIS mapping of the data, and provided the technical assistance for a "data warehouse" to be housed at the RTI.

Findings

Each of the authors of this report, the DEP, WVU and MU, have discovered data deficiencies that will preclude a complete answer for the majority of the major elements of the final report. In addition, insufficient time has elapsed to adequately evaluate the Water Use Survey data for 2003 – 2004, and the 2005 Water Use Survey has not been released. Therefore, the results presented in this report represent only preliminary and partial findings, and should not be interpreted in any other context.

The remainder of this report will examine the nine major report elements in detail. The report will not provide definite answers to the original WRPA report elements, but will evaluate the existing data, detail deficiencies in the data, and recommend actions for the coming year for the Legislature's consideration.

Some activities that were not envisioned in the original act that are essential to the successful completion of the DEP's Legislative Mandate will be discussed. These include establishment of the data warehouse, and promulgation of the Procedural Rule "Administrative Procedures and Civil Administrative Penalty Assessment – Water Resources Protection Act", and the Interpretive Rule "Confidential Information Under Water Resources Protection Act".

Chapter 1 - Location and Quantity of All Surface and Groundwater Resources

1.1 Surface Water Resources

West Virginia has been blessed with an abundance of rivers and streams. These rivers and streams have been designated by the state for a variety of uses, including fish and wildlife propagation, recreation, transportation, drinking, agriculture, and industry.

Table 1 is an atlas of West Virginia surface water resources. According to the National Hydrography Dataset (NHD), which is the most accurate coverage of West Virginia streams, the state contains approximately 52,500 unique streams that total approximately 55,400 miles. A breakdown of stream statistics by major watershed is provided in Appendix B.

Table 1. West Virginia Surface Water Resource Atlas

Number of major watersheds	32
Number of uniquely named streams (approx.)	8,700
Number of unnamed streams (approx.)	43,800
Miles of uniquely named streams (approx.)	28,200
Miles of unnamed streams (approx.)	27,200
Number of border stream miles	619
Number of lakes/reservoirs/ponds (publicly-owned)	104
Number of lakes/reservoirs/ponds (privately-owned)	358
Acres of lakes/reservoirs/ponds (publicly-owned)	17,474
Acres of lakes/reservoirs/ponds (privately-owned)	8,092

According to the DEP's Dam Safety Office, the state contains 104 public lakes that total 17,474 acres. In addition, the state contains 358 private lakes that total 8092 acres. The current inventory of lakes is provided in Appendix C. The Dam Safety Office has location data (latitude/longitude) for the dam site at each lake, however, much of the data is old and inaccurate. The Office is in the process of updating the dam locations with coordinates that are more accurate. The new information will be available early in 2006.

Although estimating absolute stream volume is not feasible, data exists for flow rates at various gauging stations on many of the state's larger streams. The flow rate data will enable DEP to answer many of the questions posed by the Water Resources Protection Act. The location of active USGS gauging stations is shown in Figure 1.

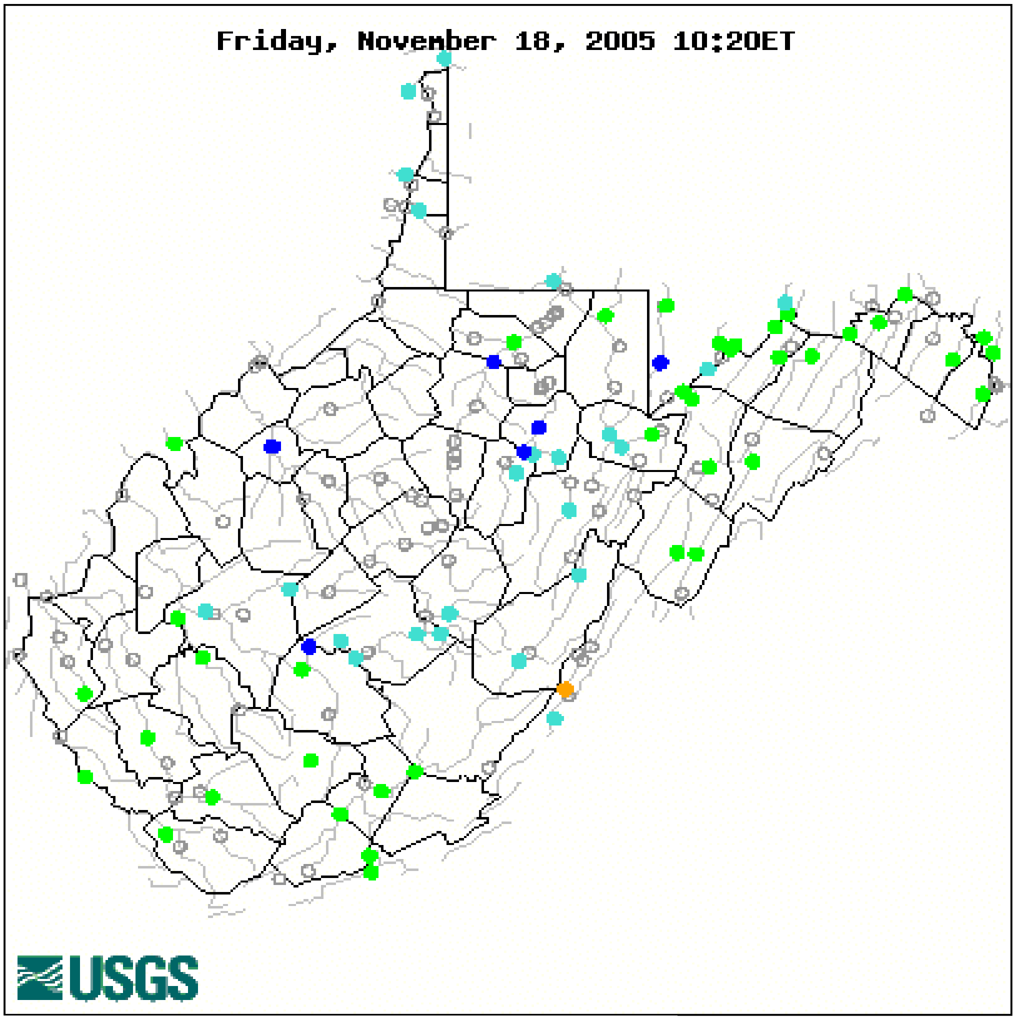


Figure 1. West Virginia Stream Flow Gauging Stations

There are 124 active stream flow-gauging stations in the state. A breakdown of the gauging stations by watershed is provided in Appendix D. These stations automatically record flow data at a given point on the stream. Instantaneous real-time flow data can be obtained by visiting the USGS web site: http://wv.usgs.gov/wrt/. Various flow statistics are calculated for each station, and these can be obtained on the web site. An example of the type of flow data from the web site is given in Table 2. Data are available for the entire period of record at each site, which in some instances spans more than 50 years.

Table 2. Average Annual Streamflow for Potomac River @ Hancock Maryland

1933-2003							
Year	**Annual mean Streamflow, in gal/s**	**Year**	**Annual mean Streamflow, in gal/s**	**Year**	**Annual mean Streamflow, in gal/s**	**Year**	**Annual mean Streamflow, in gal/s**
1933	34,991	**1951**	35,754	**1969**	13,898	**1987**	30,219
1934	17,787	**1952**	35,769	**1970**	33,488	**1988**	24,781
1935	32,022	**1953**	29,643	**1971**	38,978	**1989**	34,991
1936	44,611	**1954**	24,953	**1972**	56,654	**1990**	27,661
1937	45,291	**1955**	32,703	**1973**	40,242	**1991**	24,856
1938	18,117	**1956**	30,339	**1974**	29,972	**1992**	23,899
1939	29,583	**1957**	25,604	**1975**	42,651	**1993**	40,414
1940	32,396	**1958**	28,865	**1976**	30,907	**1994**	43,160
1941	18,880	**1959**	19,426	**1977**	25,148	**1995**	24,243
1942	36,667	**1960**	29,853	**1978**	38,896	**1996**	68,075
1943	27,586	**1961**	33,204	**1979**	50,550	**1997**	27,295
1944	28,701	**1962**	29,434	**1980**	31,790	**1998**	41,783
1945	32,149	**1963**	24,467	**1981**	22,934	**1999**	17,024
1946	23,106	**1964**	26,614	**1982**	30,930	**2000**	20,480
1947	16,531	**1965**	24,706	**1983**	35,231	**2001**	21,221
1948	34,827	**1966**	21,550	**1984**	40,699	**2002**	24,101
1949	34,909	**1967**	32,875	**1985**	38,821	**2003**	61,560
1950	35,044	**1968**	25,649	**1986**	25,469		

Flow data exists for many stream sites in West Virginia; however, most streams are unmonitored. USGS is currently working on a stream flow model that will be able to predict the flow rate at any point on any stream in West Virginia. This model will be able to predict both low flow (7Q10) and median flow statistics. One of the purposes of the model is to quantify water availability so that water resources can be more effectively managed. This valuable research will be completed in 2007.

As previously noted, the absolute volume of water cannot be calculated for streams. However, it can be calculated with a fair degree of accuracy for lakes. According to the DEP Dam Safety Office, West Virginia lakes (both public and private) contain 885,630 acre-feet (289.6 billion gallons) of water at normal pool levels.

1.1.1 Surface Water Recommendations

There are areas of the state where stream gauges have either not been installed, or have become inactive for lack of funding for operation and maintenance (O&M). The USGS has selected six gauging sites it considers essential to complete gaps in its existing network to provide information on water use. The sites are listed in Table 3, along with installation costs and yearly O&M costs. The DEP recommends funding for these sites.

Table 3. USGS Recommended Stream Gauging Stations

Site Name	Yearly O&M Cost	Construction & Instrumentation
Middle Island Creek	$13,500	$25,000
Fishing Creek near New Martinsville	$13,500	$25,000
Kings Creek at Weirton	$13,500	Existing gauge scheduled for removal
Cacapon River above Wardensville	$13,500	$25,000
Pocatalico River at Sissonville	$13,500	Flood warning gauge to be built by WVDHSEM
Mud River near Milton	$13,500	$25,000

1.2 Ground Water

West Virginia is heavily dependent on ground water, especially in rural areas. Data on the ground water resource has been collected for a number of years by the Department of Health and Human Resources in the form of yearly withdrawal data and Sanitary Surveys. The USGS published a ground water atlas by watershed between 1980 and 1985. The USGS has located and maintained as many as eleven ground water level monitoring wells. Although some have records dating from the mid 1970's, several were only established after 2000.

To fully identify and quantify the ground water resources of the state, the aquifers must be identified, mapped, and tested. Data on the aerial distribution, thickness, fractures, yield rates, and lithology of the aquifers would be required.

This data has never been acquired. Although the Department of Health has years of water withdrawal data, the aquifers have not been mapped, and potential maximum withdrawal rates have not been studied. The Sanitary Surveys are predominately aimed at protecting human health, and were never designed to supply detailed aquifer data. The Sanitary Surveys do contain some data on the aquifers from which the water is withdrawn, but it is inconsistently collected and test methods have not been standardized. Water elevations have not been consistently recorded.

The USGS water level monitoring wells are too sparsely distributed to be of use in developing a statewide understanding of the groundwater resource (Figure 2). In Federal Fiscal Year 2006, USGS will lose funding for all but three of their ground water level monitoring wells.

The Interstate Commission on the Potomac River Basin (ICPRB) acquired funding to drill two ground water level monitoring wells in the eastern panhandle. However, the funding was not continued, and these wells have never been equipped with gauges or telemetry equipment (Figure 2).

The 2003-2004 Water Use Survey did not provide much information on aquifers. Only 14 respondents, mostly coal companies, were able to complete the information for formation name and lithology type.

1.2.1 Ground Water Recommendations

Data has been amassed from various sources regarding the groundwater resource. At this time, the DEP has not fully analyzed the existing data. Preliminary analysis has revealed many shortfalls in the type of data collected. Therefore, the DEP does not believe it can make valid final recommendations to the Legislature. However, an immediate concern is to continue funding the water depth monitoring well network established by the USGS and the ICPRB. There are nine existing wells that could, with adequate funding, still supply water level information (Figure 2).

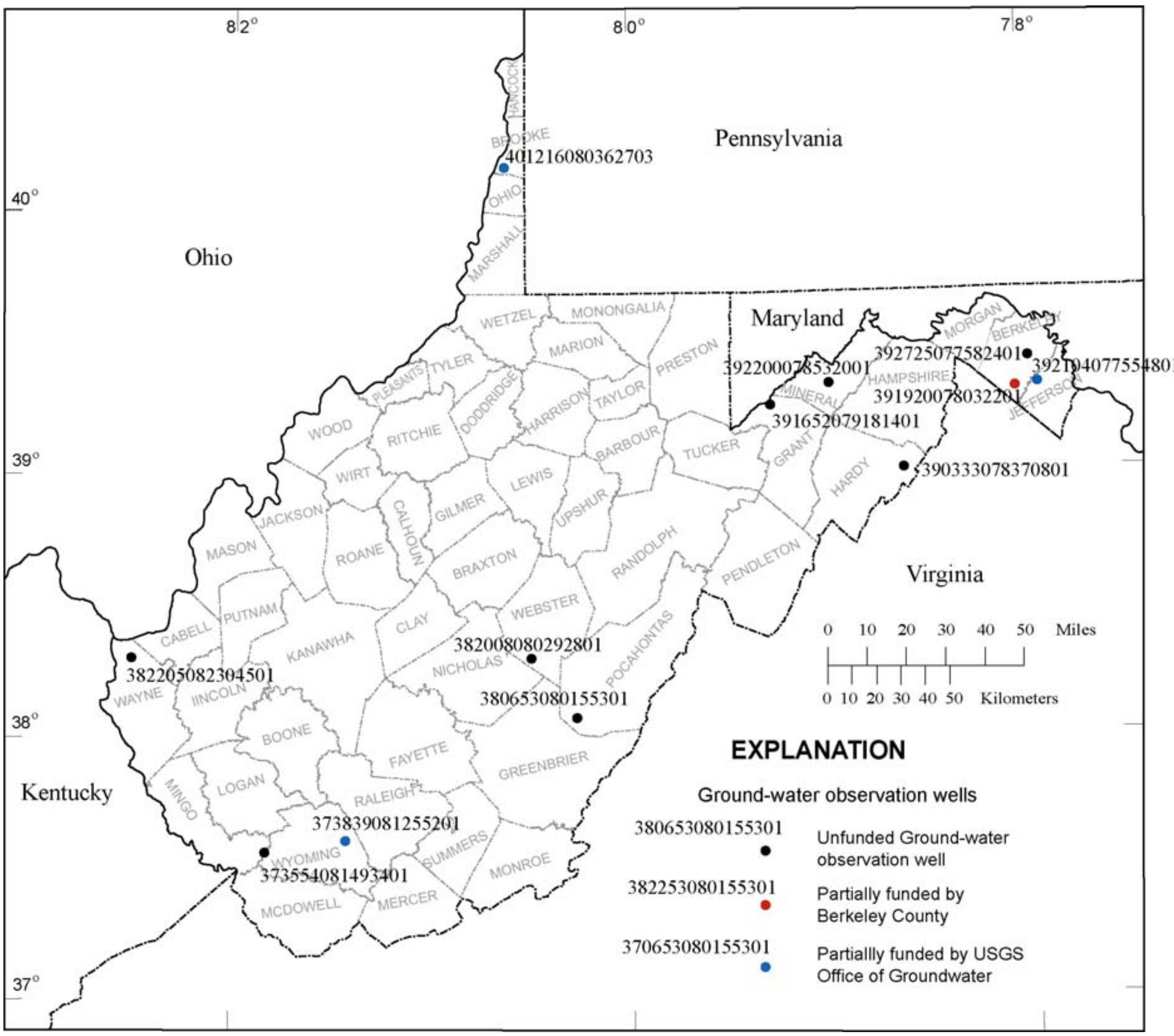


Figure 2. USGS Ground Water Level Monitoring Wells

The ICPRB wells could be equipped with gauges and telemetry radios for approximately $4,600 each, for a total one time expense of $9,200. Annual operating expenses are approximately $4,000 per well. A yearly expenditure of $36,000 would provide for the operation of the seven USGS and two ICPRB wells that will be unfunded in the coming federal fiscal year.

Although data from these wells will not result in a complete understanding of the ground water resources of the state, it is essential for any future understanding of this important state resource. If the data from this year is not collected, it will not be possible to capture it in the future. Funding for the continued operation of these wells beyond fiscal year 2006 is recommended.

Chapter 2 - Consumptive and Non-consumptive Withdrawals

As per the Act, consumptive use is defined as any withdrawal of water that returns less water to the water body than is withdrawn. With this in mind, the DEP designed the survey to ask users from where they withdrew their water, including: latitude and longitude; stream, river, lake, or spring name; county; and well information. Details were also requested regarding discharge information, specifically: wastewater treatment facility, stream, underground injection well/septic system, private reservoir, lake, and other. In each of those categories, the respondent had to give the latitude and longitude, county, name or description of discharge point, and permit number (if applicable). Water providers were asked to provide the zip codes for the areas in which they distribute water.

2.1 Deficiencies

Upon review and preliminary mapping of the data, it became apparent that not all participants gave all of the requested information, had duplicate information, or inadvertently gave inaccurate data. For example, it became apparent during the mapping phase, that while efforts were made to eliminate inaccurate latitude and longitude data by making sure the data given was inside the West Virginia quadrant, some data points were plotted outside of the state. It was also noted during our discussions with facilities prior to survey development and during our training sessions, that very few industries meter their intakes or discharges. In an effort to ensure accurate data, the DEP requested a description and explanation of how the facilities estimated their withdrawal if it was not metered. During these discussions, it was noted that lack of metering would make it nearly impossible to account for any storm water that enters their systems. With stormwater entering the system, some facilities may show a negative net discharge, giving the appearance of discharging more water than was withdrawn. This will create problems in calculating consumptive use.

The DEP will make an effort to contact facilities with data for which it has questions and will give all facilities the opportunity to amend or correct data from 2003 and 2004 on the 2005 survey. The DEP also made changes in the survey as discussed in Chapter 3 to help facilities provide the most accurate data possible.

Chapter 3 - Survey Results for the Years 2003 and 2004

The DEP began its initial design of a survey/registration form based on a review of forms and registration programs from other states and input from the USGS and WVGES. Both WVGES and USGS have previously published survey reports on water use for West Virginia. Cooperative agreements with both agencies regarding work needed for implementation of various aspects of the Act were executed.

The WVGES had considerable input into the reports authored by the USGS on water use in West Virginia. The DEP executed a contract with WVGES for $10,000 for assistance with developing the survey and interpreting the survey results.

3.1 Large Water User Determination

The USGS and DEP entered into a cooperative cost sharing agreement to provide estimates of water use by businesses in the state and assist with other aspects of preparation of the final report. The DEP contributed $93,000 and USGS provided $76,500 in matching funds (Total: $169,500) for project funding. The first deliverable was for water use estimates for businesses in the state. The DEP used these estimates to identify persons who may have been required to complete the survey.

The water use estimates prepared by the USGS are calculated using SIC and NAICS codes to determine the type of business, the number of employees at the facility, and a water use coefficient derived from prior research. The required data for each facility was obtained from the Harris Survey, a marketing research tool developed by Harris Interactive, Inc. The estimate is for average water use throughout the year, not the maximum water use during any particular month. Therefore, when determining which businesses should complete the survey, the DEP contacted businesses that may have exceeded 750,000 gallons during any month of the year.

The Harris Survey listed 6,875 businesses in West Virginia. Preliminary estimates indicated that 807 facilities might have water use above 750,000 gallons in any given month. Water use estimates for an additional 170 facilities could not be calculated because water use coefficients have not been determined for their particular SIC code. Use of alternate water use coefficients resulted in another 100 to 200 facilities being classified as large quantity users. Therefore, the total number of large quantity water users in the state, based on the Harris Survey, was as high as 1,200. The USGS information did not distinguish between which businesses withdrew from waters of the state and which purchased their water. The DEP had to contact all of the businesses to determine that information.

Although the Harris Survey does not list every business in West Virginia (estimated at 40,000), DEP believes that the USGS estimates have captured most of the large quantity users in the state.

The DEP also contacted the WV Bureau for Public Health (BPH) to gather data on public water suppliers that exceeded the 750,000-gallon withdrawal threshold during any month of 2003 or 2004. The DEP was able to obtain records that showed 268 water supply facilities in WV exceeded the 750,000-gallon reporting requirement.

3.2 Survey Testing and Notification

Shortly after reviewing other states' water use program requirements, and meeting with various state agencies, the DEP began developing the Internet-based survey form. The form, and its associated Oracle database, was alpha tested beginning on November 22, 2004. The Survey was presented to Appalachian Electric Power (AEP), Arch Coal and West Virginia American Water for beta testing on December 10, 2004. The target date for completion of the beta 1 test was January 21, 2005. Based on the results of beta 1, the DEP made modifications to the survey and released it to the testers for a beta 2 test. The end of beta 2 was February 28, 2005. The survey was then released to the public on March 31, 2005 with a deadline of July 1, 2005 for submission.

In an effort to notify the large quantity users about the survey, the DEP issued 1600 postcards that provided the web address of the survey, contact information, and the survey deadline. These were mailed prior to the survey release and again in mid-May as a reminder to complete the survey. The DEP's Public Information Office issued several press releases via its email contact list. The following organizations also sent email messages to their contact lists reminding them of the necessity to complete the survey or contact the DEP if they were ineligible: WV Chamber of Commerce, WV Rural Water Association, and WV Coal Association. In a related effort to offer the public the opportunity to ask questions and receive training on completing the survey, the DEP held training at the following locations: Charleston, Wheeling, Morgantown, Martinsburg, Beckley, and Parkersburg. Due to the complexities of water use by mining industries, the WV Coal Association requested additional training sessions for their members and these were held in Flatwoods and Logan.

3.3 Preliminary Survey Results

Of the 1600 facilities that were notified, 383 submitted a survey and 381 notified DEP that they were exempt from completing the survey since they were either purchasing water or withdrew less than 750,000 gallons in any given month. A list of survey respondents may be found in Appendix F. The DEP requested a written statement from these facilities explaining why they were claiming an exemption. In an effort to pare down the approximately 800 non-responders, the DEP contacted WV American Water Company and requested they review the list and identify any that purchased water from their facilities. This eliminated 200 facilities from the non-responder list. The remaining 600 non-responders were notified by letter to either complete the survey or, if exempt, return the pre-paid postcard by November 15, 2005. The postcard requested the facilities to indicate whether they purchased water and list the provider, or indicate they withdrew less than 750,000 gallons in any month and list their maximum monthly usage. All but 60 responded to the letter notification. The DEP is attempting to determine the status of the remaining 60 non-responders via telephone.

Preliminary results from the 2003/2004 survey (consumptive and non-consumptive uses) are:

1. Total average yearly water withdrawal: 3.54 trillion gallons

2. Total average percentage of water from ground water: 0.9%

3. For public water suppliers:

    a. Average yearly surface water withdrawal: 41.68 billion gallons
    b. Average yearly ground water withdrawal: 15.61 billion gallons
    c. Public water supply percentage from ground water: 27.3%
    d. Public water supply percentage from surface water: 72.7%

4. For industrial users:

    a. Average yearly surface water withdrawal: 3.47 trillion gallons
    b. Average yearly ground water withdrawal: 16.37 billion gallons
    c. Industrial percentage from ground water: 0.47%
    d. Industrial percentage from surface water: 99.53%

In preparation for collecting data for 2005, the DEP made several modifications to the survey and made an effort to include a wider spectrum of beta testers. Two additional facilities that had some technical difficulty in completing the first survey were asked to participate. Beta testers for the 2005 survey are Arch Coal, AEP, WV American Water, Union Williams Public Service District (PSD), and Bright Industries. Beta testing began November 4, 2005. The 2005 survey's anticipated release is early January 2006.

3.4 Deficiencies

It has been noted that not all of the facilities provided all requested information. Some of the survey respondents did not provide latitude, longitude, or county information to enable us to map their facility. Some information given misclassified the type of facility the respondents represented. For example, a water provider was showing up in the data as an industrial facility. Another issue is few facilities meter their water intake. Some of the facilities accidentally saved multiple screens of the same data. It is accepted that the data will be an estimate based on the facility's best judgment of the amount of water needed in their system. As a result of these issues, the DEP is preparing to review all of the data manually to assure the validity of the information, prior to drawing any conclusions.

The DEP, with assistance from USGS, has done its best to identify all potential large water users. However, there is no way to verify 100 percent success in this effort.

3.5 Conclusions

Based upon lessons learned from the first survey and suggestions by the users, the DEP made changes to the upcoming survey with the intention of eliminating some of the problems. The following changes were made:

- Ability to delete unwanted screens
- Commas can be inputted in data screens
- All information is available from the previous survey for updating and correction. Links to pages remain the same and visible to access.
- Ability to name all data screens rather than having random numbers assigned. (i.e. If you had a groundwater link number 613 assigned to your intake point, click on 613 and your previous data is available along with the ability to name the groundwater point east well 1)
- Inability to submit the survey without latitude and longitude being given.

A copy of the 2005 Survey can be found in Appendix E.

Chapter 4 - Drought, Flood, and Low Flow Conditions

- Water Research Institute of West Virginia University

Flooding

The Water Resource Protection Act research elements related to flooding entail the identification and mapping of historically flood-prone areas of the state, the anthropogenic factors exacerbating flood conditions, and areas in which high flows negatively affect beneficial uses.

Floods are seemingly easy events to define and identify. In West Virginia, however, no uniform and accepted definition exists to facilitate event tracking, thus complicating attempts to evaluate flooding events and trends in the state. Floods can be defined as when flow exceeds bankfull, when flows expand beyond 100-year flood plains, or when flows begin to threaten human safety and property. As well, flooding varies by frequency, severity, and economic impact. Additional complexities include the differences between natural flood patterns, flash flooding, and human-exacerbated flood flows (e.g. sedimentation, inappropriate land use practices), and human-exacerbated flood damages (e.g. inappropriate and uninsured development in floodplain).

The State of West Virginia has funded significant research on flooding over the past few years. The Flood Advisory Technical Taskforce Report, the State Flood Plan, and the State All-Hazards Plan are key resources for analysis of flooding in West Virginia. These reports provide the foundation for flood analysis requested in the Act.

Three findings stand out among the others in this section. The first is that one-time-event driven research projects will continue to produce incomplete and potentially misleading findings until more resources are invested in expanding and maintaining our state's water monitoring infrastructure so that trends, anomalies, and problem areas can be evaluated within historical context. Streamflow data are monitored and recorded in 50 of the state's 159 watersheds (10 digit HUCs), and in only 31of the state's 55 counties.

The second important finding is that the US Army Corps of Engineers (USACE) Statewide Flood Report and the State All-Hazards Mitigation Plan both comprehensively address the flood-related research questions outlined in the Water Resource Protection Act (taking into consideration the stream flow data). This report references those findings and adds some new information, but the original reports should be referenced for more complete flooding information, specifically relative to "Conditions that exacerbate flooding."

Finally, framing the question around "impacts on beneficial use" was important. However, this aspect of the question can only be addressed generally. To address these issues in a detailed manner, they must be evaluated on a watershed basis, which would require significant local participation and feedback at the information gathering stages.

4.1 Conditions That Indicate Where Flooding has or is Likely to Occur

This section presents four approaches to identifying and mapping areas where flooding has or is likely to occur. These are as follow: 1) identify existing flood monitoring data; 2) identify indirect indicators of flood events (insurance damages); 3) conduct statistical analysis on historical stream flow data; 4) model land and stream characteristics that are likely to contribute to flood events. The four approaches are used because of the paucity of direct flood monitoring data and lack of a consistent definition of flooding.

4.1.1 Direct Flood Monitoring Data

West Virginia monitors the threat of flooding in the state on a real-time basis based on precipitation (iFLOWS program) but invests little in maintaining flood records after the immediate threat at hand disappears. The State Office of Emergency Services and the National Climate Data Center are two agencies that maintain a historical record of flooding in the state (Figures 3 and 4).

Unfortunately, each agency has different criteria and methodology for measuring flooding and, therefore, analysis of their data indicates contradictory flood-prone areas as well as dramatically different perspectives on flooding frequency. OES data are based on official emergency declarations, while NCDC data reflects a variety of sources including staff observations, citizen phone calls, and newspaper clippings. OES floods are limited to the most severe cases that warranted FEMA intervention. In determining areas that are "flood-prone," however, based on the Figures 3 and 4, there appears to be a difference between areas that are prone to frequent floods (NCDC, Figure 4) and areas that are prone to severe floods (OES, Figure 3).

NCDC also provides the state's only historical record of flash flooding in the state (Figure 5). This is not necessarily an accurate representation of actual flash flooding events. A quick glance of the low estimated number of flash floods over the past 10 years, particularly in southern counties such as Mingo, Wyoming, and McDowell warrant concern over the meaningfulness of these numbers. Flash flooding numbers are based in part on predictions of heavy rainfall that generate flash flood warnings. These warnings are then noted as actual events if newspapers or citizen/employee calls verify that flash flooding did occur in the county.

The rate of flash flood verifications to flash flood events is not uniform across all counties. As a result, the total numbers by county are erroneous, as are the indicators of relative flash flooding problems among different regions of the state. Finally, because these numbers have only been tracked for ten years, it is not possible to identify trends such as increased or decreased flooding in watersheds or counties.

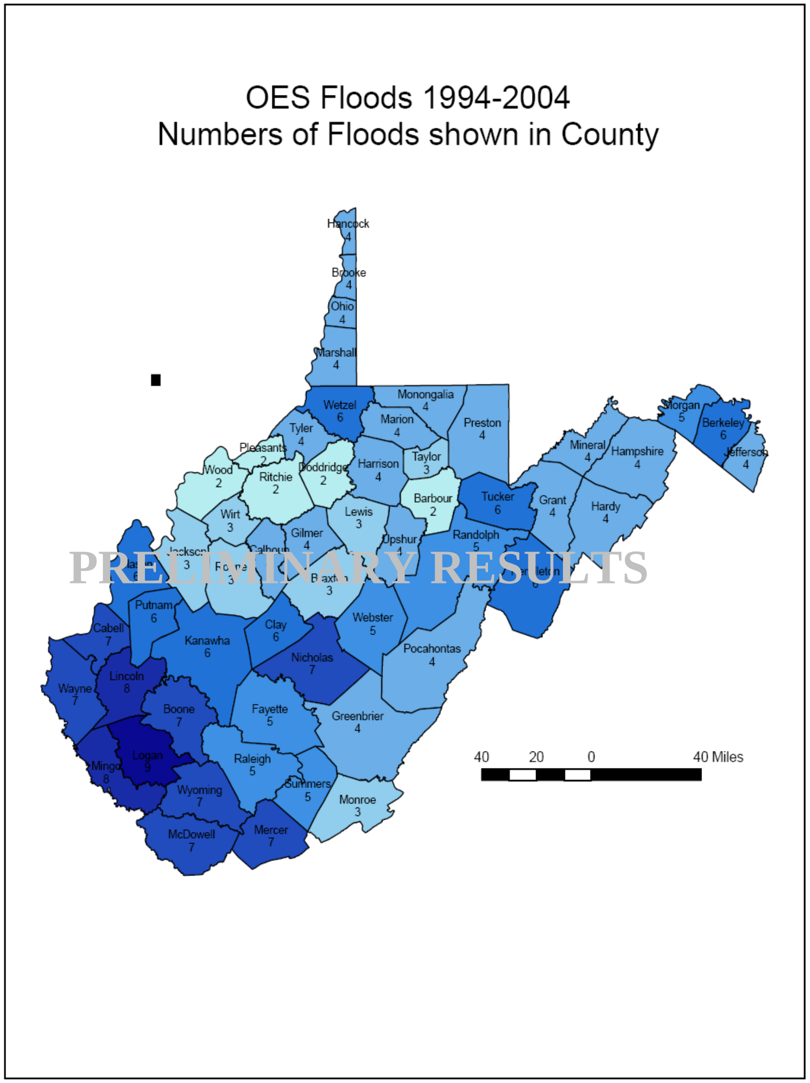


Figure 3. Floods 1994-2004, OES

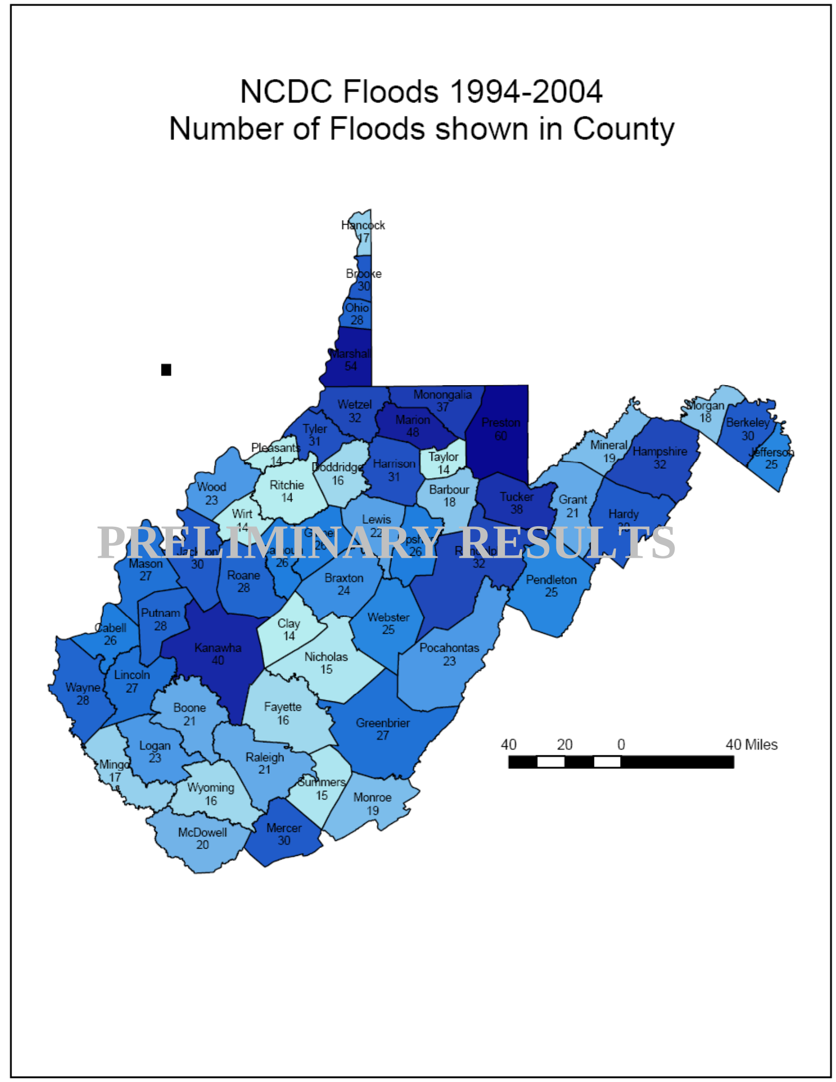


Figure 4. Floods 1994-2004, NCDC

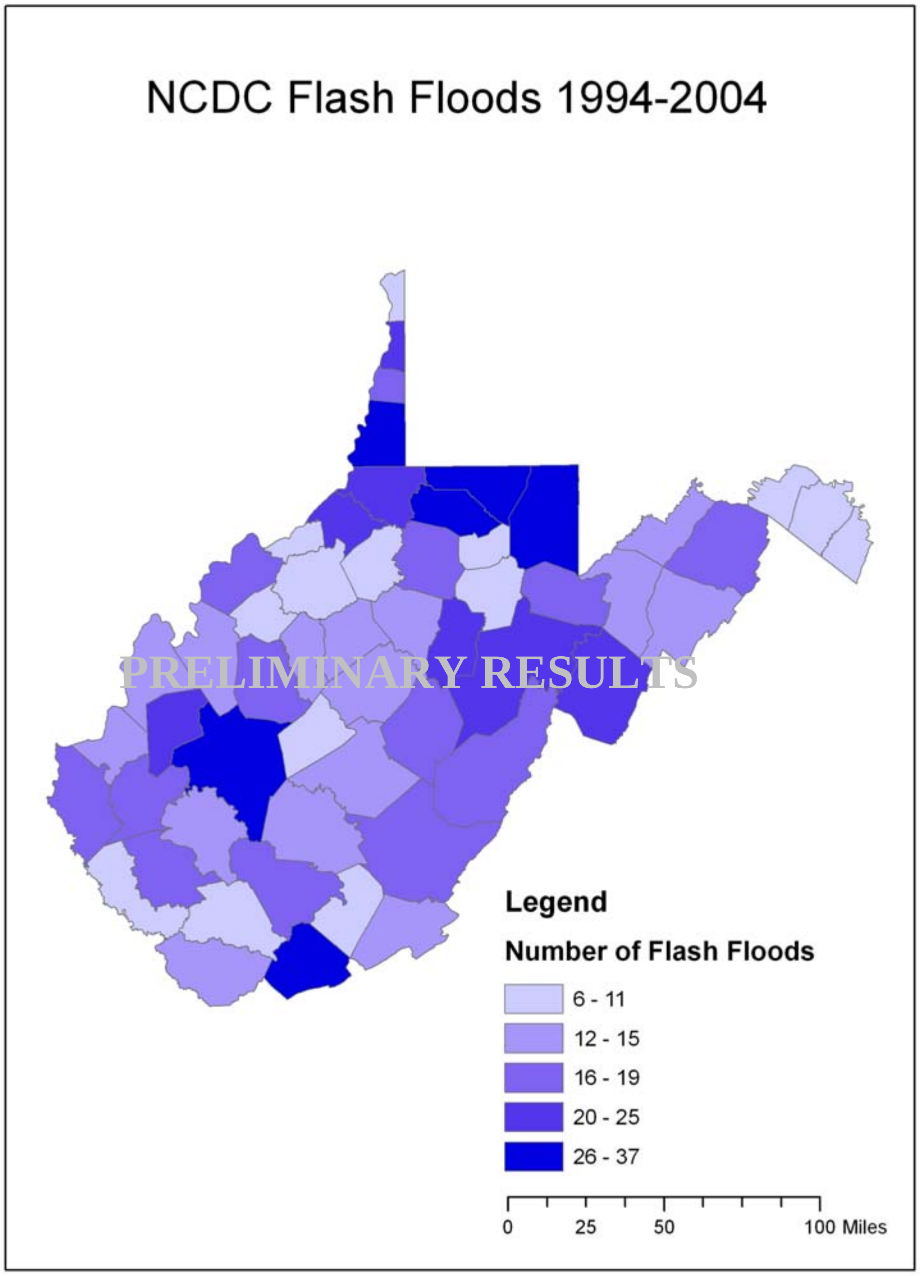


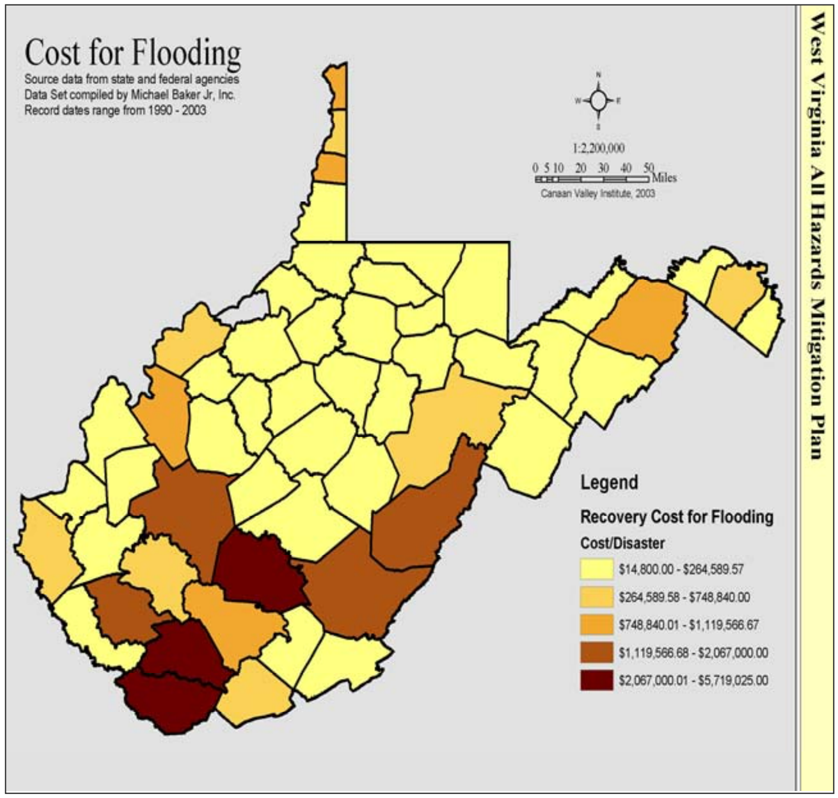
Figure 5. Flash Floods 1994-2004, NCDC

4.1.2 Indirect Flood Monitoring Data

One approach to measuring the incidence of flooding and, in particular, economic impacts of flood events is to evaluate the costs of flood damages. The State All-Hazards Report used this approach by evaluating National Flood Insurance Program (NFIP) payment trends. The maps in Figure 6 illustrate relative scale of payments as well as recurrence rates of claims.

The cost estimates reflect only damage to properties insured by the NFIP. As a result, the distribution of claims and damages paid by this program reflects the distribution of flooding in the state skewed by the uneven distribution of NFIP coverage. According to the OES, NFIP coverage rates of floodplain structures range from 10-90% across the state (mean coverage is only 34% per county).

For the final report, pending data availability, we would like to include a map that illustrates NFIP coverage rates relative to number of floodplain structures. This would help to identify some of the insurance coverage disparity biases across counties that now appear to be flood cost differences.



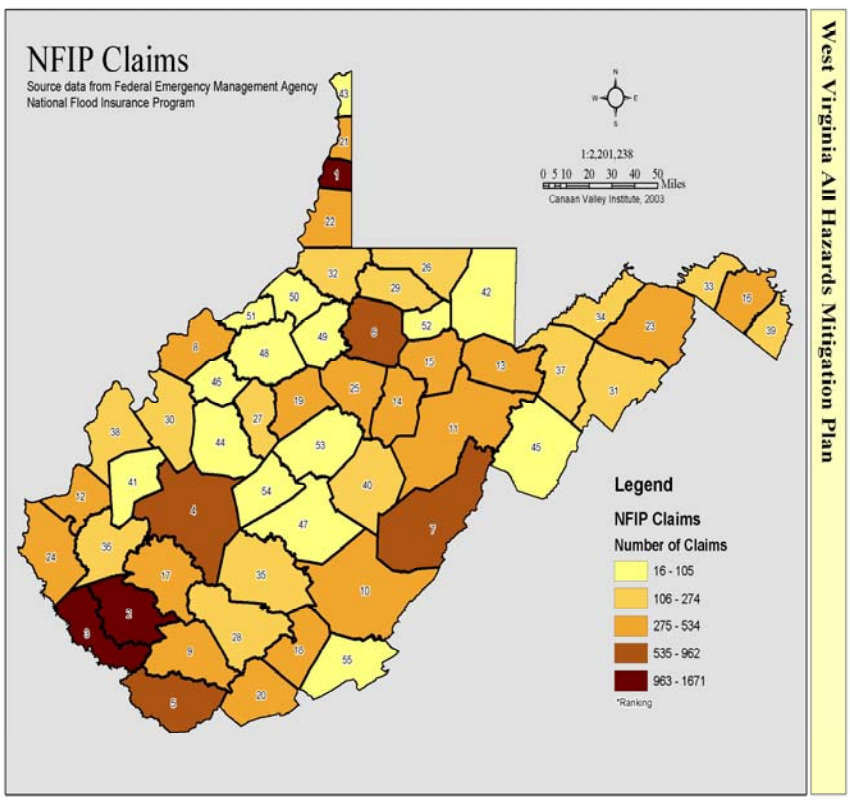


Figure 6. National Flood Insurance Program Payments, 1990-2003

4.1.3 Statistical Analysis of Stream Flows

It is reasonable to imagine that streamflow gauges would be good indicators of flood events. Flows on ungauged low order stream (smaller streams) cannot reliably be linked to gauged flows on higher order streams (larger rivers). While the USGS is working to develop a methodology to link small stream flows to monitored behavior on high order gauged streams, the model accuracy will be limited by lack of land use data in many areas. Furthermore, the model may be successful at detecting regular floods on low-order streams but will not likely be able to detect tributary flash flooding. Detecting unreported flash floods through data collection stations, given the paucity of stream gauge stations and limited historical detailed meteorological data, will be challenging well into the future. For the short term, attention can be directed to improving the methodology of collecting and tracking flood and flash flood reports to the NCDC.

Aforementioned limitations considered, stream gauge analysis was conducted on all gauges with at least 30 years of data in the state (where watersheds crossed state boundaries and there were no gauges in WV, gauges were used from neighboring states). These data were compared with the period of record available for each gauge to determine the statistical 5, 10, 50, and 100-year flood flows and the frequency of their occurrences over the past 30 years. The maps below (Figure 7) indicate relative flooding frequencies among different gauges for two of the calculated levels of flood severity (percent time in a 10-50 year flood and percent time in >100 year flood).

Information in the maps of Figures 7 and 8 should be interpreted with caution. Gauge station flow analysis **cannot** be extrapolated to indicate flooding trends by watershed or county because of the problems with relating gauged and ungauged streamflow behavior within a watershed (described above). Furthermore, the interpretive value of these maps is limited due to extensive gauge funding cuts in 1994. Many gauges were taken off-line in 1995, so analysis was conducted on those gauges with a 30-year period from 1964-1994. As a result, no 100-year or greater floods appear to have occurred in Wyoming County over the past 30 years according the maps in Figure 7. Yet, the county suffered two greater than 100-year floods since 2000. Watersheds that currently have real time or “on-line” flow monitoring gauges are shown in Figure 9.

The final approach to gauge data collection as an indicator of flooding was to combine National Weather Service (NWS) flood stage (height) estimates with USGS flow data by using ratings tables (flow to height conversion equations). Flood heights have been established by NWS agents’ trips to each gauge station in which they identified a local flood stage based on community input regarding the flow height at which floodwaters would begin to cause a threat to lives or property. Using USGS ratings curves, we determined what flow would raise the river to the NWS flood stage. Then, using historical USGS flow data; we produced a statistical analysis of historical flow data to determine the flood stage recurrence interval (how often flows would reach flood stage heights).

The results are mapped in Figure 8. There are clearly problems with the inputs to this analysis since some gauges appear to experience flood stage exceedence every year or two while others have recurrence intervals that indicate thousands of years between floods.

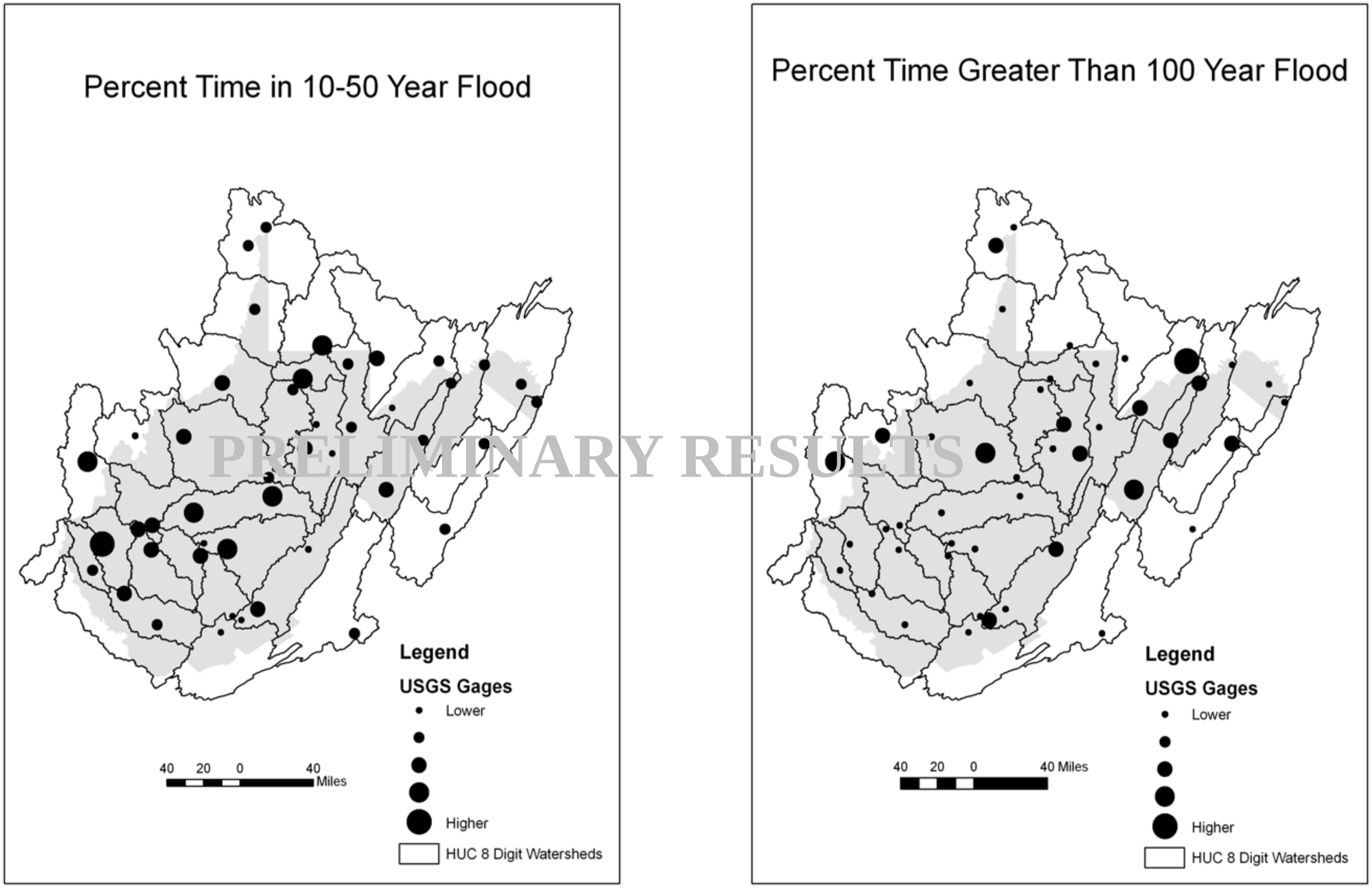


Figure 7. Relative Indicator of Flood Frequencies among Relevant Gauge Stations, 1965-1994

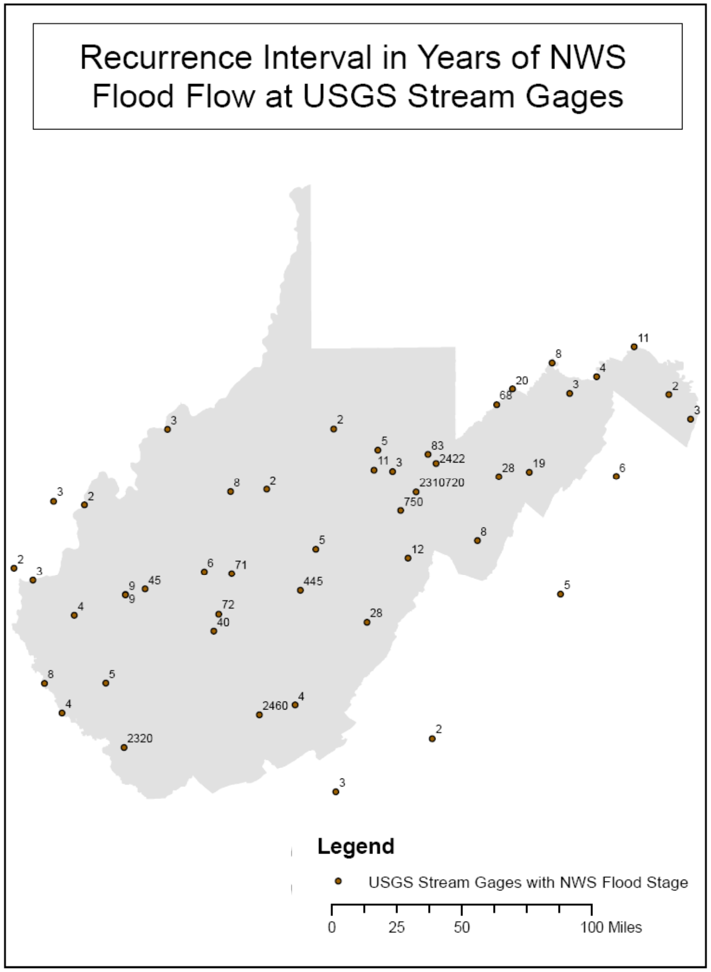


Figure 8. Recurrence Intervals for NWS-Defined Floods

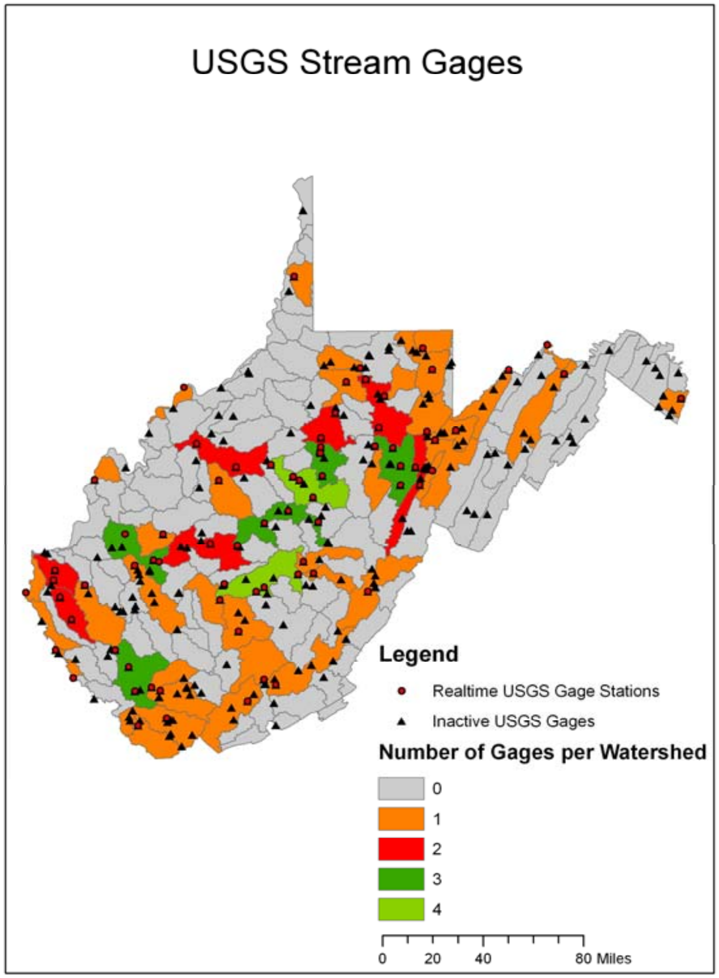


Figure 9. Watersheds with Active USGS Stream gauges

Without making site visits to and analyses of each gauge station, it is not possible to determine whether data inaccuracies lie with the stage heights recorded or with the rating curves provided by the USGS.

4.1.4 Modeled Flooding Risk Factors

The Water Research Institute is working to model flood vulnerability by watershed at the 10-digit HUC level. The model will integrate flood-related factors such as the following:

- Slope/Topography
- Land use/imperviousness
- Stream sinuosity/Vegetative cover
- Soil type
- Storage capacity/wetlands
- Watershed area

The Institute anticipates completing this map in early 2006. While data quality constraints may limit the reliability of the map generated, development of the model will be important for future efforts, anticipating improved state data collection efforts.

4.2 Factors that Exacerbate Flooding

As noted earlier, a great deal of state-funded work has recently been completed in West Virginia on flooding. The "West Virginia Statewide Flood Report" was written by a Task Force of experts from various State and Federal agencies responding to the governor's call to address the increasing number of devastating floods in the State. The Report notes that flooding has affected all 32 major watersheds and all 55 counties of West Virginia. USGS work on flood trends, valley fill impacts, and the Flood Advisory Task Force report are additional important and publicly funded reports that address flood issues in the state. Findings from these reports will be summarized for the bulk of our response to this task in the final report.

Specific topic areas to be raised in the final report will include:

- Precipitation and Runoff
- Floodplain Development
- Resource Extraction (mining, timbering, natural gas exploration, etc.)
- Valley Fill
- Mine Subsidence and "Blowouts"
- Water Transfers
- Dams
- Channel Restrictions
- Insufficient Flood Prevention

Drought

The purpose of drought analysis is to a) determine areas where historical drought and low-flow conditions have threatened beneficial uses of water and b) map drought-prone areas of the state.

The same complexities make flood events difficult to define and map also plague the issues of drought and low flow. Many of these complexities are discussed in section 4.1. The variety of drought definitions introduces some of the variety of factors at play in drought analysis.

Four drought definitions are often used to discern various sources and effects: meteorological, hydrological, agricultural, and socioeconomic (Table 4). With the exception of meteorological drought, differentiating between natural and anthropogenic causes of water scarcity is difficult to impossible. Consumptive resource use, interbasin transfers, and land use change are among many factors that can exacerbate dry meteorological conditions and cause supply-demand imbalance.

Droughts affect people, the economy, and the environment differently depending on the event's stage, severity, timing, and spatial impact. Agricultural productivity is affected when the soil moisture becomes too low for optimal plant development. This can result from a short-term precipitation deficit. Diminished flow in major navigable rivers is one of the last impacts of a long-term drought. These rivers have large watersheds that may extend beyond the meteorological drought; also the base flow of rivers is sustained by groundwater discharge, which is not strongly influenced by short-term precipitation deficits.

Meteorological Drought **-** a measured departure of precipitation from normal and the duration of a dry period for a given geographic area.

Hydrological Drought **-** amount of surface and groundwater relative to normal levels as measured by streamflow, snowpack, and lake, reservoir and groundwater levels. There is usually a delay between lack of precipitation and reduced water levels in streams, lakes and reservoirs. It can occur from a persistent meteorological drought *and/or* unsustainable withdrawal and consumptive use rates.

Agricultural Drought **-** inadequate soil moisture for a particular crop at a particular time. Factors include precipitation, ground water/reservoir levels, evapotranspiration, weather conditions, accessible irrigation technology, crop variety and stage of growth, soil type, and relative availability of water/moisture in prior growing stages.

Socioeconomic Drought **-** physical water shortages affect the health, well being, and quality of life of the people. Measurements integrate consumption patterns, production technologies, and resource management practices with natural climatological patterns.

Table 4. Types of Drought

4.3 Conditions that Indicate Where Low Flow Conditions have or are Likely to Occur

4.3.1 Existing Drought Indicators

The National Climate Data Center (NCDC), Office of Emergence Services (OES) and the WV Department of Agriculture (WVDA) each use different systems for drought declaration. Mapping the history of these declarations serves primarily to illustrate inconsistency in the states' current capacity to evaluate and address water scarcity problems. OES and NCDC droughts are mapped (Figures 10 & 11) for period of record (POR). NCDC declarations are based on a variety of information sources including weather reports, local calls and newspaper stories. OES drought declarations are based only on events that require FEMA payments. WVDA drought declaration history is based on payments made to farmers due to agricultural droughts declared by WV, bordering states, or the Federal Department of Agriculture. Data on these droughts are available in discontinuous intervals over the past two decades making a mapped analysis unreliable.

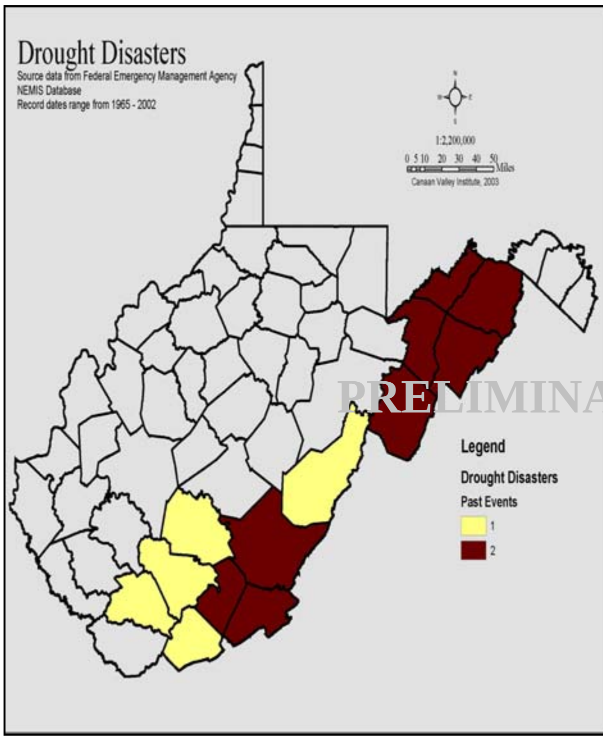


Figure 10. All--Hazards Mitigation Report shows only two cases of drought in nearly 40 years.

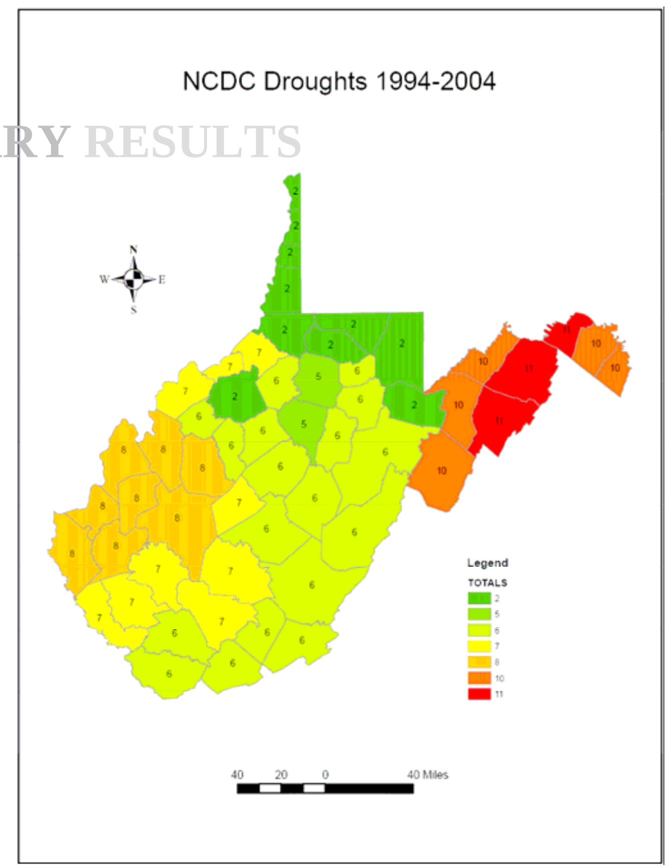


Figure 11. NCDC Reported Droughts 1994-2004

Upon review of the existing maps, it is evident that there are contradictions among data sources and indicators. An important interim finding is that more data collection and investment in reliable data analysis methodologies is necessary to produce reliable indicators of drought prone areas. Furthermore, a standardized approach to local-level data collection is likely to be the best source of information for indicating the impact of low flows and drought on beneficial uses as well for identifying anthropogenic factors.

4.3.2 Alternative Approach: Drought Severity Index

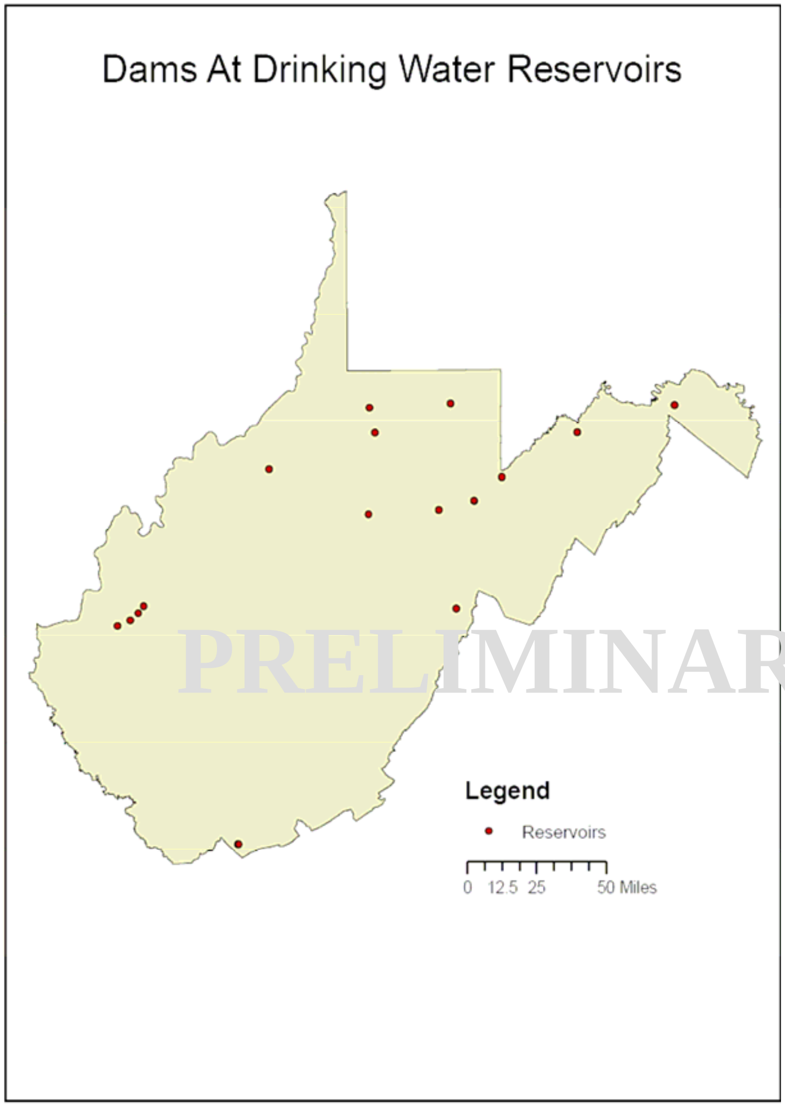
Drought monitoring trends in a region are generally based on an index of multiple drought indicators. An index of multiple drought indicators is useful because water resources are affected differently given the severity, timing, and duration of a drought and differences across topographies and geological contexts can also play a role in drought.

Looking to neighboring states' models, most rely on five indicators - precipitation, streamflow, soil moisture, groundwater, and reservoir levels - to comprehensively determine drought conditions. For WV, we combine only three indicators in an index to provide a snapshot of historically drought-prone areas including precipitation, streamflows, and the Palmer Drought Severity Index (PDSI – soil moisture). Groundwater and public water supply reservoir levels should be included as additional index variables, but the number of gauges and period of record for existing gauges are insufficient to support a reliable analysis (Figures 12 and 13).

The three-factor index does not necessarily provide a reliable indicator of relative drought-prone areas in the state. The model does, however, demonstrate the objective standard for WV. Pennsylvania and other neighboring states use drought indices both as a tool for historical record keeping as well as an on-going drought monitoring mechanism (http://www.dep.state.pa.us/dep/subject/hotopics/drought/). As a monitoring mechanism, the index allows state officials to declare drought watches, drought warnings, and drought emergencies in different regions of the state depending on the severity of drought in that area. A standardized set of voluntary and mandatory conservation practices are automatically announced and implemented under each category. With a standardized procedure for declaring drought at different levels of severity, agencies are better able to balance physical resource needs with political pressures when declaring droughts and suggesting conservation practices.

The following maps (12 & 13) illustrate why groundwater and reservoir data cannot be used for WV drought monitoring. These are followed by maps that illustrate the remaining three drought indicators (soil moisture – Figure 14; streamflow – Figure 15; and precipitation – Figure 16). Finally, the equation used to calculate state index values is presented with an explanation of methodology and resulting maps.

The results of the application of the multifactor index at the county and watershed level are illustrated in Figures 15 &16. It is evident from these figures that the areas affected by historical drought severity and frequency differs based on spatial-unit boundaries.



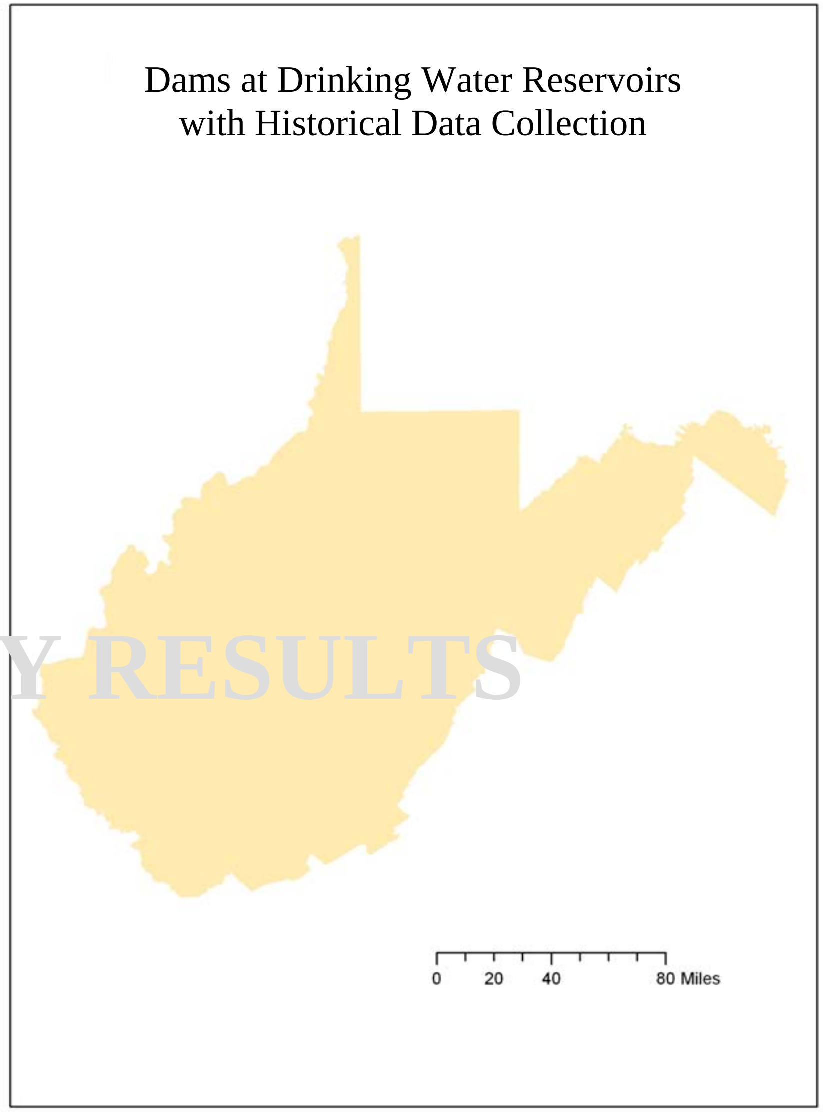
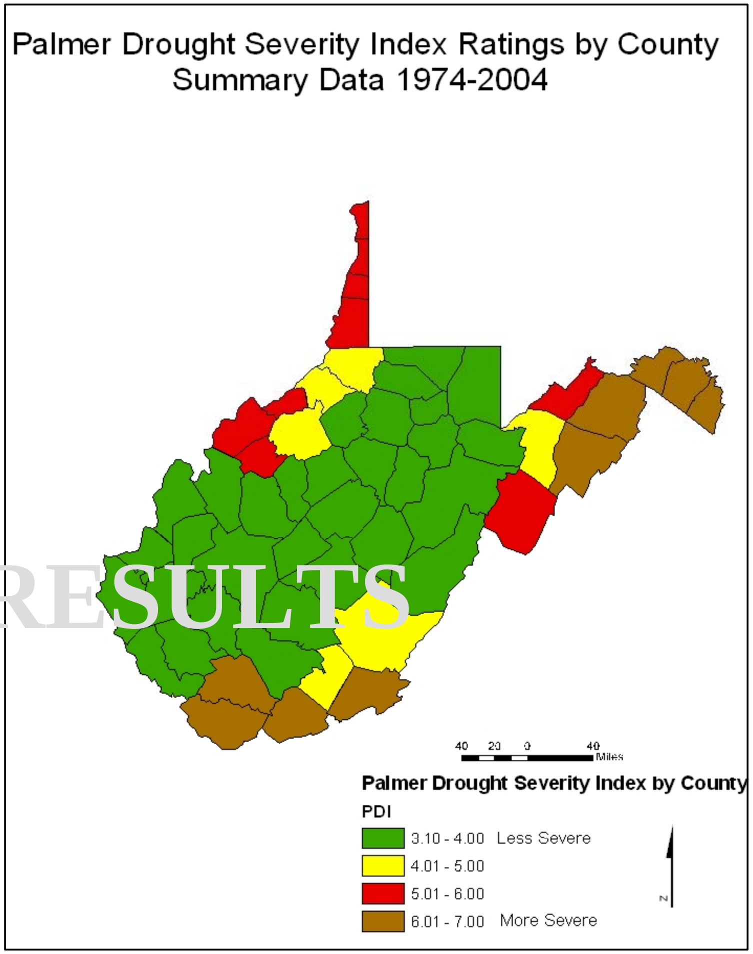


Figure 12. Public Water Supply Reservoirs with Monitoring Data Collection Capacity

This indicator is not used in the drought index.



PRELIMINARY RESULTS

Figure 13. USGS Groundwater Monitoring Stations

Two of the five remaining monitoring wells are slated to be turned off this year due to federal budget cuts. This indicator is not used in the index.

Figure 14. Soil Moisture Drought Indicator (PDSI)

This indicator is used in the index.

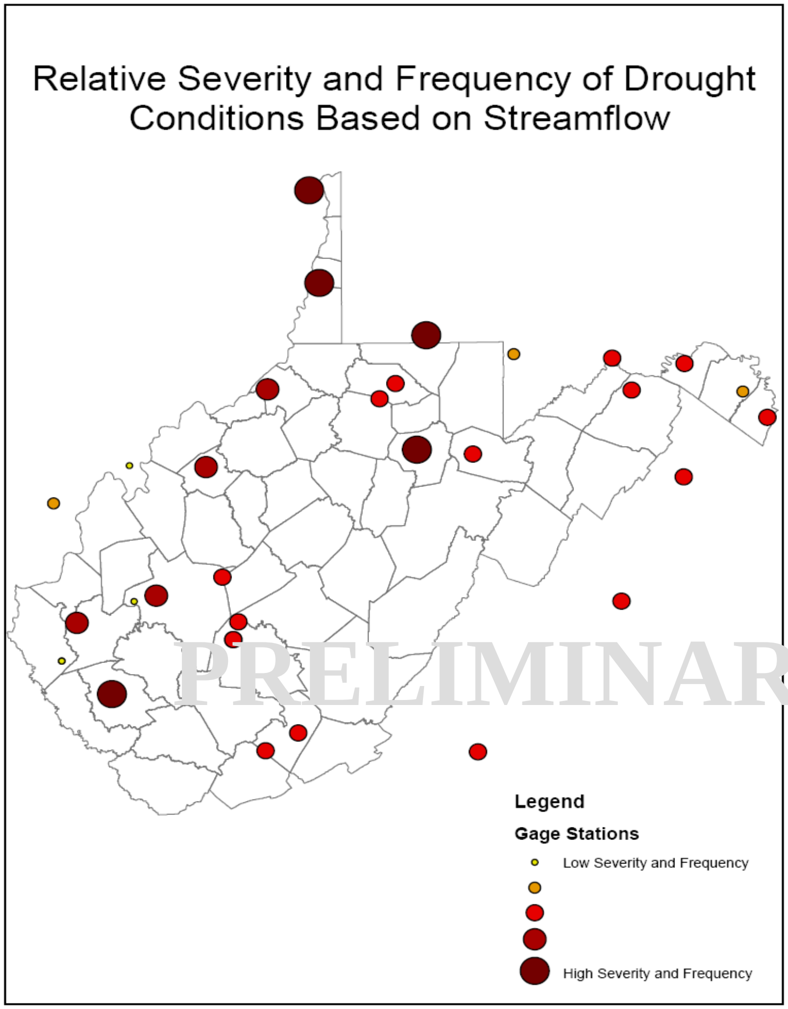


Figure 15. Streamflow Drought Indicator

State coverage by stream gauges, particularly gauges with 30-years of historical data, is not good. Data collected above were used in the index calculations, though it is not recommended that a stream gauge point be used as an indicator of flow patterns for its own watershed or neighboring watersheds.

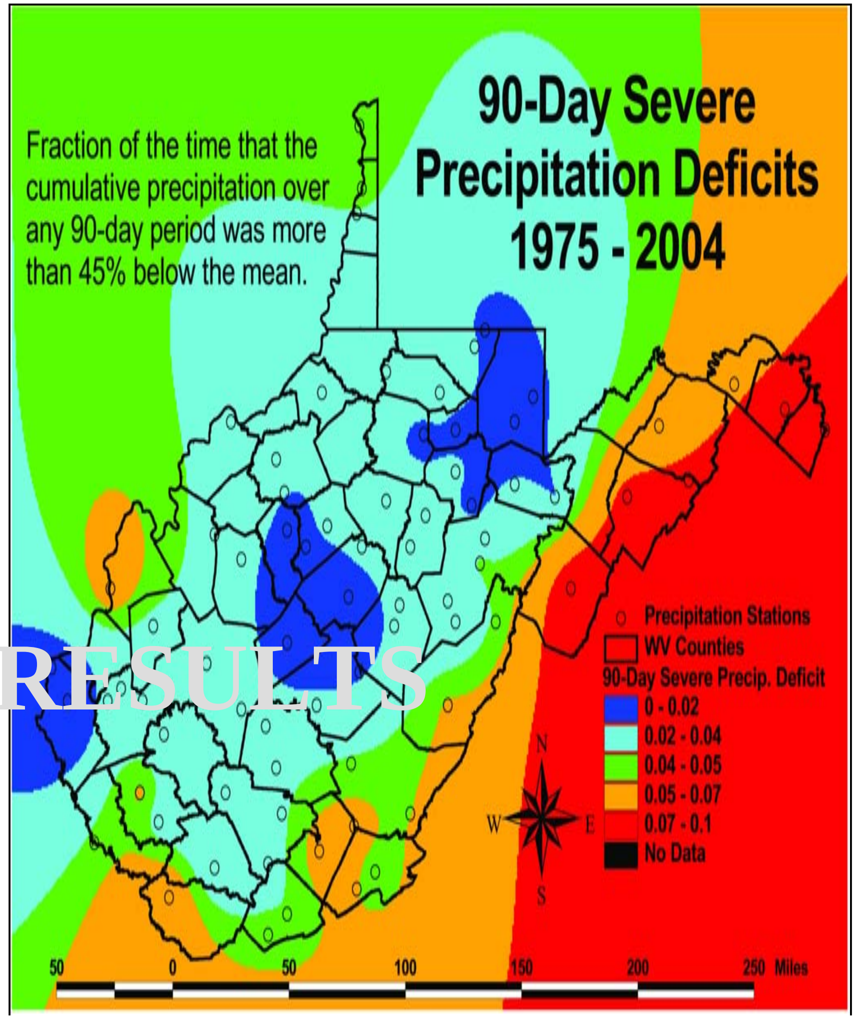


Figure 16. Precipitation Drought Indicator

This indicator is used in the index. The 90-day deficits indicate medium-term precipitation deficits, 30-day (short-term) and 360-day (long-term) deficits are also calculated and included in the index. Precipitation station coverage in the state is adequate.

The combined data for the drought index are spatially based on precipitation gauge location. Each precipitation gauge is assigned a corresponding PDSI value (climatological region) and a corresponding stream gauge based first on shared watershed and then, where there are multiple stream gauges in a watershed, by proximity. At each gauge site, all three indicators are evaluated separately, on a daily basis over the past 30 years, for drought severity ratings. Precipitation station points are assessed by number of days spent in drought, with each day being weighted by the severity of the drought ranking of each indicator and by the number of the three factors indicating drought (one, two or three indicators in extreme or severe drought on any given day). Cumulative index values for each station are then gridded across the state, and spatially-weighted values assigned to each county and 8-digit watershed.

DROUGHT INDEX VARIABLES

- X Reservoir levels
- X Groundwater
- Soil moisture (Palmer Drought Severity Index)
- Precipitation
- Stream gauges

The equation of the drought index is described below.

$$D_i = \frac{1}{9}\left[P_i^{30} + P_i^{90} + P_i^{365} + 3S_i + 3I_i\right]$$

D = Drought severity index for a particular precipitation gauge.

t = Time index, days.

= Duration of the total precipitation deficit code; 30, 60, or 365 days.

P_i^t = The t-day total precipitation deficit code.

S_i = 30-day mean stream discharge flow rate deficit code.

I_i = Palmer drought index code for precipitation gauge's climatological region.

Figure 17. WV Drought Index Equation

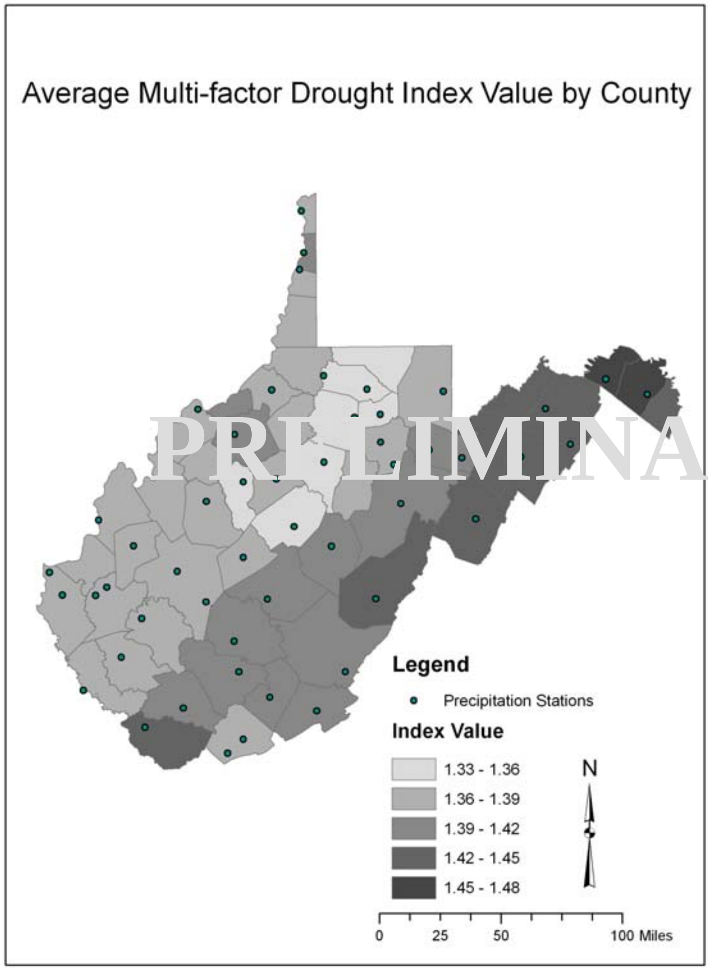


Figure 18. Drought Index by 8-Digit Watershed

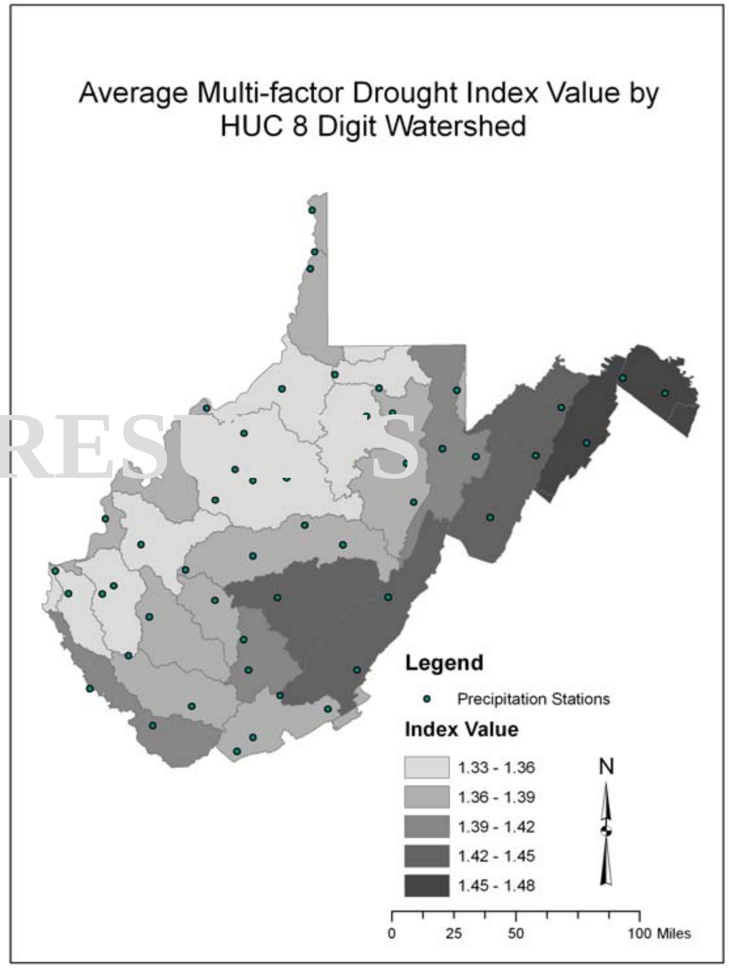


Figure 19. Drought Index Values by County

4.4 Impact of Drought and Low Flows on Beneficial Use

Data do not exist for most drought/low flow impacts on beneficial uses at the local or state levels. Furthermore, because drought affects beneficial uses of water resources differently depending on the season, duration, and type of drought as well as region-specific competing demands on water resources, it is difficult to extrapolate generalizations from case-specific data. Below are some important issues that should be considered in the evaluation of state water resources.

The section below identifies main categories of beneficial water use and describes how low flow conditions could impact those uses. Information was requested for drought-impact estimates for at least one case in each category. This is followed by a review of the US Army Corps of Engineers' drought-based integrated water resource management strategy in the Kanawha River Valley, which focuses on balancing the protection of different types of beneficial use during resource scarcity.

Beneficial uses of water can be classified as consumptive or non-consumptive. Non-consumptive uses can be further divided into the following categories: ecological services, recreation and tourism, direct-market services, and transportation. The list in Table 5 is by no means complete. Each region and watershed will have a unique docket of water users and resource needs, which are often interrelated and interdependent.

NON-CONSUMPTIVE USES
Ecological Services
Habitat
Effluent dilution
Temperature/oxygen regulation
Ambient/soil moisture
Input to natural production functions (tree, plant, animal growth)
Recreation/Tourism
Swimming
Fishing
Boating/rafting
Aesthetic/existence values
Direct Market Services
Aquaculture
Public utility supply
Hydro-energy production
Transportation
CONSUMPTIVE USES
Industrial/commercial
Public utility supply
Energy production
Agriculture
Water bottling
Mining/natural resource extraction

Table 5. Beneficial Uses Affected by Low Flow Conditions

Ecological services of stream flows include natural habitat and effluent dilution, temperature and oxygen regulation, and it functions as an input in the production of natural goods and services. Naturally occurring low flow conditions reflect the expected fluctuations of dynamic ecosystems. These natural events should be understood and anticipated in land and water use planning and development.

An unnatural increase in the frequency or duration of low flow conditions may have a negative impact on the beneficial use of water through the destabilization of natural streambed morphology, degradation and reduction of wildlife habitat and other ecological services such as prevention of eutrophication. Low flows reduce stream velocity and result the reduced capacity for the water to carry out natural stream-cleansing services, leading to embeddedness and loss of aquatic habitat.

Drought conditions can also have costly effects on state forest ecosystems. Drought increases tree susceptibility to disease, and it is identified by the State All Hazards Plan as a factor in the spread of wildfires. Drought-related losses were compounded in 1999 by extensive forest fires understood to have been an effect of the dry weather conditions. Between 1991 and 2000 on average 1,080 wildfires burned 65,435 acres *per year* in West Virginia costing the state $196,700,200 (almost exclusively in the Southwestern region of the state). Wildfires can reduce post-fire landscapes' ability to retain soil moisture in the short run, exacerbating sedimentation and flash flooding factors.

Water-based recreation and tourism is widely recognized to be an engine of economic growth at local and state levels. Tourism and amusement-related sectors are leading the state in employment generation where other traditional sectors are declining. Fishing and boating are two important water-dependent recreation industries in the state.

Low flows can reduce fishing and rafting opportunities directly through insufficient flow and/or indirectly if reduced water quantities translate into quality problems that produce odor, public health threats, and reduced stream clarity. Whitewater rafting alone has consistently attracted over 200,000 visitors to the state annually for the past decade. As surrounding states invest in the development of competing recreation and tourism industries, protecting water quality and quantity will become increasingly important.

WV Department of Agriculture figures indicate that WV aquaculture (primarily for trout stocking) is a $2 million-a-year sub sector activity that generates an additional $1 million in related income and taxes. Anglers' visits alone generate $2.5 million per 20,000 fishing trips. According to the DNR, trout stocked in 1999 were significantly smaller than previous years due to drought conditions that started in the summer of 1998 (1.9 trout per pound down from the average 1.5 – more than a 20% production loss). Groundwater sources for commercial fishery production and adequate stream flows to attract anglers and protect fish habitat are important economic resources that are sensitive to natural flows.

Direct market services include aquaculture, public water utilities, and hydro-energy production. Drought threatens these uses when there is insufficient water to continue operations at full capacity. Reduced capacity for these users relates directly to reduced production and/or increased costs of production – resulting in lost revenue accordingly. In the cases of public utilities and hydro-energy production, drought-related production reductions often occur at the same time demand increases (watering lawns, swimming pools, running air conditioning etc.). Potential losses in each case are site and drought specific.

In Berkeley County in 2002, drought caused a 25% reduction in water supply as a result of a 50% reduction in the flow rate of two major springs. While the county is attempting to prepare for the next drought, population growth will inevitably result in future socio-economic droughts. Maryland granted temporary permission to increase daily maximum withdrawals from the Potomac River by over 30% (2.67 to 3.864 MGD) and emergency withdrawals of 5.52 MGD.

County officials are concerned about growing groundwater scarcity due to the increased percent coverage of impervious surfaces in the county (limiting aquifer recharge) and degraded groundwater quality (reducing the quantity of useable water supply/increasing treatment costs). Costly temporary building and development halts have already been implemented in the Eastern Panhandle and parts of Maryland due to water scarcity.

Consumptive uses of water include industrial manufacturing, public utilities with trans-basin service districts; energy production that requires water for cooling towers, agriculture that exports production, water bottling facilities, and mining/natural resource extraction operations that result in bulk transfers of groundwater to surface water.

Drought and low flow conditions threaten energy production when discharge stream temperatures or flows limit facilities' discharge water or when intake water temperatures or flows reduce cooling capacity of the plant. Power companies do not keep records of drought-related production losses and estimates of such losses would have to be made on a facility-by-facility basis. Power generation is affected by drought because temperature and flow of cooling water supply are determinants of the plant production capacity. The impact on each plant is unique and event-specific.

Agriculture production is threatened by drought when goods are smaller in size, misshapen, or diseased due to drought stress. The Department of Agriculture compiled historical data on financial compensation for drought-related agriculture losses but the data was not continuous enough to generate a meaningful report. Though during the 1999 drought alone, USDA reported the $200 million in agriculture-related drought losses.

There are 155 DHHR-licensed water-bottling facilities in the state (11 are WV-owned). Water bottling facilities are not required to report the quantity of water they extract to any state agency (with the exception of the current DEP survey). There are no regulations that require facilities to measure the effects of pumping on neighboring wells or to determine baseline supplies/flows. Facilities are only regulated by DHHR for water quality and facility sanitation regulations. Low flows can threaten water-bottling facilities if other users who rely on surface water are forced to switch to groundwater sources, becoming competing users. As well, excessive surface water consumption can reduce groundwater recharge rates in some cases depending on the region's geology, hydrology and economic activities.

Monroe County, home to a number of bottlers and a growing population, is currently working to prevent conflict over surface and groundwater supplies through countywide planning. Jefferson County's efforts to plan for future water supplies were limited to public utility planning. The county's Source Water Assessment and Protection Program (SWAP) specifically notes that a new water-intensive manufacturing facility or water-bottling facility in the area would result in severe water scarcity for the public water utility.

Chapter 5 - Uses that Contribute Detrimental Low Flow Conditions

- Water Research Institute of West Virginia University

As stated above, distinguishing natural from anthropogenic causes of water scarcity can be difficult to impossible. Understanding the relationship between surface and groundwater movement, particularly in karst areas, can make it nearly impossible to predict where and to what degree one user's withdrawal or diversions may impact another's supply. This complication is compounded by the fact that there is little to no data on withdrawal quantities – making it impossible to understand how those withdrawals impact the hydrology around them.

Five general category practices have been identified to date as exacerbating low flow conditions. These problems are interrelated in many ways, as is illustrated in the discussion below. But general categories include the following:

- Over-extraction (DNR v Tingler, 2005)
- Rapid growth/contamination (Eastern Panhandle)
- Competing uses (USACE Shared Vision balance of energy, boating, and ecology interests in Gauley basin during drought)
- Resource extraction (mining/quarries; Pennsylvania Act 54)
- Sedimentation (Hurricane, WV)

The WVU Hydrogeology Research Center attempted to identify natural and water resource extraction-based impacts on water levels in aquifers of the Eastern Panhandle, but has largely found the indicators to be confounding, even with significant project-based measurement and monitoring expenditure. DEP efforts to allocate liabilities in stream and well dewatering cases surrounding sub-surface mining operations are also hindered by problems distinguishing between natural and anthropogenic flow factors. Lack of flow and groundwater monitoring data further limits our ability to provide a comprehensive analysis of this already complicated question.

Among the most important practices that exacerbate natural low flow conditions are over-extraction of water for consumptive uses and bulk water transfers (most often related to natural resource extraction). Countless anecdotes circulate of well owners who lose their water supply due to new water extraction practices on a neighboring parcel or due to underground mining activity. In these cases, lack of data and information about groundwater extraction, supply, and underground water flows becomes a serious problem.

In WV, stream and well dewatering problems that stem from nearby mining activity cannot be tracked or monitored without extensive manual research. Pennsylvania mandates regular collection and reporting of mine-related dewatering data (Act 54). Based on our attempts to repeat this research in WV, we identified and will provide WVDEP with a PA-based guide for collecting similar pertinent information in order to better monitor this problem.

The WVDNR faced water scarcity problems in Randolph County (WVDNR vs Tingler) when a neighbor began pumping groundwater next to a DNR fish hatchery. The resulting reduced spring flows on DNR property caused the hatchery to close (the case was recently ruled in favor of DNR).

Interestingly, many anthropogenic factors that cause and/or exacerbate low flow conditions can also exacerbate flood conditions. Increased coverage of impervious surfaces and increased erosion are two such factors in West Virginia. Increased sedimentation (the state's leading water quality impairment) from land use practices that lead to erosion causes sediment to accumulate in streambeds (aggradation). Raised streambeds exacerbate flooding and erosion problems, but result in streams that are increasingly shallow, wider, and warmer, losing more water to evaporation and having lower dissolved oxygen levels than they would in their natural condition.

In Figure 20, the Hurricane Public Water Supply Reservoir illustrates how land use, flooding, and low flows or water scarcity are related issues. Inappropriate land use practices at construction sites (sub-photo) upstream from the reservoir caused almost $.5 million in damages to this reservoir. Dredging was necessary to increase the water supply. Reduced water storage capacity also brought the floor of the reservoir dangerously close to developed structures and roads. Finally, sediment transport brings with it the transport of pathogens that can contaminate streams and reservoirs. A special enforcement sweep upstream and throughout Putnam County resulted in 119 Notices of Violation at 33 of the 41 inspected sites.

Figure 20. Sedimentation of the Hurricane Reservoir - A Factor that Exacerbates Low Flows and Flood

Land use changes that significantly increase the degree of imperviousness in a watershed is another contributor to both drought and flood events – this includes mine land reclamation practices as well as urbanization practices. Water that would otherwise percolate into soil and underground aquifer systems instead flows directly into surface water streams, often transporting contaminants such as pesticides, oils, sediments, and other watershed-specific contaminants – a problem particularly in sensitive karst area. Increased surface flow volume and velocity can exacerbate flooding in the short run and destabilize streambeds in the long run.

Canaan Valley Institute is working to develop geospatial models of sediment-based relationships between land use and changing stream morphology in a sub-watershed of the Little Kanawha as part of its work to update FEMA maps in the watershed. Once completed, such information will provide important lessons for other areas of the state. Land use-based reduced flows cannot be summarized quantitatively for the state with existing data. Land use-related factors are also absent in USGS low-flow modeling efforts.

Drought management Drought's impact on various beneficial uses can also vary depending on how the drought is managed by local and state officials and by each water user. A drought warning and response system can help users plan for water scarcity by employing water conservation measures, by understanding their own use in the context of other users and the watershed system, and by preparing users to contribute to watershed or county-based contingency plans that are acceptable to all stakeholders. The case below illustrates how integrated water resource management reduced and distributed the impact of drought on beneficial uses in a way that was politically accepted due to stakeholder participation in the planning process. It further illustrates how flows can be managed, at least on some streams, by planning for natural low flow conditions.

The Kanawha River The Kanawha River and its tributaries drain 12,300 square miles of land starting in North Carolina and crossing into Virginia and West Virginia before joining the Ohio River. Major tributaries in the state include the Gauley, the New, the Elk and the Greenbrier. Minimum in-stream requirements maintain fish and wildlife habitat, transportation, and ecological services (primarily dilution of downstream effluent discharges) but rely on reservoir releases from Summersville and Sutton dams. The whitewater industry provides the region with millions of dollars in revenue every summer and Appalachian Power Company has hydropower plants on three corps multipurpose reservoirs and owns a fourth reservoir at Claytor Lake.

A drought that began with low rainfall in 1987 and continued through the fall of 1988 restricted important whitewater releases during weekdays, costing millions of dollars in lost local revenues. US Army Corps reservoir releases eventually fell below what was necessary to maintain minimum in-stream flow requirements (for ecological services, wildlife, and transport) at a perceptible cost to water quality and habitat.

USACE convened a study team of experts to evaluate the situation and develop a series of policy alternatives to the status quo management plan. For each alternative, impacts on lake recreation, water quality, rafting, navigation, and hydropower were evaluated. A group of stakeholders was convened to debate the various management scenarios and the corresponding implications. Debate and discussion eventually lead to the endorsement and implementation of situation-tailored plan to manage water resources that both protected the ecological and economic services of the watershed resources.

In 1993, when drought again required exceptional water resource allocation decisions be made, informed and experienced stakeholders reconvened with the Corps using the “Shared Vision” model and decided on a new strategy given the specific drought conditions they faced.

The regional drought watch was lifted after heavy rains eliminated the resource scarcity problem, however, the Kanawha case study illustrates the usefulness of and need for regional drought readiness and management planning. Each drought event poses different types of scarcity depending on when it occurs, duration and other events going on at the time. Each region faces different water resource demands and may prioritize needs for each drought event differently given the temporally and regionally unique context. This is particularly useful when water resource uses can be coordinated to facilitate multiple-use management of scarce resources. Combining the participatory and information-driven approaches of the Shared Vision model helped to develop a team of local experts interested in and capable of finding the best management solution for the region. Such participation is likely to provide additional benefits of stakeholder cooperation during the implementation phase of any drought mitigation plan.

Chapter 6 - Potential Groundwater Well Network

The DEP will propose, in the final report issued at the end of 2006, a ground water monitoring well network. The full criteria upon which the well locations will be selected are currently under consideration. Because of the expense of installing, logging, testing, and maintaining monitoring wells, the DEP expects installation of the network will take place over a period of years. Prioritization of the well locations will be established based on multiple factors, including, but not limited to, areas of expected growth, areas of major groundwater use and dependency, and unique geologic factors.

In the interim, the DEP recommends funding for maintenance of the existing ground water level monitoring wells currently operated by the USGS (see Chapter 1 for details on costs and locations). A number of these wells are in the eastern and northern panhandles, areas of high groundwater use and anticipated growth, and will be important components of any future monitoring network proposed by the DEP.

Chapter 7 – Competition for Water Resources in Potential Growth Areas

- Center for Environmental, Geotechnical and Applied Sciences of Marshall University

7.1 <u>Potential Growth Areas</u>

The goal of this task is to identify potential economic growth areas that would impact water consumption and apply that expectation to forecasts of near-term regional economic development.

7.1.1 Commercial and Industrial

Economic activity for the years 2005 through 2010 is forecast based on the North American Industry Classification System (NAICS). Future water use is based on economic activity and recent county-level trends combined with aggregate statewide forecasts of industry-specific employment change.

Economic forecasts published by West Virginia University's Bureau of Business and Economic Research (BBER) in their 2005 Economic Outlook are used to calculate industry forecasts for the State as a whole. [1] The following industry categories were evaluated as listed below, along with BBER's forecasted rate of change for employment by industry at the two-digit NAICS level. The industries with the highest rate of growth are the service industries. These industries generally have lower rates of water consumption than non-services industries. Other industries projected to experience growth are recreation and accommodation and food services. The mining industry is also projected to see employment growth, although that growth is not projected to translate into increased water use from current levels as 2006 coal production is expected to be at a level that is the high for the decade.

For most industries it is assumed that negative employment growth corresponds with a decline in water use for that industry, and that an increase in employment represents an increase in water use. However, this relationship is not necessarily true for some industries, including power generation and mining, and was not assumed in this analysis for those two industries. A direct correlation may also not be true for many manufacturing facilities, but due to the lack of data defining an actual relationship a direct employment to water use coefficient was utilized.

[1] West Virginia University, Bureau of Business and Economic Research, 2005. "West Virginia Economic Outlook."

Table 6. WVU BBER Forecasted Employment by Industry

		WVU BBER Employment Annual change
NAICS	**Industry**	**2004-2009**
11 Forestry, fishing, hunting, and agriculture support		-2.7%
21 Mining		0.3%
22 Utilities		-1.8%
23 Construction		0.2%
31-33 Manufacturing		-0.6%
42 Wholesale trade		0.2%
44-45 Retail trade		0.3%
48-49 Transportation & warehousing		1.0%
51 Information		0.4%
52 Finance & insurance		0.6%
53 Real estate & rental & leasing		0.6%
54 Professional, scientific & technical services		2.3%
55 Management of companies & enterprises		2.3%
56 Admin, support, waste mgt, remediation services		2.3%
61 Educational services		0.3%
62 Health care and social assistance		1.5%
71 Arts, entertainment & recreation		1.2%
72 Accommodation & food services		1.2%
81 Other services (except public administration)		0.9%
92 Public Administration		-0.1%

CBER compiled individual county-level economic activity data provided by the Bureau of Employment Programs for 1998 and 2003. To translate this economic activity into water consumption levels, trends in number of establishments, number of employees and payroll were examined at the two-digit NAICS code and for some sector at the six-digit code. For industries with economic activity that generates little variation in water use, the higher two-digit level of activity was evaluated. These industries comprise the majority of NAICS sectors but a relatively small portion of water use.

The following two-digit industries were evaluated at the six-digit industry code for water consumption, due to economic activity that creates more variation in water use per employee. These industries were analyzed at a lower level of activity to account for as much detail as possible. Major use activities are described below.

- Forestry, Fishing, Hunting and Agriculture Support -Sub-industry activities include agriculture and logging, with livestock accounting for the largest quantity of water use.
- Arts and Recreation – This group includes fitness centers, theaters, casinos and sports. Golf courses are the largest sub-group in terms of water use.

- Manufacturing – This sector includes activities ranging from chemical manufacturing to food production. Sub-industry water use estimates were obtained from a combination of USGS and DEP survey data for gross consumption. The highest use sub-industries are in chemical manufacturing.
- Utilities -Thermoelectric power generation (NAICS 221112 -Fossil Fuel Electric Power Generation) was calculated separately.
- Mining – Coal mining, quarries and oil production were evaluated separately.

The results of the DEP major user survey, which provides consumption data at the facility level and thus corresponds with the six-digit NAICS level of economic activity, were applied to these sectors whenever possible. The remaining industry categories all consume water at consistent levels, at lower levels as represented by commercial office users or higher levels as represented by hospitals or other types of accommodation, that can be applied at the two-digit level of economic activity. Few facilities within these sectors were required to participate in the DEP survey due to water consumption not meeting the required quantity. Data provided within the USGS survey of water users was applied to estimate water withdrawals for these industries.[2]

7.1.2 Residential

Household consumption is directly related to population growth, which in aggregate is projected to be flat through 2010. Average annual consumption estimates were calculated using publicly available annual reports for public service districts from the West Virginia Public Service Commission website (www.state.psc.wv.us). These consumption levels are then applied to individual counties. The assumptions to this analysis are provided in the residential part of the Water Use Calculation Section.

7.2 Impacts of Out-of-State Industries

The goal of this task is to evaluate out-of-state industries' impact on water use. This task has not yet been completed, as the list of out-of-state users has not yet been compiled in entirety. The DEP has collected data on Ohio facilities that withdraw water from the Ohio River, and is in the process of collecting equivalent data for the other states that border West Virginia. This task will be completed in 2006.

7.3 Potential Future Water Needs

The goal of this task is to estimate water demand by industry and households in the near term. This projection was completed for 2005 through 2010. These estimates cover the state at the county level, although results are often presented at the state level. The numbers presented here are preliminary calculations and for many sectors are based on sparse data regarding actual gross and net consumption.

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[2] USGS, Dunn & Bradstreet and Harris Interactive, Inc, 2004.

7.3.1 Net Use versus Withdrawals

It is important to note the distinguishing of net versus gross water consumption. While estimates of total withdrawals, or gross consumption, are available for most industry groups, estimates of net consumption (withdrawals minus discharges) are less readily available. This report focuses on net consumption, due to emphasis by the WRPA on estimating consumptive use. The DEP survey results include figures that can be used to calculate net consumption, although some calculations often resulted in negative net consumption.

7.3.2 Water Use Calculation

Number of employees is used to calculate water consumption for most industries due to the availability of estimates that are a function of number of employees. No assumptions were made regarding the underlying productivity of labor in any water-consuming industry in West Virginia. This implies that industrial efficiency is constant with the addition or subtraction of employees and that water use is directly proportional to employment. This method has been criticized for not accounting for operational efficiencies achieved by many facilities that have been able to maintain output with reductions in employment or that have reduced water consumption while maintaining output. This criticism is legitimate, but due to the lack of alternative methods of estimation gallons per employee per day (GED) was used for most industries evaluated in this report.

Water consumption for the power industry was calculated based on production and at rates determined by consultation with industry. Mining consumption is also based on production, but due to the range of estimates, a more thorough analysis at the county or watershed level is needed. Recent trends in employment by industry and by county were analyzed to provide a basis for near-term consumption trends. For industries where water consumption was calculated based on number of employees, the forecast for state-level employment was matched to the WVU BBER forecast shown above. Individual county growth within that forecast was estimated from data on employment changes between 1998 and 2003. A logic formula was applied to project a percentage growth in a specific two-digit industry for a specific county based on the recent historical growth. Historical county-level growth was grouped into tiers and used to project future county growth, also in tiers, that is representative of past growth, while also matching the overall projected state growth.

In other words, the projected 2005 to 2010 employment growth rate for $County_y$ in $Industry_x$ is a function of 1998 to 2003 employment growth rate for $County_y$ in $Industry_x$, plus WVU BBER's forecasted employment growth for West Virginia in $Industry_x$. The logic formula applied to each county to determine the projected growth rate is based on four conditions:

1. If historical employment growth was positive and greater than a, then projected growth is a_1;
2. If historical growth was positive and less than or equal to a, but greater than 0, then projected growth is a_2;

3. If historical growth was less than or equal to 0, but greater than b, then projected growth is b_1; and,
4. If historical growth was less than or equal to b, then projected growth is b_2.

The four growth rates, a_1, a_2, b_1 and b_2, were calculated using an iterative process that forces the combined employment for all counties in each sector to equal the growth rate forecasted by WVU BBER. For example, counties that experienced greater than four percent annual growth in employment in the accommodation and food service industry are projected to continue that growth, although at a slower pace of three percent. Counties that saw positive growth of less than four percent are projected to see one percent growth and counties that lost employment in this industry are projected to continue to do so at a rate of negative one percent. Total aggregate county employment growth in accommodation equals 1.2%. The following chart shows projected changes in net water use by sector for 2005 to 2010 based on these employment calculations.

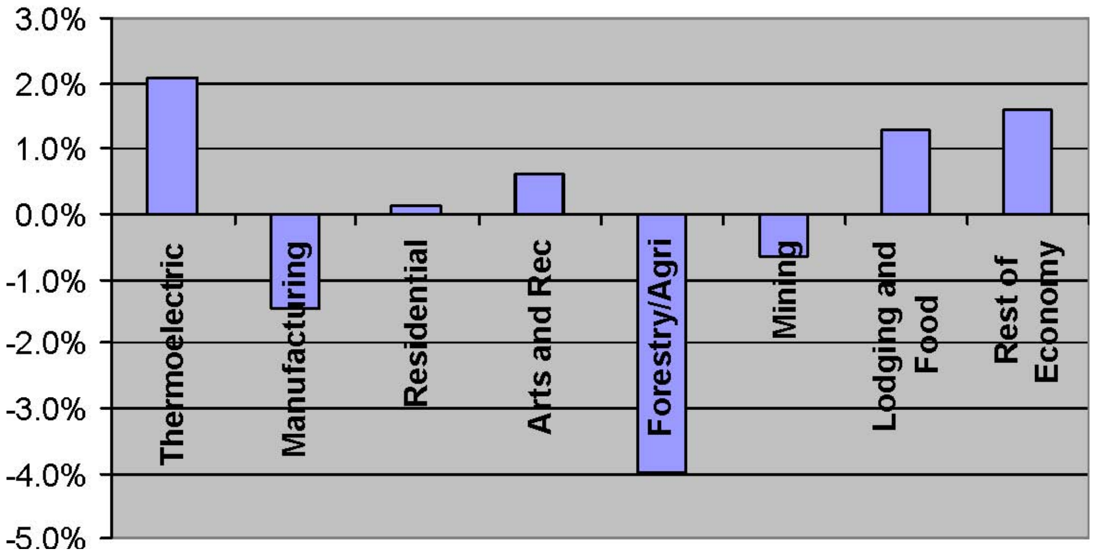

Figure 21. Projected Annual Percentage Growth in Net Water Use, by Sector

The following map describes the overall results for the change in projected water consumption by county between 2005 and 2010:

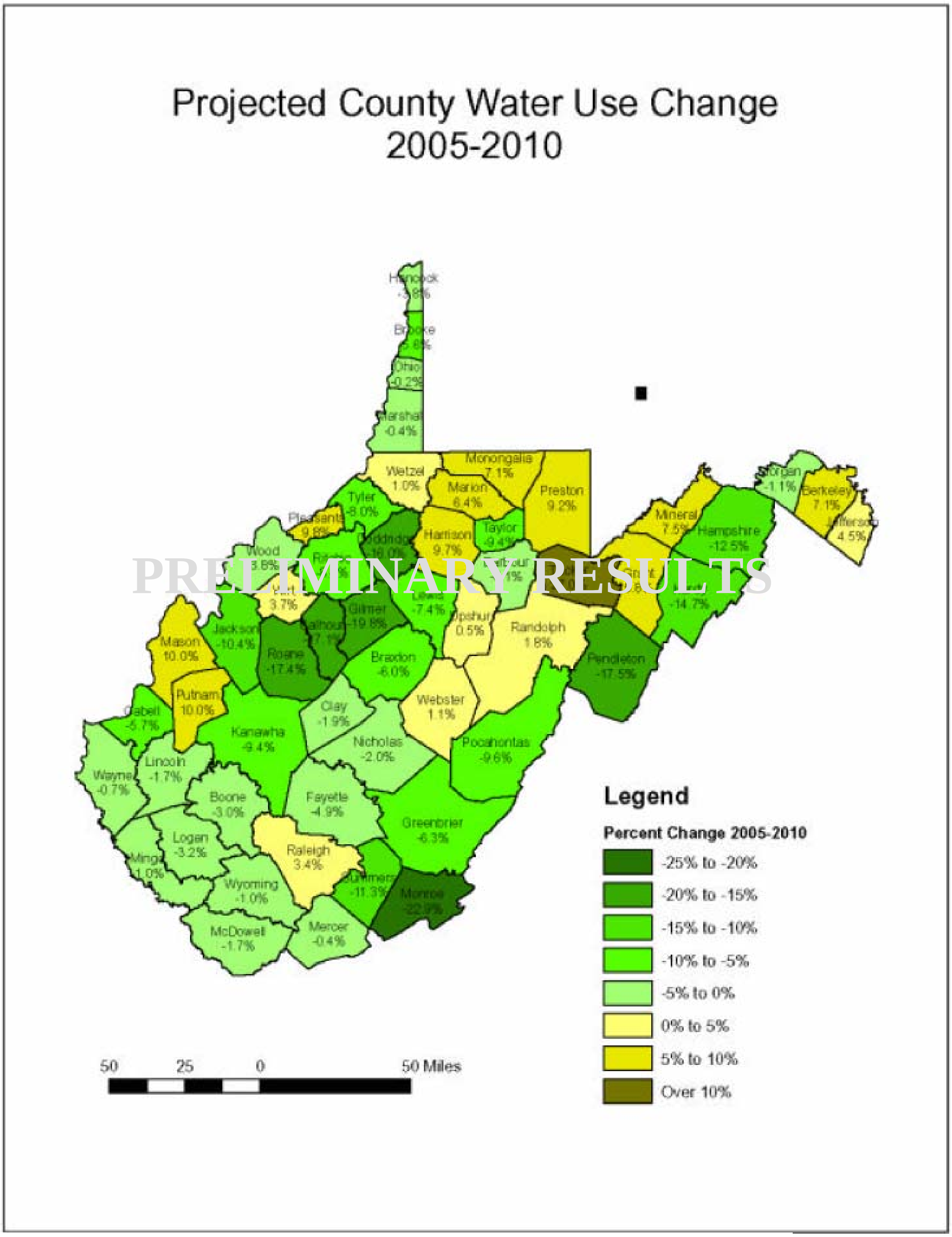

Figure 22. Preliminary Estimates of County Water Use Change, 2005 - 2010

The next chart describes relative net water use projected by sector for 2005. The category "Rest of Economy" represents all other water consumption that is not covered in the other sectors and is primarily lodging and food services, schools, commercial office buildings and healthcare facilities. Most of the businesses within these sectors will use water from public sources. The relative levels of consumption are not significantly changed over the forecast period and, with the exception of the assumed increase in thermoelectric power generation, are for the most part not observable on a chart of this scale.

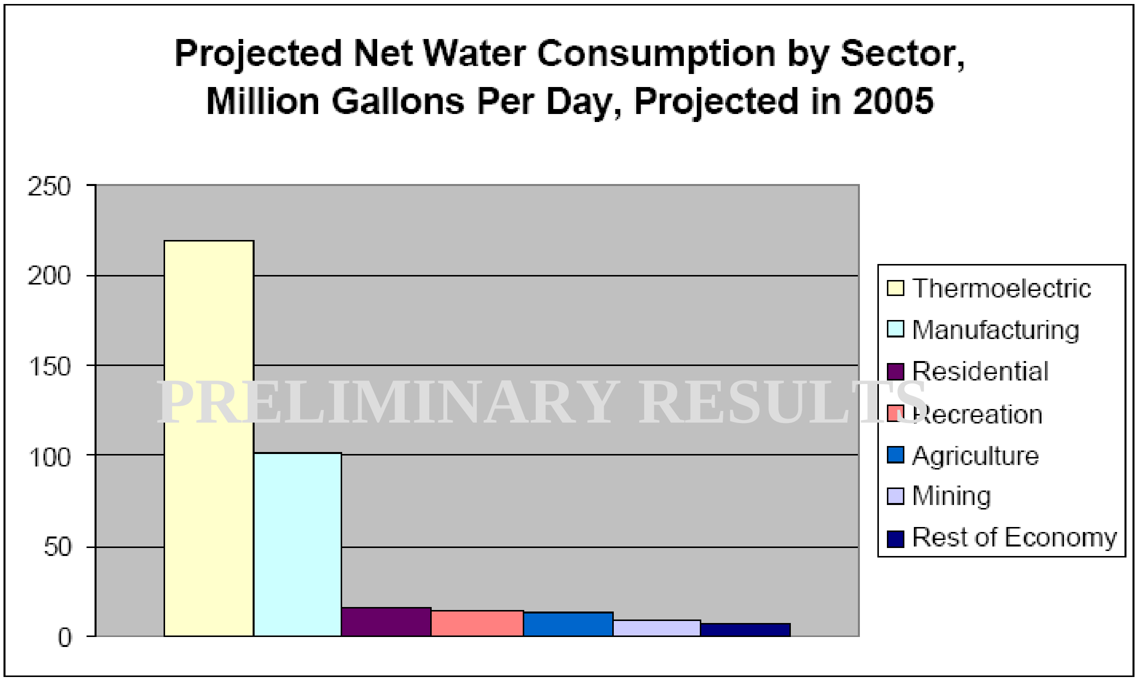

Figure 23. Projected Net Water Consumption by Sector, Million Gallons Per Day, Projected in 2005

This report will next describe water use estimation for individual sectors of the economy. Because thermoelectric power generation for dispatch to the electricity grid accounts for the single largest category of water use, both gross and net consumption, this industry is reported first.

7.3.3 Thermoelectric Power Generation

Utility thermoelectric power generation occurs in ten counties in West Virginia. With the exception of one plant, all the facilities rely on a major river or water body for cooling water. Total water withdrawals for this category of activity were 3,785 million gallons per day (mgpd) in 2004. For comparison, the USGS estimated this category of withdrawals at 3,950 mgpd in 2000 for West Virginia. The range of both gross and net withdrawals by plant is fairly large and depends on the type of cooling system utilized. Once-through cooling systems withdraw at much higher rates than do recirculating systems, although recirculating systems return a much lower portion to the water system due to evaporation. By county, net water use (withdrawals minus discharges) ranges from 1% to 81% for power generation.

Rates of return also vary for plants utilizing the same type of system. Due to NPDES standards regarding thermal discharges, plants that utilize once-through cooling tend to overestimate water discharges. This practice led to the reporting of negative water consumption for several of these plants. For this analysis, a one percent net water consumption was assumed based on discussion with industry regarding typical plant operation.[3]

One small power plant in the state, located in Grant County, utilizes an air-cooled condenser and thus relies much less on water for cooling. This plant's water consumption was not reported in the DEP's water survey. Thus, an intake rate of 1% of a similar vintage once-through system was assumed.[4] Net use of eight percent was assumed.[5]

Forecasted net water consumption from utility power generation is shown below. A two percent annual increase is assumed, matching expected increases in power generation for the country. Increases also reflect the addition of scrubbers to several of the plants, between 2007 and 2009, in compliance with the Clean Air Act.[6] These plants are all located along major rivers and most take 100% of their water from those rivers. One exception is the Mountaineer Plant in Mason County. That plant reported two percent of its withdrawals from groundwater.[7]

These quantities do not include water consumed by utility employees in operation of utility offices. This consumption is calculated separately and included in the category referred to as "Rest of Economy." While some overlap may exist, as power plants also report water used in plant offices, the majority of utility employees are not located on site of a power plant. Utility employment is dispersed throughout the state and is represented in 54 counties. This employment also includes those employed by water and gas utilities. And, while power generation is expected to increase by two percent annually over the next five to six years, total employment in the utility industry is projected to decline by 1.6% per year. A spatial representation of the counties expected to see growth in water use resulting from increased thermoelectric power generation is shown in Figure 24.

[3] Bill Cannon of Allegheny Energy provided fundamental guidance on calculation of net consumption.
[4] The plant of similar vintage is the Morgantown Energy Facility. This percentage is from the EPA's overview report on dry cooling facilities, http://www.epa.gov/waterscience/316b/technical/ch4.pdf.
[5] Afonso, Rui (2001). Energy and Environmental Strategies for the Clean Air Task Force. "Dry vs. Wet-Cooling Technologies."
[6] Bill Cannon of Allegheny Energy and Tim Mallen of American Electric Power provided guidance on calculation of water use related to scrubber installation.
[7] DEP Water User Survey, 2005.

Table 7. Projected Net Water Consumption from Utility Power Generation, by County, Million Gallons per Day (2005-2010)

County	2005	2006	2007	2008	2009	2010
Grant	11.79	12.03	12.27	12.51	12.76	13.02
Harrison	32.26	32.90	33.56	34.23	34.92	35.62
Kanawha	3.51	3.58	3.65	3.72	3.80	3.87
Marion	3.60	3.67	3.75	3.82	3.90	3.98
Marshall	10.11	10.31	10.52	10.73	10.94	11.16
Mason	108.14	110.30	112.51	114.76	117.05	119.39
Monongalia	8.49	8.66	8.83	9.01	9.19	9.37
Pleasants	10.98	11.20	11.43	11.66	11.89	12.13
Preston	3.11	3.17	3.23	3.30	3.36	3.43
Putnam	26.90	27.44	27.99	28.55	29.12	29.70

7.3.4 Manufacturing

Manufacturing water use was evaluated by county at the six-digit industry code and aggregated at the county level. Water use is a function of the number of employees in an establishment. Because manufacturing employment is projected to decline over the next five years, water consumption from manufacturing is also projected to decline in most counties. The 14 counties that have been experiencing growth in manufacturing employment are projected to continue that trend, at rates of either two or three percent a year. These counties are: Boone, Greenbrier, Hardy, Mineral, Mingo, Monongalia, Nicholas, Ohio, Preston, Putnam, Raleigh, Randolph, Ritchie and Wirt. Again, these counties are projected to have increases due to the recent trends of increasing employment and the expectation that these trends will continue. The remaining counties are projected to experience declines in water use, also in continuation of recent trends.

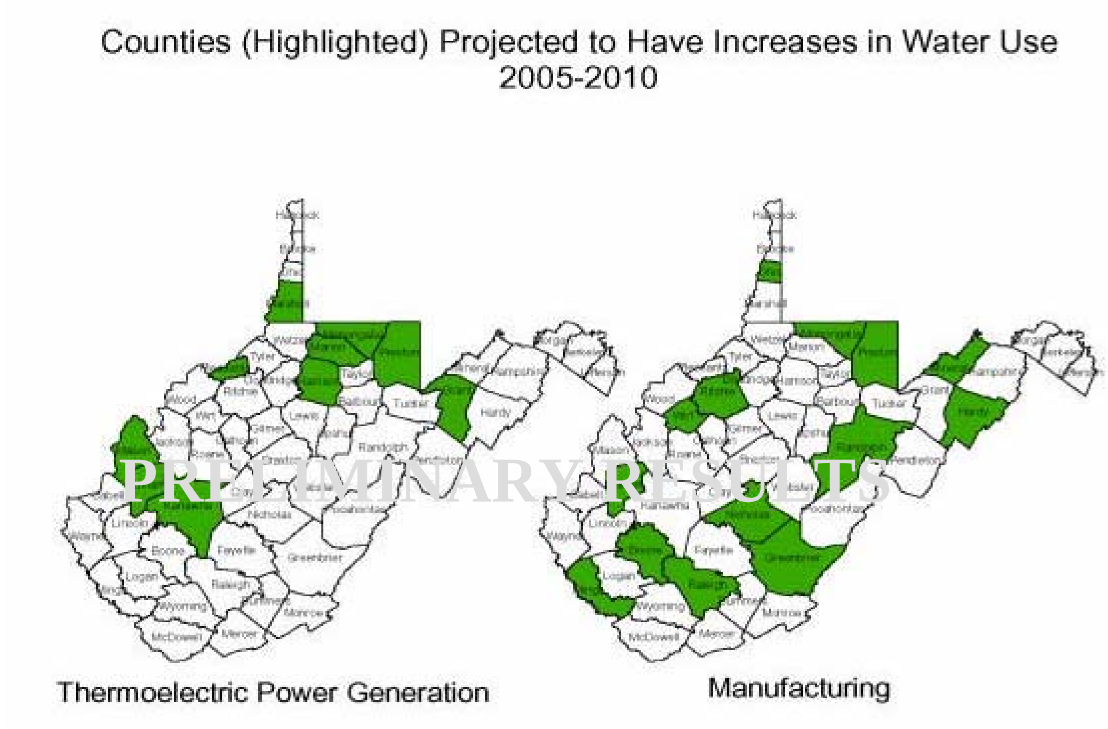

Figure 24. Counties Projected to Have Increases in Water Use: Thermoelectric Power Generation and Manufacturing 2005 - 2010

The distinction between withdrawals and net consumptive use is very important, yet difficult to estimate for this category of economic activity. While reported and estimated withdrawals are considered to be good approximations of actual water used in the manufacturing processes, net consumption is much less accurate. This is the result of several factors:

- Varying reporting methods on water discharges
- Lack of reporting on some sub-industries
- Lack of estimates on many sub-industries. Most published estimates of consumption tend to provide ranges of consumptive use in manufacturing and those ranges are not specific to individual manufacturing sub-industries.

CBER's calculation of consumptive use based on total withdrawals and discharges reported to the DEP, varied considerably, in some cases even within the same six-digit industry. Several manufacturers also reported negative water use numbers, where total water withdrawn minus total water discharged is less than zero. This is presumed to be a function of the NPDES standards and tendency to overestimate the quantity of discharges in compliance with temperature release standards, combined with the reporting of storm-water runoff from facilities. For example, in the chemical manufacturing industry, reported net use ranged from -475% to 92%. This type of reporting is standard practice for many industries, but to avoid reporting negative consumption for this analysis, assumptions were made regarding internal water use rates.

Where positive net consumption was reported, these ratios were applied to other establishments in the same or similar manufacturing NAICS code. If a facility reported negative net use and no information was available regarding actual net internal water use for a similar manufacturer, it was assumed that the facility used 25% of its withdrawals for consumptive use. Due to the large number of manufacturers that reported negative net use and the large number of industries that were not represented in the DEP survey, the 25% rate was assumed for about two-thirds of the 1,017 county-specific manufacturing industries evaluated. By contrast, a net use rate of 15% was applied to non-manufacturing industries that typically operate out of commercial office space. It is expected that the 25% net rate overestimates some industries and underestimates others. However, due to the lack of available data this is a fair approximation, although due to the range of use estimates these calculations are considered preliminary.[8]

Total manufacturing net water consumption projected for the state is in line with overall forecasted employment decline in this sector. The counties that are projected to increase water use due to increased employment in manufacturing are shown above in Figure 24.

7.3.5 Residential

This consumption is estimated at the county level. Input data and assumptions to the analysis are as follows:

- Metered sales in gallons to residential customers and the annual average of the monthly number of customers were used to derive average household consumption.
- Data was compiled for 2003, 2002, and 2001, as it was available for each of the public service districts.
- The zip code of the primary city for each of the service districts was used to determine the representative county for further calculation. (Many public service districts transcend zip code and/or county lines and accurate determination of the exact portions of counties served by any individual service district was, at this point, impossible to establish).
- Average annual consumption data was weighted by the number of residential customers observed as purchasing metered service (households) to derive a county-level consumption figure.
- All but 6 of West Virginia's 55 counties provided a reliable estimate of annual water consumption per household using this method without modification.
- Data for Randolph and Ritchie Counties were obtained from the public service district annual reports. However, careful examination indicated that the resulting figures for these two counties were outliers as compared with the remaining observed averages as they were in excess of 5 standard deviations of the mean consumption level for all observed averages within the state.
- Averages for Cabell, Doddridge, Gilmer and Wirt Counties were not available

[8] The USGS estimates that self-supplied industrial water users' net consumption is between 10 and 40 percent of withdrawals.

from the public service district annual reports.

- To develop workable averages for these 6 counties, a spatial average was calculated based upon the counties bordering the counties with the absent consumption value. These were also weighted by the number of observed residential customers in each tabulated county. The number of counties used to calculate each new figure was necessarily limited by the geography and established boundary lines.

Population estimates from the U.S. Census Bureau were used to gather an average annual rate of population change for each of West Virginia's 55 counties.

- Estimated population changes from the Population Estimates Program at the U.S. Census Bureau for each year, beginning in July, were used to determine the average rate of change at the county level.[9]
- Straight-line projections for each year, 2005 to 2010, were maintained for counties. The straight-line method employed in these calculations appears to follow in-line with state level population projections through the year 2010 also produced by the Census Bureau. However, the state level projections indicate a marked decline in population for estimates in 2015, 2020, 2025 and 2030. This indicates that using the straight-line projection for population change beyond the 2005-2010-time period would be unreliable.
- Using the annual rate of population change for each county, population estimates for each year in the projection period 2005 to 2010 were calculated.
- The approximate number of households for each year was calculated via an estimate of average household size from the 2000 U.S. Census Summary Tape File 3 Long Form (1 in 6 sample).
- Average annual consumption patterns from the public service districts aggregated to the county level were then applied to the population projections to estimate annual water consumption in gallons per county.
- A range for each county using a +/- one standard deviation from the mean of all observed consumption patterns was also developed as a check figure to ensure the likelihood that the estimates were reliable.
- No significant outliers were observed upon comparison of the estimates and their expected ranges.

Figure 25 shows the expected change in residential water use by county. As expected, the largest increases are concentrated in the Eastern Panhandle and Putnam County.

[9] http://www.census.gov/popest/counties/

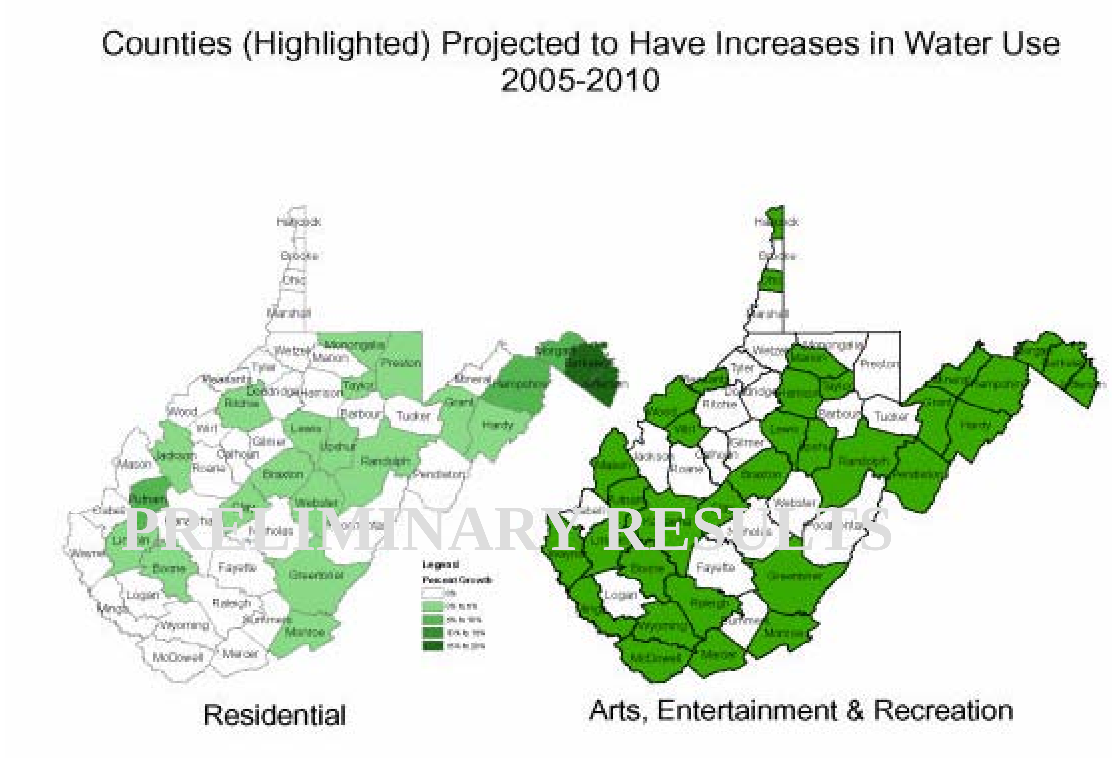

Figure 25. Counties Projected to Have Increases in Water Use: Residential and Arts, Entertainment and Recreation

7.3.6 Arts, Entertainment, and Recreation

Golf courses are the majority consumer of water in this sector, and consumption for this category of activity varies considerably. Golf courses in the DEP survey reported gross consumption equal to net consumption of between 1,800 GED for a small course and 15,000 GED for a larger course. For the purposes of this analysis, if a golf course employed 20 people or less it was considered a small course, and the 1,800 GED net consumption rate was applied. For larger golf courses the larger rate was applied. According the WVBEP, forty counties in West Virginia have golf courses.

Most other categories of activity were assumed to consume 175 GED. This rate was taken from the USGS survey and was applied to include health and fitness centers, racetracks, performing arts centers and bowling centers, and other types of recreational facilities. A 15% net rate of consumption was applied. Due to projected overall industry growth, within this category more counties are projected to have increasing water consumption than decreasing. Overall net consumption rises from about 14.2 mgpd to about 14.7 mgpd. Figure 25 above provides a spatial representation of counties expected to see increased water use from increased economic activity in this sector.

7.3.7 Forestry, Fishing, Hunting, and Agriculture

Farm animals comprise the bulk of water use in this category. County level data on the number of animals was combined with estimates of water use per animal to calculate total withdrawals for this sub-group. All 55 counties have livestock. The number one livestock producing county and thus water consuming county for this activity is Hardy County, followed by Pendleton County and Grant County. Water use per animal per day was calculated as follows, based on data estimated by the Pennsylvania State University[10]:

- Milk Cows (50% of cattle) – 35 gallons
- Dry Cows (beef cattle or steers, 25% of cattle) – 12 gallons
- Calves (10% of cattle) – 3 gallons
- Heifers (15% of cattle) – 8 gallons
- Swine – 1.5 gallons
- Horses – 12 gallons
- Sheep or Goats – 2 gallons
- Chickens (per 100 head) – 9 gallons
- Turkeys (per 100 head) – 15 gallons

A net use coefficient of 80% was applied for livestock. This rate represents that estimated by a number of eastern and mid-western states including Illinois, Indiana, Michigan, Minnesota, Ohio and Pennsylvania.[11] Other categories of water use in this industry are fruit and vegetable crops and logging. Little data or estimation was available regarding water use for crops or for logging. The USGS estimates provide gross use coefficients of 25 GED for some crops and 1,600 GED for logging, but do not estimate net consumption. These rates were applied based on the number of employees in each of these categories, with a net use rate of 90% assumed for crop production.[12] A net use rate of 2% was assumed for logging. No timbering operations were included in the DEP survey and no alternative source could be found that provided an estimate of consumption for that industry.

As described in Table 6, the state is projected to experience declines in employment in this economic sector. Water use is projected to decline at about four percent per year, although the counties that saw recent growth in this sector are projected to experience a one percent annual increase in water use. These counties are shown in Figure 26 below. This industry is worthy of additional analysis, as it is possible that efficiencies of production could overcome employment changes and the direct water use to employment relationship assumed.

[10] The Pennsylvania State University, College of Agricultural Sciences (2003). " Estimating Water Use For the Farm and Home."
[11] Great Lakes Commission and the Water Withdrawal and Use Technical Subcommittee of the Water Resources Management Decision Support System Project, 2003. "Measuring and Estimating Consumptive Use of the Great Lakes Water"
[12] Ibid.

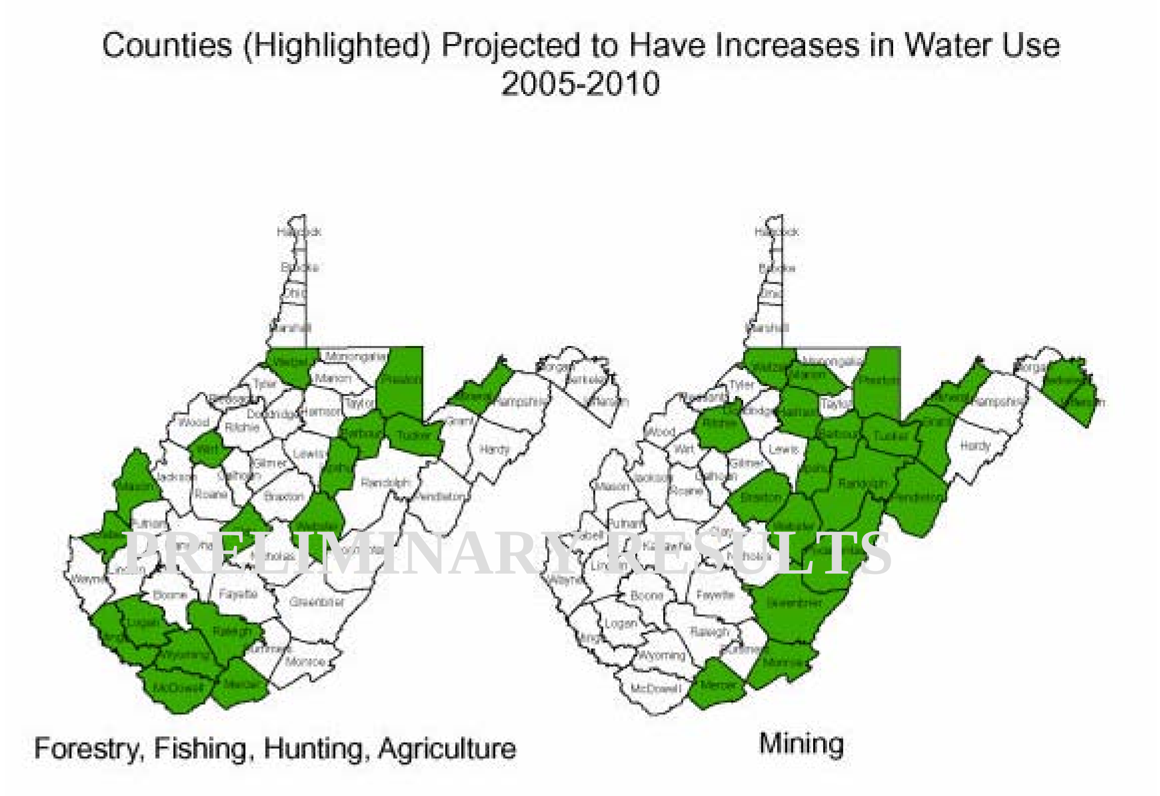

Figure 26. Counties Projected to Have Increases in Water Use: Forestry, Fishing, Hunting and Agriculture and Mining

7.3.8 Mining

7.3.8.1 Coal Mining

Estimation of both withdrawals and net consumption for the coal industry is difficult. Reported withdrawals per ton of coal mined varied considerably when calculated using a per ton or per employee rate. This is most likely the cause of the varying amount of water required for different grades of coal and different mining techniques. While most coal requires processing, some low sulfur, surface-mined coal often requires little processing and can be shipped run-of-mine.

Tonnage was chosen as the unit of consumption to evaluate due to the availability of county-level production numbers and the ability to forecast those levels. The DEP's water use survey provided a range of water use per ton. For operations where the combined mining and processing tonnage was known, the middle range was about 30 to 40 gallons per ton for mining and about 60 gallons per ton for processing. Based on these numbers, a rate of 95 gallons per ton was applied to total coal production to arrive at an estimate of water withdrawals for the 27 counties that produce coal.

The source of water used for mining is also worthy of further analysis. Groundwater that is transferred to the surface as part of the dewatering process prior to underground mining is not considered consumptive use. This practice applies most often to underground mines as groundwater is typically re-injected into the geological formation. Surface mines do not re-inject groundwater and any resulting displacement of groundwater is thus consumptive. Based on the DEP survey results, it is not possible to get a complete picture of the quantity of groundwater transferred. The encountering of groundwater during the mining process is a function of the water table, and the need to use groundwater for processing or dust control depends on the availability of other sources. Both these variables are not uniform in mining regions and may vary considerably by surface and underground operations.

About one-third of mining operations reported use of groundwater, with portions that ranged from 2% to 100%, with an average of 20%. For this analysis it was thus assumed that 20% of water used for mining is displaced groundwater, and that that rate represents net consumption for mining. This rate was applied to forecasted county-level coal production to arrive at net water use for this industry of nine mgpd in 2005. However, because the survey sample is not a statistically significant representation of either surface or underground operations for either mining or preparation, this rate is considered preliminary and needs additional analysis.

County-level coal production was calculated based on historical trends and accounts for differences in surface and underground mining. Each county's portion of total coal production was projected to remain constant through 2010, as was their portion of surface and underground coal production. Total production in West Virginia was based in part on the "Consensus Coal Production Forecast for West Virginia"[13] That forecast was pushed out by two years to account for the recent and sustained increase in coal prices and production experienced in 2004 and to date in 2005. Projected county-level increases and decreases are shown above in Figure 26.

It is likely that other variations in mining operations could also impact the quantity of water used. For example, some surface-mined coal in the southern part of the state may require less processing water per ton than surface-mined coal in the north. However, due to the difficulties of estimating what portion of production this might be, all coal was assumed to require the same quantity of water per ton, and no distinction was made between location and mode of production. Again, due to regional variation in mining and processing techniques and the resulting variation in water consumption, further analysis for this industry group is recommended.

7.3.8.2 Stone Quarries

One limestone quarry reported water consumption to the DEP. That rate was applied to all limestone quarries in the state based on the GED reported by that single producer. That reported GED was 12,078. Net use was reported as 10%. These rates were applied to operations in all 19 counties for which the DEP reported this type of mining. Use is projected to increase slightly, in line with overall mining employment.

[13] Hammond, George W, 2004. West Virginia University, Bureau of Business and Economic Research

7.3.8.3 Oil Production

West Virginia produced 1,339 barrels of oil in 2004. Of this quantity, about half is produced using secondary oil recovery methods, including water injection.[14] Wells that use production water re-inject that water back into the geological formation and the use is non-consumptive. Water injection wells that use non-production water and where water is not returned to the originating body are considered consumptive use. Thus, for this analysis only production of that nature is included. In West Virginia, this type of use is confined to Wetzel County, where production is expected to increase, and by 2010, water use will return to 2003 levels for this activity.

7.3.9 Other Industries

The following industries' gross water use is based on the withdrawal estimates calculated by the USGS. The growth projected for most of these industries is representative of overall growth in the service sector, with much of the impact on demand for water to be seen in increasing demand from commercial buildings. The large majority of these industries will demand water from public supply.

With the exception of public administration, these industries are projected to experience overall annual employment growth through 2010, at rates of between 0.2% and 2.3%. Net water is assumed to be 15%. The combined total water consumption for these industries is less than the each of the other industries profiled thus far.

Accommodation and Food Services. A gross water use coefficient of 187 gallons per employee per day was assumed for this category of activity. Positive growth is expected for all but 12 counties.

Construction. A gross water use coefficient of 20 gallons per employee per day was assumed. Growth is expected for 23 counties and overall growth leads declines.

Utilities. A water use coefficient of 7 gallons per employee per day was assumed for utility services. With the exception of Doddridge County, all counties have employment in utility services. This level of activity excludes the power generation process. That water use is accounted for separately under thermoelectric power generation. Growth is expected in 23 counties. Overall, declines lead increases.

Wholesale Trade. This category is broken down into durable and non-durable goods. A water use coefficient of 21 GED was assumed for durable goods, and a coefficient of 77 GED was assumed for non-durable goods. Employment in the two categories varies by county, with most counties having more activity in durable goods. Statewide, about 60% of the employment occurs in non-durable goods. However, as expected, the more agricultural counties have larger portions of employment in non-durable goods. The range for the population of counties is 21, for four counties with no wholesale activity in non-durable

[14] Energy Information Administration, 2005. www.eia.doe.gov/oil_gas/petroleum/info_glance/crudeoil.html.

goods, and 77 for two counties with no wholesale activity in durable goods. Growth is expected in 18 counties.

Educational Services. A gross water use coefficient of 56 GED per day was assumed for this category of activity. Growth is expected in 23 counties.

Healthcare and Social Assistance. A gross water use coefficient of 70 GED was assumed for this category of activity. Growth is expected in all but nine counties.

Retail Trade. A gross water use coefficient of 31 GED was assumed for this category of activity. Growth is expected in 20 counties.

Other Categories. Industries with businesses that operate out of commercial office space are assumed to have gross water use of 47 GED. These include: Administration, Support, Waste Management and Remediation, Information, Finance and Insurance, Real Estate Professional, Scientific and Technical Services, Management of Companies and Enterprises, Public Administration, Other Services, Unclassified Establishments and Transportation and Warehousing.

With the exception of Public Administration, growth is expected in all these industries statewide. That growth is spread throughout West Virginia's 55 counties, with more counties seeing growth than declines for these activities.

7.3.10 Conclusions

This analysis projects net water consumption for the State of West Virginia based on forecasts of economic activity. Consumption is calculated at both the county and industry level (Appendix L). The largest increase in water consumption is expected to occur in thermoelectric power generation. Other increases are expected in the food and lodging industry, the recreation industry and in what is termed for this analysis, the "rest of the economy" that represents the service industries, education, healthcare and construction. Over the 2005 to 2010 time period, small declines are projected in the mining industry and larger decline in the agriculture and manufacturing industries.

By county, changes in water use are a function of expected levels of economic activity. For this report, this is an expectation of the continuation of recent trends. Thus, growth in water consumption is located in most of the Eastern Panhandle, the northern counties with the exception of the Northern Panhandle, and the counties in which power generation facilities are located. Declines in consumption are expected in most of the mid-Ohio valley counties, many of the central counties, the southern counties and in the eastern counties due to declines in agricultural employment. Overall, 19 counties are expected to have growth in water consumption and growth leads declines as West Virginia as a whole is projected to see growth of 3.7% over the forecast time period.

The estimates reported here should be considered imperfect, but reasonable approximations of actual consumptive water use. Projections for most sectors could be improved with more thorough evaluation and more data. A primary issue is the calculation of net versus gross consumption. Little data exists on which to base net consumption equations. A more in-depth review of the DEP user survey combined with acquisition of other state data could prove informative and help to refine these preliminary estimates.

7.4 Areas Where Competition for Water Resources May Occur

The goal of this task is to evaluate potential competing use scenarios regarding existing water resources for both surface water and groundwater. Estimates of the supply of surface water are not available for all bodies of water, nor are groundwater data available. Because the question of potential competing use requires analysis of demand and supply of both surface and groundwater, this analysis could not be completed. However, some data on groundwater use was collected from the DEP's major user survey that provides a starting point on which to evaluate this issue.[15] It is expected that additional insight on how to compare water demand data with data on water availability will develop in the next stage of this project.

[15] The DEP survey results have considerably more information on the use of groundwater and surface water by facilities than was able to be incorporated into this analysis. Not all the data was provided in enough detail to attribute consumption to a particular county and industry.

Chapter 8 - Interfering Water Withdrawals

Of the 383 surveys received by DEP in 2005, none of the respondents indicated that their ability to withdraw water was negatively affected by withdrawals from other individuals or businesses using the same water source. However, since only major water users were required to complete the survey, it is unknown whether any minor users were adversely affected by competition for the same water source. It would be difficult for DEP to predict with current data whether conflicts for water supplies might arise in the future. However, it is logical to assume that conflicts would be more likely to occur on smaller streams where water quantity is more limited.

Research has revealed two historical cases of water use conflict between adjacent riparian landowners: *Halltown Paperboard Company v. The C.L. Robinson Corporation*, 150 W.Va. 624, 48 S.E.2d 721 (1986) and *Roberts v. Martin*, 77 W.Va. 535 (1913). In both of these cases, the court ruled in favor of the lower riparian landowner. The basis of the rulings was that natural flow is a property right that may be enforced by a lower riparian landowner.

A third case involving interfering withdrawals was WVDNR v. Tingler (2005). The DNR faced water scarcity problems in Randolph County when a neighbor began pumping groundwater next to a DNR fish hatchery. The resulting reduced spring flows on DNR property caused the hatchery to close (the case was recently ruled in favor of DNR).

Chapter 9 - Water Conservation Practices
- Water Research Institute of West Virginia University

9.1 Identify Practices to Reduce Water Withdrawals

Given the state's abundance of water resources, water conservation has not been priority for many lawmakers or regulatory officials. Water conservation practices in water rich regions reduce costs associated with water diversion, filtering, transportation, and wastewater treatment.

9.1.1 WVDEP Survey Results

In preliminary results from the WVDEP Water Users Survey, 76 of 383 respondents claimed to practice some type of water conservation practices. These respondents fell within at least 23 different SIC sectors. Of those 76 respondents, some of the water conservation practices listed were not voluntary or were implemented for objectives that were unrelated to conservation strategies but resulted in reduced water use. Practices fell into three Conservation Categories of 1) on-site water reuse or recycling; 2) leak or excess water use detection systems; and 3) eliminating or reducing water use need by employing alternative methods to achieve the same goals.

Washington Works (plastics), in Wood County, stands out among the respondents as having implemented one of the biggest water-saving systems in terms of gallons of water conserved. The plant's survey indicates only, "*Site procedures are in place that include the review of projects impacting water consumption. This review includes consideration of water conservation in the approval process*." The estimated water savings at the plant, which uses ground and surface water for "*Cooling Water, Chemical Reactions, & Steam generation*", is 50,000,000 gallons per month. The facility has capacity to withdraw 3,260,400,000 gallons per month.

The facility is considering plans for "*a project involving the recovery and recycling of steam condensate used in steam production at the site.... This project would conserve the use of ground water.*" Washington Works' planned projects in Wood County would save 13,000,000 gallons per month at an estimated cost of $2,000,000.

Likewise the Follansbee Coke Plant (129,600,000 gallon monthly withdrawal) in Brooke County is saving 31,248,000 gallons per month by using cooling water that was previously discharged as boiler feed water.

Both the Follansbee and Washington Works plants fall into Conservation Category 1, intra-system water reuse. In Conservation Category 2, leak or excess water use detection, Huntington Alloys Corporation (28,000,000 gallon monthly withdrawal) installed leak detection system that reportedly saves the facility 10,000,000 gallons monthly.

A number of coal processing plants cited efforts to reduce water use by recirculating water from sediment ponds back through the facility (Conservation Category 1) and by paving or otherwise treating dusty roads to reduce the use of water in dust-suppression activities (Conservation Category 3).

9.1.2 Case: Toyota

While not the largest water user in the area, the new Toyota Plant in Buffalo, WV is certainly one of the more innovative and progressive facilities in the state in terms of implementing voluntary conservation standards. The plant is implementing conservation plans that will save them millions of gallons of water per year. While there is no water shortage in the Buffalo area, Toyota understands that capturing, filtering, transporting water, and treating excess wastewater are all costly activities. Reducing use, therefore, reduces operating costs. Toyota's goal is to match the plant's own zero solid waste discharge standard in the area of water resources.

According to Toyota's environmental specialist, Sean McCarthy, stormwater from about 100 acres of impervious surface (building and parking lot) is already captured and used for landscape irrigation (20-25 acres), saving the plant .5 million gallons/year.

Currently, the plant is losing 14 million gallons/year to evaporation while operating its cooling compressors and tower. In an effort to reduce this loss, the plant is in the final research and development stages of an on-site water treatment facility that will help save 10-11 million evaporated gallons/yr. This move will also reduce the plant's demand on the local public water utility to 3 million gal/yr. Just 20 miles outside of Charleston, this demand reduction will provide the city of Buffalo with important opportunities to extend public service to growing residential and commercial demand without incurring additional capital costs for water system expansions.

Chapter 10 – Data Warehouse

- Center for Environmental, Geotechnical and Applied Sciences of Marshall University

10.1 WV Water Resources Information Management System

To assist the Secretary of WVDEP in meeting the mandates of SB 163 the WVWRI and the CEGAS have teamed to provide qualitative and quantitative water resource assessment tools. Key components have been interfacing and coordinating with WVDEP; collecting existing water resource data; and establishing the WV Water Resource Information Center at CEGAS/RTI, Marshall University.

The CEGAS server will be the entry point for new water resource data. The new/transferred data will be "cleaned" and formatted to the new geospatial data standards. The CEGAS system will function with the RTI data warehouse, which can house up to 10 terra bytes of data (911, DOT and state photogrametry), to develop a significant reporting, mapping and analytical capability for the state of West Virginia.

10.1.1 Goals

- Integrate water related data from various sources
- Clean the data
- Store data in a standard database format
- Make data available through secure, role-based web access
- Support queries using standard query language
- Implement default queries to fulfil typical data requirements
- Support data editing functions and tracking of changes

10.1.2 Data Files

- PSDs
  - Public Health Sanitary survey
  - WRPA Water Survey
- Large-Usage Industrial facilities
  - WRPA
- Water Sources
  - Groundwater (wells and springs)
    - Sanitary Survey groundwater
    - WRPA groundwater
    - USGS groundwater data
    - Well historic water level data
  - Surface Water
    - WRPA groundwater
    - Stream gauge drought severity
  - Purchased Water
    - WPRA purchased water

- Water Discharge
    - WRPA Data
- Precipitation
- Aquifer definitions
- Watershed definitions
- Climactic regions
- County
    - Population data
- Drought data
    - Stream gauge data
    - Well list data

10.1.3 Spatial Data Standard (SDS)

- Developed by the Corps of Engineers CADD/GIS Technology Center
- Becoming standard database for storing utility data with geospatial data
- Some SDS entity sets:
    - Common – facilities, owners, addresses, point-of-contact, counties
    - Utility – water utilities, water plants, water sources
    - Hydrography – aquifers, watersheds, surface water, groundwater
    - Improvements - wells
- Advantages
    - Single standard database to hold majority of data listed on previous slide
    - Include tabular data with geospatial data (aquifers, watersheds, counties)
- Disadvantages
    - Some common entities, such as PSD, Facility, and water source are not linked to other entities in the expected manner.
    - Set of codes used in spreadsheets may not be available (remap codes)

Currently CEGAS is mapping WV data sets to SDS database.

10.1.4 Current Status

- SDS Database has been built as MS Sql Server Database
- Correlation matrix has been built for some files
- Correlation matrix includes SQL script to load data into SDS database
- Historic data added as separate tables (left in original format)
- Moving database (minus lat/long) to CEGAS server
- Building web pages to display some of the basic data

10.1.5 Next Steps

- Consolidate well data from different well data sources
    - (match wells where possible using description, lat/longs, etc)
- Determine default settings for various well data status fields

- Examine unmapped fields and determine what to do with them
- Add additional queries
- Add update functions
- Add geospatial tables for:
    - Aquifers
    - Watersheds
    - Climatic divisions
- Add meta-data descriptions

Chapter 11 – ASIWPCA Survey

In an attempt to gain more knowledge about the possibilities of a statewide water use program in West Virginia, a questionnaire was sent to the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). This survey asked respondents to provide information about program(s) to control or monitor their state's water resources. Specific data concerning type of program, program length, withdrawal amounts, statewide annual water use, program budget, and obstacles/challenges were requested. Of the states that responded, most had some type of permitting or withdrawal registration program, ranging in age from newly developed to 100 years. The mean water withdrawal amount that required registration was 100,000 gallons per day and the annual budgets ranged from $60,000 to $6,000,000.

A common response among all that provided feedback about their programs was the challenge of implementation. Most cited lack of funds or inadequate staff, difficulty with public/permitee cooperation, or challenges to data collection. Complete results are listed in Appendix G.

Chapter 12 – Rules

After consultation with numerous interest groups, The DEP determined there was a need for rules to address concerns regarding penalties and confidential information requests. The first rule, “Administrative Procedures and Civil Administrative Penalty Assessment – Water Resources Protection Act”, 60 CSR 6 (Appendix J) became effective May 16, 2005. To date, the DEP has not believed it necessary to assess a penalty under the authority given in the Act.

The second rule, 60 CSR 7 “Confidential Information Under Water Resources Protection Act” (Appendix K), had an effective date of October 11, 2005. Only two requests for confidentiality were received. One accompanied an explanation for why the company should not be required to complete the survey. The DEP agreed with the company’s position, and since there was no need to retain the information, it was returned. The second request involved public water supply intake locations. Since DEP determined, in consultation with the Department of Military Affairs, West Virginia Division of Homeland Security, that such information was considered secure critical infrastructure data, and thus confidential, the request did not require further action.

The DEP has executed security agreements with MU and WVU, and has requests from the USGS and the ICPRB pending. The DEP envisions execution of these pending agreements by the end of January 2006.

Chapter 13- Conclusions and Recommendations

West Virginia has taken the first step in understanding the scope of one of its most important natural resources: water. Activities undertaken during the past year by the Department of Environmental Protection, Marshall University, and West Virginia University have been aimed at identifying and quantifying the water resources of the state and how they are utilized.

We now realize how much we do not know about the state's water resources. This realization is an important first step that cannot be over emphasized. We know that we have enough existing data to make a reasonable analysis of the surface waters of the state. However, that analysis will be greatly enhanced by the completion, in 2007, of the low- and median-flow stream models being developed by the United States Geological Survey under contract from the DEP. We know that groundwater data is woefully inadequate for an analysis of use, and to understand this resource will take several years and a long-term investment of both personnel and money. We know which areas of the state are expected to experience the most growth in water usage, and can use this knowledge when mapping a water use strategy for the state. We know, with reasonable certainty, the major water users in the state, where they are located, and how they utilize their water. We are aware that a more thorough understanding of the water resource will require long term data collection, and that federal and state funding for gauging stations is dwindling.

Notwithstanding all of this effort, data collection and analysis remains incomplete. The 2005 water use survey will be released in January 2006, and the DEP will continue to collect data from other agencies and bordering states. Preliminary analysis of the existing data has poignantly identified where data does not exist. This information is vital to the understanding of water location and quantity within the state. Though final analysis must wait until 2006, initial review of the data has served to refine the scope of the DEP's coming efforts.

The following constitutes recommendations on what actions need to be taken during the upcoming year:

- Marshall University and West Virginia University have stated that for continued support on the Water Resources Protection Act, they have budgetary needs of $155,000 and $108,000, respectively (Appendices H and I). These funds will ensure continued research and support, and operation and maintenance of the data warehouse at the Nick J. Rahall II Appalachian Transportation Institute.

- The primary problem with the existing data is the lack of long-term information from which to draw any meaningful conclusions. Although the following information will not result in a complete understanding of the ground water resources of the state, it is essential for any future understanding of this important state resource. The DEP recommends that the state move toward making long-term commitments for both ground water and stream gauge monitoring:

- The United States Geologic Survey (USGS) recently lost federal funding for nine ground water monitoring wells. According to USGS, a one-time expenditure of $9,200 for installation of gauges and telemetry radios for two wells and a yearly expenditure of $36,000 for the operation of all nine wells is needed.

- In addition, the USGS will lose federal funding for stream gauges in 2006/07. According to USGS, $81,000 is needed for continued stream gauge monitoring at sites that will lose funding and $100,000 is needed to install new stream gauges.

Water is a vital natural resource, which West Virginia normally has in abundance. An understanding of the surface and ground waters of the state, and how they are interrelated, is essential for the wise management of that resource. Continued support from the Legislature, and the people of the state for whom the waters have been claimed, will ensure this valuable resource is wisely managed.