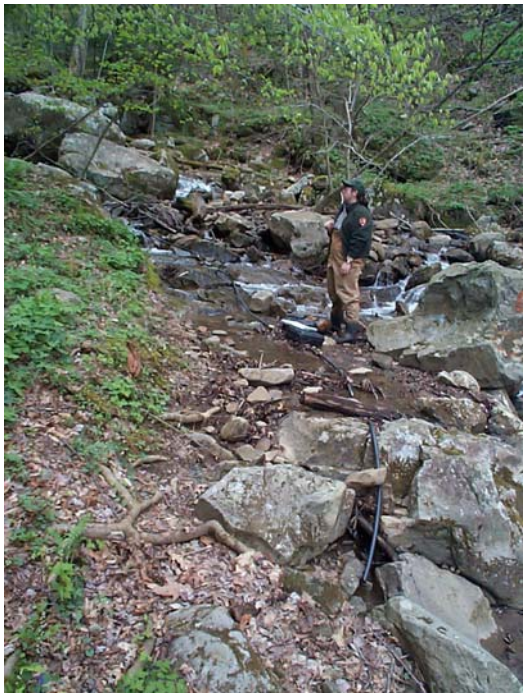
Water Quality Monitoring Program 2001- 2003
New River Gorge National River
Bluestone National Scenic River
Gauley River National Recreation Area



Lisa Wilson
Karen Vandersall
Jesse M. Purvis

July 2006

New River Gorge National River was established by Public Law (PL) 95- 625 on November 10, 1978. The park was created to conserve and interpret outstanding natural values and objects, and to preserve an important segment of the New River as a free- flowing stream for the benefit and enjoyment of present and future generations.

Gauley River National Recreation Area was established on October 26, 1988 by PL 100- 534. The park was created to protect and preserve scenic, recreational, geological, and fish and wildlife resources of the Gauley River and its tributary, the Meadow River.

The legislation that established Gauley River National Recreation Area also made boundary adjustments to New River Gorge National River, and amended the Wild and Scenic Rivers Act (16 USC 1274(a)), to designate Bluestone National Scenic River. This designation was made to protect and enhance the natural, scenic, cultural and recreational values of a free- flowing segment of the Bluestone River for the benefit and enjoyment of present and future generations.

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Cover: Two photographs, taken three months apart, of the same site on Slater Creek in New River Gorge National River, show the magnitude of impacts from the flood of 8 July 2001. The top photograph was taken on 16 April 2001, while the bottom one was taken on 23 July 2001. Note the small size of the stream in April, when National Park Service Biological Technician Lisa Wilson can nearly step across the channel. Flooding deepened and widened the channel so much that in July Lisa is nearly lost among the debris flow of boulders.

United States Department of the Interior
National Park Service
Glen Jean, West Virginia

June 2006

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EXECUTIVE SUMMARY

New River Gorge National River and Gauley River National Recreation Area contain some of the most popular and demanding whitewater recreation in the eastern United States. New River Gorge National River supports the most significant and highest quality warm water fishery in West Virginia. Bluestone National Scenic River remains one of the last vestiges of relatively undisturbed reaches of riverine habitat in the central Appalachians, and provides outstanding opportunities for solitude. Taken together, these three parks represent some of the most significant water resources in the National Park System.

Situated in the Kanawha- New River basin of the Ohio River drainage, areas in and around the three parks have experienced extensive resource extraction activities. Mining of low- sulfur coal and timbering removed vegetation and led to increased erosion and sedimentation. Development of automobile and rail transportation networks, and communities to handle the influx of people, inflicted further impacts upon the land, and upon the streams draining the land.

As coal and timber were depleted, many people lost their jobs and moved away. Decreased resource extraction allowed re- establishment of natural communities and ecosystems. Lush mixed mesophytic forests now cover most of the three parks. Commercial whitewater rafting, rock climbing, angling, and other outdoor activities now draw hundreds of thousands of visitors to the New River area.

Appalachia has a long history of impoverishment. Today this is reflected in infrastructure that is often less than adequate. Sewage treatment is woefully inadequate in many areas, including the New River watershed in the vicinity of the three parks. In areas with inadequate sewage treatment, untreated or partially treated household sewage commonly ends up in local streams and rivers.

The National Park Service monitors water quality for indicators of human domestic waste pollution, in and around the three parks. This monitoring is designed to assess the state of park resources and the potential health risk of people engaged in water- based recreational activities. This report presents water quality data collected from 2001 through 2003.

This report provide a general overview of water quality conditions and trends over the monitoring period, including special analyses of water quality following the floods of July, 2001, and of water quality following storm events. These data, when combined with data from previous years, provide a broad basis for evaluating status and trends of water quality in the three parks, and permits National Park Service decision- makers to more accurately assess activities that may impact, or be impacted by, water resources.

ACKNOWLEDGEMENTS

Our thanks is extended to the following people and agencies for their assistance with this study: United States Army Corps of Engineers, Bluestone Dam, Hinton, West Virginia and Summersville Dam, Summersville, West Virginia; United States Geological Survey, Water Resources Division, West Virginia District; West Virginia Department of Natural Resources, Bluestone State Park and Pipestem State Park; West Virginia Department of Environmental Protection Inspectors Ron Garrett, Susan Kershner, Nick Lewis, Larry Robertson and their supervisor, John Fredericks; National Weather Service, Beckley and Charleston, West Virginia; the family of Charles Page Kuntz; former plant operators Kim Deane and Jack Pennington of the Mount Hope Waste Water Treatment Plant; and plant operators Mike Giannini of the Oak Hill Sewage Treatment Plant, Randy Atwell of the Fayetteville Sewage Treatment Plant, Robert Zimmerman of the Arbuckle Public Service District, and Frank Morris of the White Oak Public Service District.

Completion of this report benefited from the contributions of specialists at New River Gorge National River. Andy Steel produced the maps. Greg Phillips provided expert computer assistance. Field and laboratory assistance was provided by Kathy Oney, Jacob Hess, James Barker, Mary White, Angel Allen, Sarah Coffey, Jennifer Lynch, Steve Robinson, Lori Hindson, and Bryant Brim. National Park Service rangers Brian Hunter, Dave Finch, Sandy Shuck, Joe Coughlin, Adonis Martin, Andy Blake, and Audie Critchley supported this effort during river trips to collect some samples.

Additional thanks are extended to staff from other Divisions at New River Gorge National River and other individuals whom we may have neglected to mention.

The summary boxes for each monitoring site are based on a suggestion from Dr. C. T. Purvis.

TABLE OF CONTENTS

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INTRODUCTION

WATER QUALITY MONITORING PROGRAM

The history of water quality monitoring by the National Park Service in New River Gorge National River (NERI), Bluestone National Scenic River (BLUE), and Gauley River National Recreation Area (GARI) was summarized in a previous report (Wilson and Purvis 2003). Basically this effort began in 1980, approached its present form in 1987, and continues to the present. Monitoring of Bluestone National Scenic River and Gauley River National Recreation Area began in 1991. Monitoring has focused on fecal coliform bacteria, an indicator of sewage pollution.

Fecal coliform bacteria live in the lower gut of warm- blooded animals (mammals and birds), and are excreted with the feces. Fecal coliforms are not necessarily pathogenic (disease- causing). However, other microorganisms (including bacteria, protozoa, and viruses) that are pathogenic also live in the lower gut and are excreted with the feces. Fecal coliform bacteria are relatively easy to detect, and serve as an indicator of sewage pollution. They are the basis for a relevant water quality standard. The State of West Virginia standard for waters suitable for primary contact recreation is that fecal coliform bacteria not exceed a density of 200 per 100 milliliters (200 FC/100ml) of water (West Virginia Water Resources Board 1998). This standard is based on the geometric mean of at least five samples per month. Alternately, waters should not exceed 400 FC/100ml in more than 10% of samples taken during a month. Fecal coliform bacteria can be influenced by temperature, environmental conditions and water type (Pipes 1982).

Several reports summarize the water quality monitoring effort (West Virginia Department of Natural Resources 1988, 1989; Wood 1990a, b, c; Schmidt and Hebner 1991; Hebner 1991a, b; Sullivan 1993a, b, c; Gibson 1993; Purvis and Wilson 1999; Wilson and Purvis 2000, 2003).

THE 2001- 2003 EFFORT

This report presents water quality data collected by the National Park Service at the three parks between 2001 and 2003. These data represent the primary monitoring effort to determine baseline conditions, as well as special monitoring to evaluate impacts of the July, 2001 floods.

Baseline monitoring is a continuation of the existing water quality monitoring program. Baseline monitoring is designed to produce a long- term estimate of average conditions in the streams of the three parks. Samples for baseline monitoring were collected at 43 sites, 33 associated with NERI, and five each

associated with GARI and BLUE. Samples were analyzed for basic field parameters (temperature, conductivity, turbidity, dissolved oxygen, and pH), and fecal coliform bacteria. Interpretation of the results focuses on fecal coliform bacteria, and their relationship with factors (turbidity, discharge, recent precipitation, land use, and sewage treatment patterns) shown to be related to changes in fecal coliform density.

Some changes were made in the baseline sampling sites during 2001 – 2003. New sites were added in 2003 to try and obtain a better definition of the relative influence of the New and Greenbrier Rivers. Two sites, New River below Bluestone Dam and Greenbrier River at Willowwood, were added to obtain water quality information above the confluence of these two rivers. Also, it was felt that even though the New River at Hinton Visitor Center site was below the confluence of these rivers, that the islands below the confluence limited mixing of the two rivers at this site. Since more complete mixing should occur by Brooks Falls, the New River at Brooks Falls site was added. One site, New River above Sandstone Falls was discontinued. Comparison of data from this site and the New River below Sandstone Falls site showed minor difference that may have been attributable to the slow river current velocity of the site above the falls, and that the site below the falls provided a more representative picture of water quality in this area. Other site changes were made to try and obtain a better definition of tributary stream influences. The New River at (below) Prince site was replaced after 2002 by the New River below Laurel Creek site. This change also accommodated a safety concern, as samples from the Prince site had been taken from a heavily traveled bridge. Another site, New River below Piney Creek, was also added.

In addition to the above changes in New River sites, changes were also made in some tributary sites. Regular sampling began at Mill Creek, since it is crossed in reaching the Glade Creek site. Dowdy Creek was discontinued as a regular site after 2002 because fecal coliform densities were always extremely low (maximum = 11 FC/100ml) in this stream that drains a sparsely populated watershed. Another site, Slater Creek at mouth, was added because the community of Thayer lies between this site and the Slater Creek at McKendree Road site. Two sites, Keeney Creek above Winona and Keeney Creek below Winona, were added for several reasons. Improvement of a State Road allowed more reliable access to Keeney Creek below Winona, so we moved the Keeney Creek sampling site closer to the park boundary. This provides a better picture of water quality in the park, and permits integration of all of the contribution from the community of Winona into the samples. Both the long- standing Keeney Creek at Winona site and the new Keeney Creek below Winona site will be sampled for several years to get good correlation between the two sites. Also, Winona has been chosen for a demonstration project to provide sewer equivalency to this presently unsewered area through the use of non- centralized wastewater treatment technologies. The

Keeney Creek above Winona site was added at the request of the Fayette County Water Quality Coalition. Comparison of data from this site and the site below Winona will provide a better evaluation of the success of the sewer equivalency project, and will demonstrate the magnitude of wastewater treatment needs for the inhabited area of the Keeney Creek watershed above Winona as Fayette County pursues a county- wide wastewater treatment plan.

The New River Gorge National River area experienced severe flooding on July 8, 26 and 29, 2001 (Resource Assessment Team 2001). As much as 11 inches of rain was reported in about 7 hours on July 8. This produced major flooding in several streams, including most New River tributaries from Laurel Creek (Quinnimont) north. The high volume of water and sediment being discharged by these streams, and their steep gradients within New River Gorge, resulted in large debris flows. Boulders larger than automobiles were moved significant distances downstream in the more severely affected tributaries, streams jumped their banks, channels were incised deeper and widened, roads and trails were washed away, sewage systems were damaged or failed, and many streams were scoured to bedrock.

Just as the area was recovering from the July 8 flood, additional significant rain fell on the still saturated soil on July 26 and 29, and more flooding ensued. These later floods were generally not as severe as the flood of July 8, although the July 26 flood did reach the same height at park headquarters in Glen Jean (Dunloup Creek) as the earlier flood. The July 29 flooding also affected tributaries to Gauley River National Recreation Area.

In response to these events, the National Park Service devised schemes to examine the impact of such large floods on water quality. Since the July 8 flood damaged the water quality laboratory at park headquarters, initial flood response sampling did not begin until the week following that flood. Because the flood response sampling schemes, including many sampling sites, were so different from the baseline monitoring program, this material is presented separately. Initial results of the 2001 flood monitoring were presented in an earlier report (Vandersall and Purvis 2001). That report was produced in a short time frame as part of an emergency response plan (Resource Assessment Team 2001), and precluded in- depth data analyses. Such analyses are presented in this report.

Most samples were analyzed by National Park Service staff at the New River Gorge National River Water Quality Laboratory at park headquarters. Due to flood- damaged facilities and sampling volume, many of the 2001 flood samples were analyzed by one or more of the local commercial testing laboratories. Also, to check on data accuracy and reliability (quality assurance/quality control or QA/QC), some samples were split, and one or both portions were analyzed by one or more of the commercial laboratories.

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METHODS

STUDY AREA

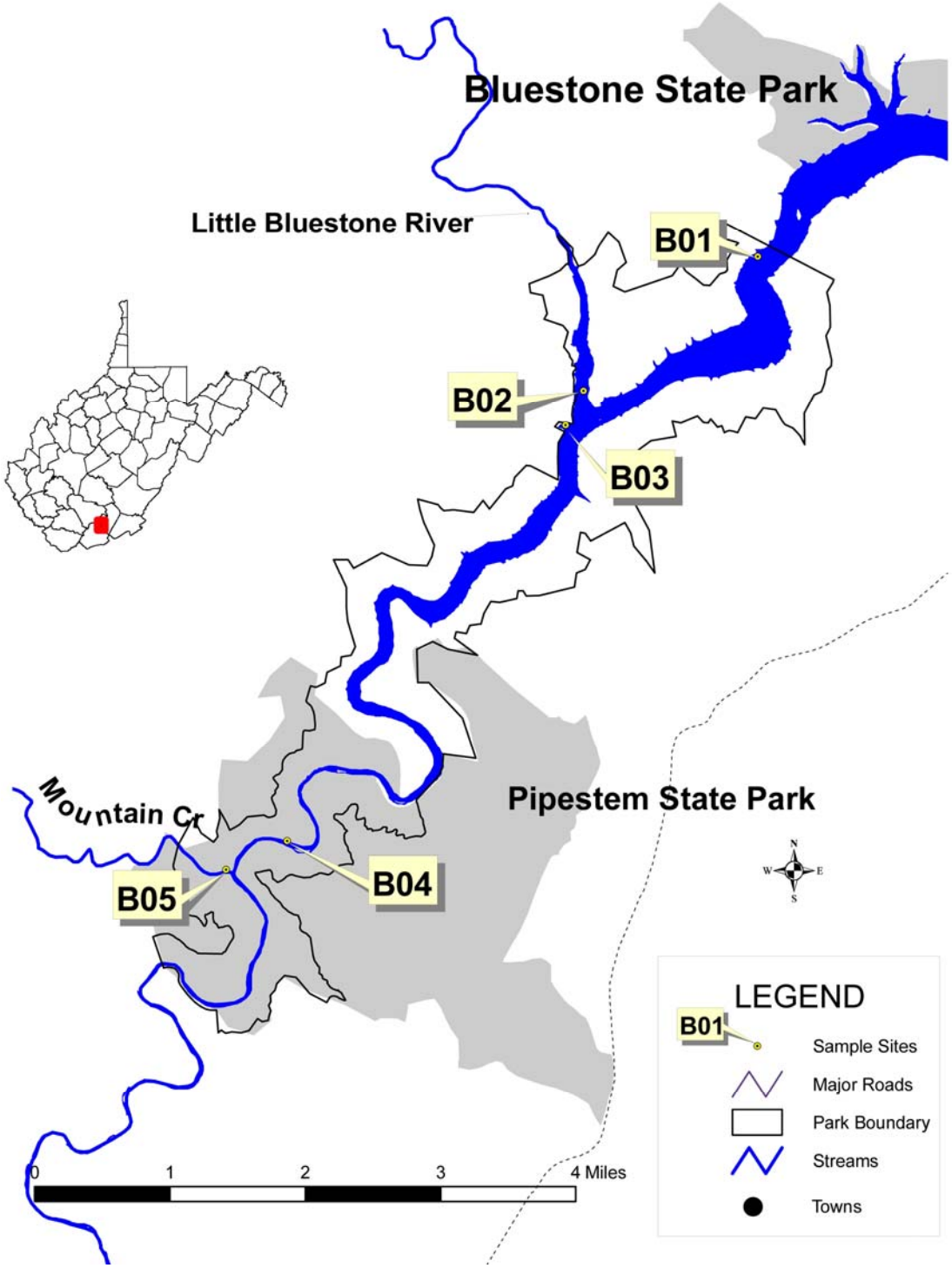
All three parks lie within the Kanawha- New River watershed (Fig. 1). The New River begins in the Blue Ridge Mountains near Blowing Rock, North Carolina. The river flows generally northward 250 miles, through Virginia and West Virginia. The two major tributaries to the New River (West Virginia Department of Natural Resources 1983b), the Bluestone River and the Greenbrier River (West Virginia Department of Natural Resources 1983a), both enter within a few miles of each other near Hinton, West Virginia. The Bluestone River enters the New River in Bluestone Lake from river left about 3 miles upstream of Bluestone Dam, and about 4 miles upstream of the confluence of the Greenbrier River. The New River then flows north and northwest to its confluence with the Gauley River at Gauley Bridge, West Virginia. Confluence of the New and Gauley Rivers forms the Kanawha River. The Kanawha River flows northwest 97 miles to its mouth on the Ohio River, a tributary of the Mississippi River, at Point Pleasant, West Virginia. The New River watershed includes 5,274 square miles: 756 square miles in North Carolina, 3,044 square miles in Virginia, and 1,474 square miles in West Virginia. The entire Kanawha- New River watershed includes 12,233 square miles.

The Bluestone River originates on the north slope of East River Mountain in Tazewell County, Virginia. It flows northeasterly for 77 miles to its confluence with the New River. The lower 60 miles of Bluestone River are in West Virginia. The western side of the main channel valley has broad, gently sloping ridges, while nearly continuous ridges parallel the eastern side. Therefore, most Bluestone River tributaries enter on the western side of the 462 square mile watershed (West Virginia Department of Natural Resources 1983b). The Bluestone River is unimpounded, with natural seasonal flows. High flows generally occur from late winter to early spring as a result of snowmelt and precipitation.

Bluestone National Scenic River (Fig. 2) is located between Pipestem State Park on the upstream end and Bluestone State Park on the downstream end, and includes 10.5 miles of the lower Bluestone River. Also, Bluestone National Scenic River is included within the boundary of the WVDNR- managed Bluestone Wildlife Management Area (West Virginia Department of Natural Resources 1983). The Bluestone River within Bluestone National Scenic River sustains a high quality warmwater fishery. Visitors come to the area for the many opportunities to fish, hike, and bike along a river in a natural setting relatively undisturbed by modern influences. Due to the shallowness of the Bluestone River, opportunities for boating in the park are usually limited to high water periods.

Figure 1. Kanawha - New River watershed, showing the locations of Bluestone National Scenic River, New River Gorge National River, and Gauley River National Recreation Area.

Figure 2. Bluestone National Scenic River Water Quality Sample Sites



Water quality of the lower Bluestone River in terms of fecal coliform bacteria is generally satisfactory for water contact recreation. Domestic, municipal, agricultural, and industrial (including mining) pollution is contributed from developed areas in the upper watershed, above the Scenic River boundary. The minimal impacts observed within BLUE may be due to discharge volume and travel time. The former factor may act to dilute pollution, and the latter may permit contaminants to settle out of the water column or become assimilated to acceptable levels.

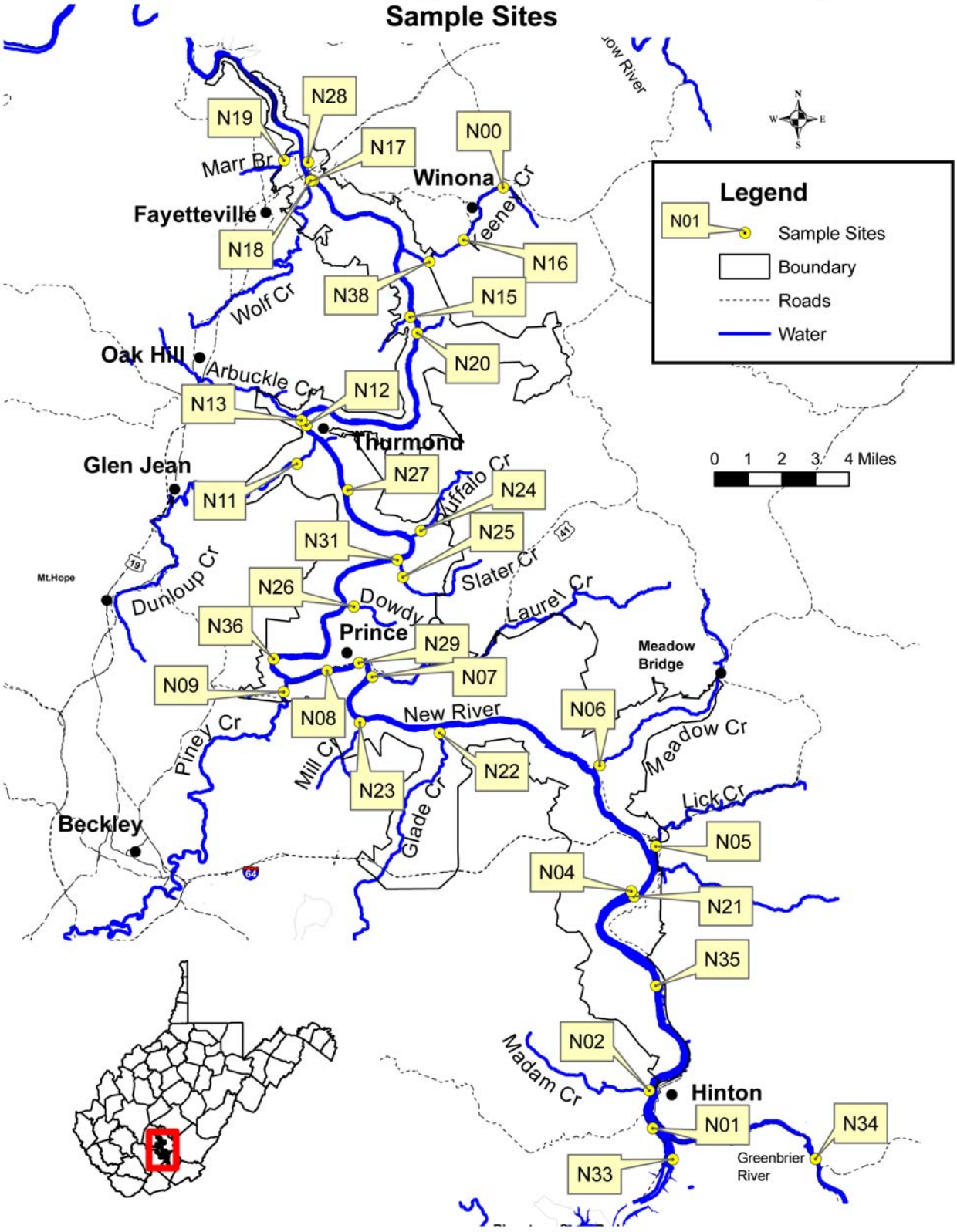
The New River within New River Gorge National River (Fig. 3) is preserved as a free- flowing stream. However, flow is regulated by Bluestone Dam, operated by the U. S. Army Corps of Engineers (COE) for flood control, recreation and low flow enhancement. Although Bluestone Dam is managed on a "run- of- the river" basis with minimal retention time, operation of this facility has lowered the magnitude and reduced the frequency of extreme high flows (Flug 1987). Therefore the New River experiences a seasonal flow pattern. Higher flows generally occur during late winter and early spring, and lower flows occurring through the summer (National Park Service 1996). The New River is also regulated by Claytor Dam in Virginia, operated for power generation on a peaking basis. The distance between Claytor Dam and Bluestone Lake, and operation of Bluestone Dam effectively eliminate peak flows generated by Claytor Dam in the New River within New River Gorge National River.

The 53 miles of the New River within New River Gorge National River begin just below Bluestone Dam, and extend downstream to Hawk's Nest State Park near the town of Ansted. Between Bluestone Dam and the downstream end of the park, 106 streams are tributary to the New River (based on blue- lines from U. S. Geological Survey 1:24000 topographic maps).

The most prominent feature of the New River watershed is New River Gorge. The gorge begins at Sandstone Falls below Hinton, and extends downstream to near the river's confluence with the Gauley River. In many places the gorge walls rise 1,000 feet above the river. The river channel prior to entering the gorge is about 1,000 feet wide and relatively shallow, with a gentle gradient. In the gorge the channel becomes narrower (200- 500 ft), deeper, and steeper. These factors contribute to the world class whitewater rafting which draws a quarter million visitors to New River Gorge each year.

Water quality of the New River in terms of fecal coliform bacteria is generally satisfactory for water contact recreation such as swimming, boating, and fishing. Some tributaries are impaired by raw or inadequately treated domestic sewage. For some of these tributaries the problem is chronic, while for others it is more episodic, with the biggest pollution problems occurring during periods of higher

Figure 3. New River Gorge National River Water Quality Sample Sites



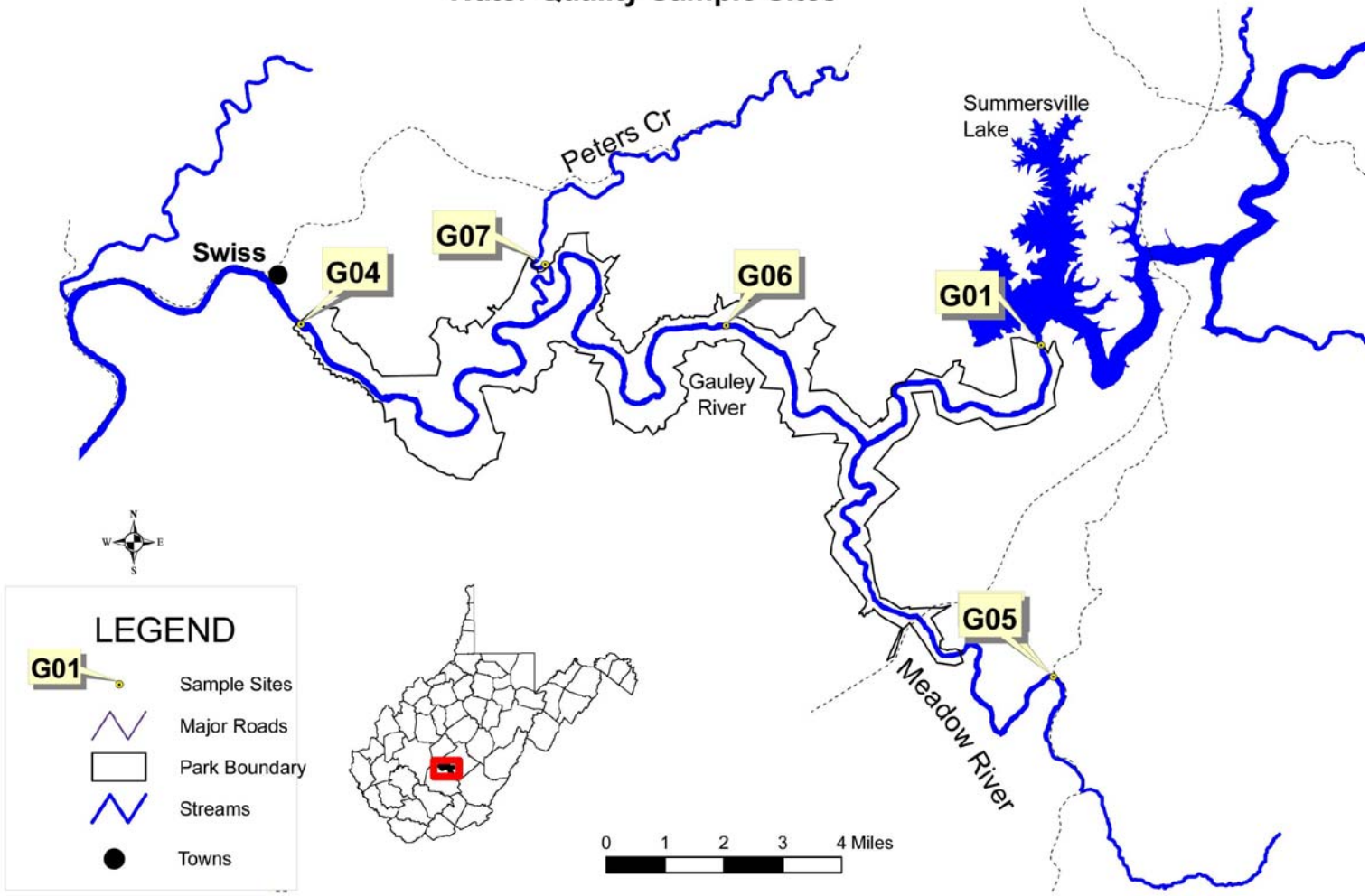
runoff that result from rainfall events. Many of these impaired tributaries enter the New River near popular access sites for recreational activities such as whitewater boating and angling. At the mouths of these polluted tributaries, and for some distance downstream, sewage pollution can be a problem in the New River. Some streams are also affected by organic industrial contaminants and acid mine drainage. Unlike other Appalachian areas, coal in the vicinity of New River Gorge National River is generally low in sulfur, and does not produce much acid mine drainage. Further, some of the extensive limestone areas traversed by the New River and its tributaries help reduce potential acid mine drainage problems, and contribute to a well- buffered, biologically productive ecosystem that supports a high- quality warmwater fishery (West Virginia Department of Natural Resources 1989).

The 107- mile long Gauley River begins in Pocahontas County, West Virginia. The Gauley flows southwest, turning more westerly following inflow of the Meadow River near Carnifax Ferry. The Gauley then continues west to its confluence with the New River. The Gauley River watershed includes 1,422 square miles (West Virginia Department of Natural Resources 1984).

Within Gauley River National Recreation Area (Fig. 4) are 25 miles of the Gauley River and the lower 5.5 miles of the Meadow River. The Gauley River portion extends downstream from just below Summersville Dam to near the community of Swiss. Summersville Dam regulates the flow of the Gauley River within the National Recreation Area. Part of the Water Resources Development Act of 1986 requires the COE to release water from Summersville Dam for recreational activities in the Gauley River below the dam (National Park Service 1993). This occurs during a six- week period in autumn, and creates the famous "Gauley Season" avidly anticipated among whitewater enthusiasts. The Gauley River is noted for outstanding whitewater, and is one of the most technically demanding and commercially popular whitewater rivers in the nation.

The Meadow River is the largest tributary to the Gauley River within Gauley River National Recreation Area. Meadow River flows approximately 50 miles from its origin on Keeney Knob in eastern Summers County to its confluence with the Gauley River. Total drainage area is very close to the 365 square miles within the watershed above the USGS gage Meadow River near Mount Lookout, WV (03190400, hereafter in this report the Meadow River gage) that is about 1,000 feet upstream of the mouth of the river (Ward *et al.* 2003). Major industries in the watershed include coal mining, timbering and agriculture (West Virginia Department of Natural Resources 1984). Above Gauley River National Recreation Area, Meadow River is a slow, meandering stream with a large wetland complex near the headwaters. Within the park, Meadow River has a

Figure 4. Gauley River National Recreation Area
Water Quality Sample Sites



steep gradient, averaging 88 feet per mile, making it very popular with the most expert kayakers.

The Gauley and Meadow Rivers both provide excellent angling opportunities. A quality warmwater fishery exists in the lower reaches of the Gauley River. Coldwater releases support a fishery for stocked trout in the tailwaters below Summersville Dam (National Park Service 1993).

Water quality in the Gauley and Meadow Rivers in terms of fecal coliform bacteria is generally satisfactory for water contact recreation. However, inadequate disposal of human and/or animal waste was identified as a major problem in the watershed (West Virginia Department of Natural Resources 1984), and this problem continues. Further, an increasing intensity of land disturbing activities (timbering, mining, gas exploration and agricultural activities) within the Gauley River watershed have led to increased erosion and sedimentation. The impacts of mining activities and sewage contamination in GARI have their greatest expression in the Peters Creek tributary.

Torrential rains from strong stationary cells on July 7 and 8, 2001 caused highly localized serious flooding beginning on July 8 (Resource Assessment Team 2001). This flooding inundated parts of the park headquarters complex, washed out roads, led to major debris flows, and damaged sewage systems. Watersheds that received large amounts of rain from intense storm cells were severely impacted, while adjacent or nearby watersheds that received little rainfall were minimally affected. Park streams that were heavily impacted included Laurel Creek, Dowdy Creek, Slater Creek, Buffalo Creek, Dunloup Creek, Arbuckle Creek, Wolf Creek, Marr Branch, and a number of small, unnamed tributaries to the New River.

SAMPLING REGIMES

Baseline Monitoring

Of the five Bluestone National Scenic River sites, three were on the Bluestone River and two were on tributaries. Of the 33 New River Gorge National River sites, 13 were on the New River, 18 were on tributaries, and two were at springs. Of the five Gauley River National Recreation Area sites, three were on Gauley River and two were on tributaries.

Some sites were added during the study period (N34 - Greenbrier River at Willowwood, N33 - New River below Bluestone Dam, N35 - New River at Brooks Falls, N29 – New River below Laurel Creek, N31 – Slater Creek at mouth, N23 – Mill Creek, N38 - Keeney Creek below Winona, N00 - Keeney Creek above Winona) and other sites were dropped (N04 - New River above

Sandstone Falls, N08 – New River at Prince, N26 - Dowdy Creek at McKendree Road). Most site changes were made to better define water quality dynamics in New River Gorge National River. The New River below Prince site was replaced by New River below Laurel Creek because of safety concerns. Sampling at N08 required working from an active highway bridge without a separate walkway. Also, the process of lowering the bucket, rinsing it, and retrieving it to the bridge was different than the sampling procedure for the other sites. Finally, raising the filled bucket created other unnecessary safety risks.

Most sites are within National Park Service authorized boundaries, but a few are located just outside. Site B01 (Bluestone River at Bluestone State Park) is located downstream of the BLUE boundary. Sites N34 (Greenbrier River at Willowood), N33 (New River below Bluestone Dam, N01 (New River at Hinton Visitor Center), N02 (Madam Creek in Hinton), N16 (Keeney Creek in Winona), N00 (Keeney Creek above Winona) and N38 (Keeney Creek below Winona) are upstream of the NERI boundary. Site G05 (Meadow River) is upstream of the GARI boundary.

Sampling sites within New River Gorge National River were divided into two districts, north and south. Within each district, sites were further divided into two runs, long and short. Thus four runs were required to sample all NERI sites. Sites for GARI and BLUE were each considered their own district (run). Sampling was generally scheduled on a rotational basis.

Sampling usually occurred between April and September for NERI and BLUE, and continued into October for GARI. This schedule coincided with the period of greatest human recreation on the rivers, and thus greatest potential for pathogen exposure for river users. Sample frequency was constrained by budget costs, personnel availability, and the demands of other programs. We tried to collect four samples per year from each site during the sampling season.

2001 Flood Monitoring

Since the greatest impacts of the July 8 flood were in the northern (downstream) end of NERI, flood monitoring was restricted to this area. The later floods impacted both NERI and GARI, so samples also were collected from the Gauley River system. In order to determine the breadth and scope of water quality impacts from these events, sample sites for evaluating the floods included not only our baseline monitoring sites, but additional sites along the New River and on tributary streams not regularly monitored (Vandersall and Purvis 2001). To assess the local contribution of tributary streams to New River bacteria densities, some of this sampling included tributary streams and the New River above and below the mouths of these tributaries.

Sampling began on July 16, eight days after the first flood. This flood impacted the park water quality laboratory and staff offices, and emergency clean- up and damage assessment and repair were our first priorities, and precluded immediate sampling. Sampling continued through July 23.

During our assessment of the flood (Vandersall and Purvis 2001), it became apparent that we did not have a suitable protocol for examining the water quality impacts of large storm events. Previous data (e.g. Wilson and Purvis 2003) indicated that fecal coliform bacteria densities increased during high discharge events, but an earlier attempt at describing the local dynamics of this relationship on a single stream was less than satisfactory (Purvis and Wilson 1999). This was primarily due to the relatively large watershed chosen (Dunloup Creek) and the variations that occurred in rainfall intensity and location within the watershed, and the delivery of this water to the sampling site. This labor- intensive method also focused its entire effort on one stream, thus providing no data for other streams.

Therefore we developed a more area- extensive storm- event monitoring protocol to examine the effects of high discharge events on fecal coliform bacteria densities. To qualify as a storm- event of sufficient magnitude to initiate the sampling regime, a minimum threshold 24- hour rainfall of 0.4 inches was established. Monitoring sites in the affected area would then be sampled each day until the bacteria density decreased to within the West Virginia standard for contact recreation (<200 FC/100ml). If the affected area was too large to be sampled in a single day, then appropriate portions of the area would be monitored. Heavy rainfall (total 5.3 in) on July 25 and 26, 2001 led to flooding beginning on July 26, and provided us with an opportunity to try this protocol.

SAMPLING PARAMETERS

General

Samples for bacteria and turbidity analyses were collected and returned to the laboratory. Parameters recorded at each collection site included date, time, precipitation within the previous 48 hours, weather, cloud cover, water clarity, stage level, air and water and temperatures, pH, dissolved oxygen, and conductivity. Weather, cloud cover, water clarity, current velocity, and stage (discharge) level were subjective appraisals of the sample collector based on knowledge of long term conditions at each site. Codes for these observations are provided in Appendix 4.

For some sites, stage level and discharge were also based on U. S. Geological Survey (USGS) stream gage measurements (e.g. Ward *et al*. 2003) and COE dam

releases. Sources of river level information for the three parks are provided in Appendix 5.

Discharge for Bluestone River sites were provided by the USGS "Bluestone River near Pipestem" gage (03179000, referred to hereafter in this report as "Pipestem gage"). This gage is 1.2 miles downstream from Mountain Creek, 10.6 miles above the mouth of the Bluestone River, and serves a 395 square mile drainage area (Mathes *et al*. 1982).

Stage and discharge for New River sites in NERI were based on Bluestone Dam releases, and two USGS stream gages. These gages were "New River at Hinton" (03184500, referred to hereafter in this report as "Hinton gage") and "New River at Thurmond" (03185400, referred to hereafter in this report as "Thurmond gage"). The Hinton gage is on river right 0.2 miles upstream from Madam Creek and 1.5 miles downstream from the confluence of the Greenbrier River, and serves a 6,256 square mile drainage area. The Thurmond gage is on river right 0.1 miles upstream from Dunloup Creek and serves a 6,687 square mile drainage area. Stage and discharge for the Greenbrier River was obtained from the "Greenbrier River at Hilldale" gage (0318400, referred to hereafter in this report as "Greenbrier gage"). This gage is on river left, 5.5 miles upstream from the confluence of the Greenbrier and New Rivers, and serves a 1,619 square mile drainage area.

Stage and discharge information for Gauley River sites was based on Summersville Dam releases and three USGS gages. Stage and discharge for site G01 (Gauley River below Summersville Dam) were determined from dam releases and/or the "Gauley River below Summersville Dam" gage (03189600, referred to hereafter in this report as "Summersville Dam gage"). This gage is on river right, 0.4 miles downstream from Summersville Dam and serves an 806 square mile drainage area. Discharge for site G06 (Gauley River below Mason Branch) was estimated by adding the discharge from the "Meadow River near Mount Lookout" gage (03190400, referred to hereafter in this report as "Meadow River gage") to the Summersville Dam gage and/or Summersville Dam releases. The Meadow River gage also provided stage and discharge information for site G05 (Meadow River). Stage and discharge information for site G04 (Gauley River above Swiss) were provided by the "Gauley River above Belva" gage (03192000, hereafter referred to as the "Belva gage"). This gage is on river right about three miles downstream of site G04.

In addition to the continuous recording gages noted above, the USGS also maintains several stage- height staff gages on tributary streams in New River Gorge National River. Occasional stream discharge measurements are made in these streams to relate stage height to discharge, and this information is used to develop rating curves. Staff gages are present at Lick Creek, Meadow Creek,

Laurel Creek, Piney Creek, Dunloup Creek, Arbuckle Creek, Wolf Creek and Marr Branch.

Precipitation in the 48 hours prior to 0800 on the sampling date ("48- hour precipitation") was determined from the closest rain gage. For NERI sites from Glade Creek north, this gage is located at the National Park Service headquarters in Glen Jean. For BLUE sites and NERI sites from Meadow Creek south this gage is maintained by COE at Bluestone Dam. For GARI sites this gage is maintained by COE at Summersville Dam. The two COE gages were read every day. The Glen Jean gage was not read on weekends or federal holidays. This led to recording of some "48- hour" precipitation amounts that actually occurred over 72- 120 hours. These are mentioned in the "Comments" column of the Appendices, and noted in the text where these dates are discussed.

Dissolved oxygen (DO) was determined with a Yellow Springs Instruments (YSI) 55 dissolved oxygen meter. Water temperature and field conductivity were determined with a YSI 30 conductivity meter. Air temperature was measured with an alcohol thermometer. A Fisher Accumet portable temperature compensating pH meter provided pH data until it was replaced by a YSI 60 pH meter on 3 April 2002. Turbidity was measured in the lab from well mixed samples on a Hach 2100P Portalab Turbidmeter. The DO and pH meters were calibrated according to their respective operating manuals on each day of sample collection. The turbidity meter was calibrated quarterly.

Fecal Coliform Bacteria

Sampling and analysis for fecal coliform bacteria followed standard methods (American Public Health Association 1992). All procedures followed sterile techniques, including autoclaving of equipment and ultraviolet (UV) sterilization of equipment between samples.

Samples were collected below the surface in pre- washed and sterilized 250ml and 500ml Nalgene screw- cap bottles. A small amount of air space was left in the bottles. Sodium thiosulfate was added to sample bottles before sterilization to remove chlorine from sample water. Most samples were collected from shore. Site No8 (New River at Prince) was sampled by lowering a stainless steel bucket from the West Virginia Route 41 bridge. The bucket was rinsed with river water before actual sample collection. After sample collection, bottles were placed on ice for transport to the laboratory.

Samples were analyzed for fecal coliform bacteria using the membrane filter technique within six hours of sample collection. Following laboratory determination of turbidity, all or part of the sample was filtered. Volume filtered depended upon expected bacterial densities for each sample. This determination

was based on our experience with fecal coliform- turbidity relationships at each of the sites, or from similar sites. Ideally the volume chosen would provide between 20 and 60 fecal coliform colonies on the filter. To help assure that the ideal range of colonies was counted, two different volumes were filtered for each sample. Filtered volumes less than 20ml had approximately 10ml of sterile dilution water added to allow uniform dispersion of bacteria over the filter surface.

Samples were filtered under partial vacuum through sterile 47mm Millipore nitrocellulose, white grid membrane filters with a 0.45- micrometer pore size. After filtration, filters were placed into culture dishes containing absorbent pads saturated with m- FC media containing rosalic acid.

Sample blanks consisting of filtered sterile dilution water were used to check the effectiveness of sterilization. Two blanks were prepared before ("pres"), and two after ("posts"), each day's set of samples were processed. Once all filtrations were completed, culture dishes containing filtered samples were inverted and placed into plastic pouches and heat- sealed. Sealed pouches were placed in a 44.5 +/- 0.2 ℃ water bath incubator for 22 to 24 hours.

Following incubation, fecal coliform colonies were counted under 15X magnification, and the counts converted to densities (Bordner *et al*. 1978). When one or both filters contained between 20 and 60 colonies, fecal coliform density was recorded (App. 1- 3) as an exact number. If both filters contained colonies outside the 20- 60 range, density was reported as an estimate.

When fecal coliform colonies on both filters exhibited confluent growth with coliforms (CGWC), were indistinct, or when counts exceeded 200, results were listed as “too numerous to count” (TNTC). In such cases, fecal coliform density was estimated as if the filter with the weaker dilution contained 60 colonies. Results were then recorded as “greater than” (>) the value obtained. For graphical purposes in this report, these values were rounded up to the next whole number (e.g. a value reported as >2,000 FC/100ml is presented as 2,001 FC/100ml).

A similar procedure was followed if neither filter contained colonies. In these cases, density was estimated as if the filter with the stronger dilution contained one colony. Results were then recorded as “less than” (<) the value obtained. For graphical purposes, some of these values are presented as 0 FC/100ml.

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RESULTS

BASELINE MONITORING

Explanation of the results

Results are presented in downstream direction. Information on Bluestone National Scenic River is presented first, followed by New River Gorge National River, and then by Gauley River National Recreation Area. Results are also presented in downstream direction within each park, except that mainstem information is presented first, followed by information from the tributary streams.

One page is provided for the results from each sampling site. At the top of the page is the site name, followed by a unique site number. These are the same numbers used in Figures 2- 4. Underneath the names is a color- coded box containing a quick summary noting the frequency that the site exceeded 200 fecal coliforms per 100 milliliters of water (the West Virginia fecal coliform standard for contact recreation), both in the period covered by this report, and since monitoring began at the site.

These sites do not exceed the West Virginia standard more than 10% of the time, either historically or in 2001-2003.

These sites exceed the West Virginia standard more than 10% of the time but no more than 25% of the time, either historically or in 2001-2003.

These sites exceed the West Virginia standard more than 25% of the time, either historically or in 2001-2003.

These sites were recently added to the monitoring program, so reliable estimates of their water quality are not yet available.

Following the boxes is a brief description of the sample location, and its relation to other sampling locations and stream gages. Another paragraph describes the range and average values noted during 2001- 2003 for fecal coliform bacteria, turbidity, precipitation preceding sample collection, and stream discharge.

Two averages – the mean and the median – are used to describe the data. The mean (also known as the arithmetic mean) is the average with which most readers will be familiar. It is calculated by adding the values for all the samples and dividing by the number of samples. The median is the value that is the middle of the range of values for a set of samples. For example, if five samples produced values of 10, 12, 18, 20, and 540, then the median would be 18. Note that this may be quite different than the mean for this set of samples (10 + 12 + 18 + 20 + 540 = 600; 600/5 = 120). The median may be a more useful average when the sample size is small and the sampled population is not normally distributed (*i.e.* does not produce the traditional bell- shaped curve).

Another average that is mentioned in this report is the geometric mean. This average is especially useful for a set of samples where many values are close to each other, but one or a few samples have a value quite larger than the others. Such extreme values often occur in fecal coliform data, so the geometric mean is used in the appropriate West Virginia standard to determine whether or not a site is in compliance with water quality regulations. Geometric means are calculated by taking the logarithm of each value (usually done with natural logarithms, base *e*, rather than base 10), adding these logarithms, dividing the total by the number of samples, and then taking the anti-logarithm of this result. For the above example, the geometric mean would be 29.7. Note that this is closer to the median (18) than to the mean (120) for this example. The different averages can be much closer to each other. For example, if the sample set is 10, 12, 14, 18 and 20, then the median is 14, the mean is 14.8 and the geometric mean is 14.3.

A bar graph shows fecal coliform bacteria densities for each sample. Blue bars indicate samples with bacteria density less than 200 FC/100ml, yellow bars indicate samples with bacteria density between 200 and 400 FC/100ml, and red bars indicate samples with bacteria density greater than 400 FC/100ml. When deciding whether a site that had more than one sample collected on a given date exceeded the West Virginia standard for contact recreation on that date, the arithmetic mean is used in this report.

Finally, some comparisons are noted between the rankings of fecal coliform densities and the other parameters (turbidity, discharge, and precipitation) that have been shown to be correlated with fecal coliform bacteria density.

BLUESTONE NATIONAL SCENIC RIVER

BLUESTONE RIVER MAINSTEM

Bluestone River below Mountain Creek, site B04

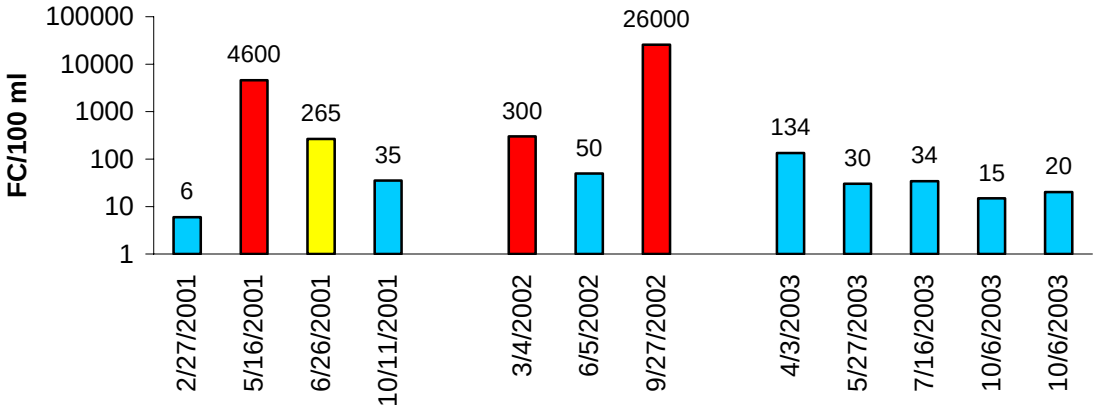
Four of the twelve samples (33%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 5).

Since 1991, 10 of 80 samples (12.5%) have exceeded 200 FC/100 ml.

The sampling site is on river left, upstream of Mountain Creek Lodge at Pipestem State Park. The site is approximately 0.5 miles upstream of the Pipestem gage. Mountain Creek (0.7 miles) and an intermittent stream (0.4 miles) enter the Bluestone River upstream from the site. Typical visitors include lodge guests, hikers, picnickers and anglers.

Between 2001 and 2003 parameter values ranged as follows (App. 1): bacteria density 6- 26000 FC/100ml (mean 2624, median 43), turbidity 0.81- 233.0 NTU (mean 31.11, median 8.35), 48- hour precipitation 0.00- 1.62 in (mean 0.41, median 0.12), discharge 42- 1170 cfs (mean 439, median 394).

Figure 5. Bluestone River below Mountain Creek



The highest bacteria density (26000 FC/100 ml on 9/27/02) coincided with the highest 48- hour precipitation (1.62 in), the second highest turbidity (52.0 NTU) and the sixth highest discharge (394 cfs). The highest turbidity (233.0 NTU on 5/16/01) coincided with the highest discharge (1170 cfs), the second highest bacteria density (4600 FC/100 ml) and the second highest 48- hour precipitation (1.25 in). The third highest bacteria density (300 FC/100 ml on 3/4/02) occurred with the third highest turbidity (15.7 NTU), 48- hour precipitation (1.01 in) and discharge (749 cfs). The second highest discharge (953 cfs on 4/3/03) coincided with the fourth highest turbidity (10.5 NTU), the fifth highest bacteria density (134 FC/100 ml) and nil 48- hour precipitation (0.00 in).

Bluestone River above Little Bluestone River, site B03

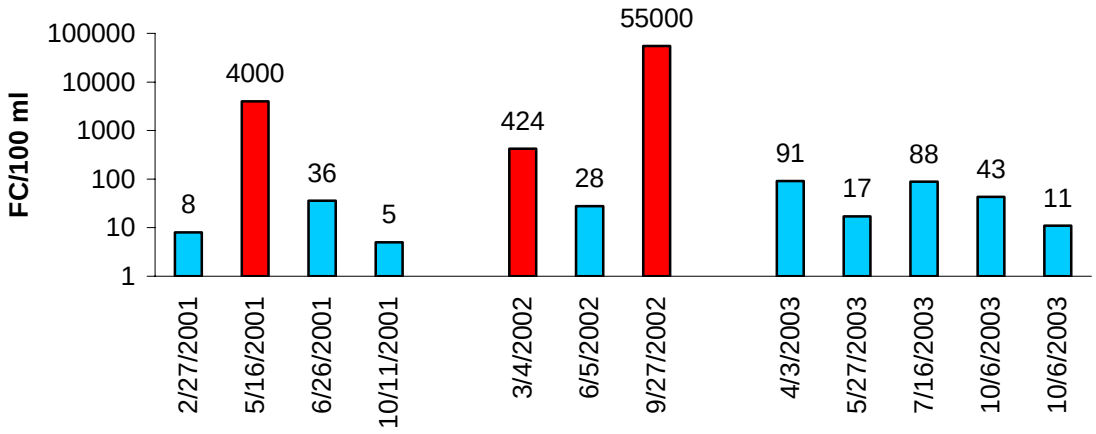
Three of the twelve samples (25%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 6).

Since 1991, 9 of 85 samples (10.6%) have exceeded 200 FC/100 ml.

This site is on river left upstream of the confluence of the Bluestone and Little Bluestone Rivers. The site is about 5.4 miles downstream of the Pipestem gage. Twelve tributaries (2 perennial and 10 intermittent) enter the Bluestone River between the Pipestem gage and this site. Typical visitors include hikers, cyclists, anglers and picnickers.

Between 2001 and 2003 parameter values ranged as follows (App. 1): bacteria density 5-55000 FC/100 ml (mean 4979, median 40), turbidity 0.97- 282.0 NTU (mean 40.67, median 8.52), 48- hour precipitation 0.00- 1.62 in (mean 0.41, median 0.12), discharge 42-1170 cfs (mean 439, median 394).

Figure 6. Bluestone River above Little Bluestone River



The highest bacteria density (55000 FC/100 ml on 9/27/02) coincided with the highest 48- hour precipitation (1.62 in), the second highest turbidity (105.0 NTU), and the sixth highest discharge (394 cfs). The highest turbidity (282.0 NTU on 5/16/01) coincided with the highest discharge (1170 cfs), the second highest bacteria density (4000 FC/100 ml) and the second highest 48- hour precipitation (1.25 in). The third highest bacteria density (424 FC/100 ml on 3/4/02) occurred with the third highest turbidity (18.5 NTU), 48- hour precipitation (1.01 in) and discharge (749 cfs). The second highest discharge (953 cfs on 4/3/03) coincided with the fourth highest bacteria density (91 FC/100 ml), and turbidity (10.6 NTU) and nil 48- hour precipitation (0.00 in).

Bluestone River above Mouth, site B01

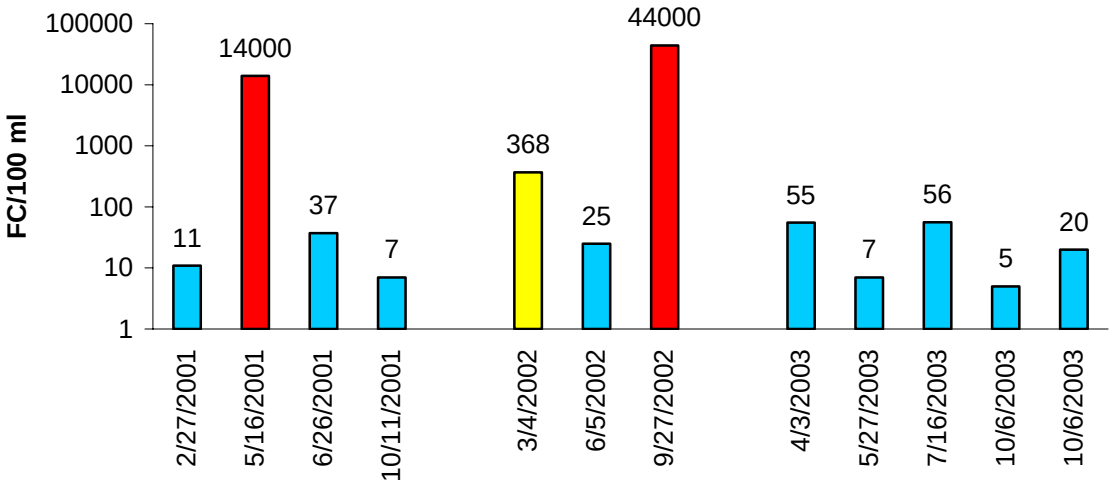
Three of the twelve samples (25%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 7).

Since 1991, 12 of 85 samples (14.1%) have exceeded 200 FC/100 ml.

This site is upstream of Bluestone State Park on river left off the Bluestone Turnpike Trail. The site is about 7.5 miles downstream of the Pipestem gage. Twenty tributaries (3 perennial and 17 intermittent) enter the Bluestone River between the Pipestem gage and this site. The largest of these tributaries is the Little Bluestone River. Visitors are attracted to this area due to the close proximity of Bluestone State Park, Bluestone Lake and Bluestone Wildlife Management Area. Typical visitors include hikers, cyclists, anglers, and those on horseback.

Between 2001 and 2003 parameter values ranged as follows (App. 1): bacteria density 5- 44000 FC/100 ml (mean 4883, median 31), turbidity 0.55- 604.0 NTU (mean 70.73, median 8.23), 48- hour precipitation 0.00- 1.62 in (mean 0.41, median 0.12), discharge 42- 1170 cfs (mean 439, median 394).

Figure 7. Bluestone River above Mouth



The highest bacteria density (44000 FC/100 ml on 9/27/02) coincided with the highest 48- hour precipitation (1.62 in), the second highest turbidity (116.0 NTU) and the sixth highest discharge (394 cfs). The highest turbidity (604.0 NTU on 5/16/01) coincided with the highest discharge (1170 cfs), the second highest bacteria density (14000 FC/100 ml) and the second highest 48- hour precipitation (1.25 in). The third highest bacteria density (368 FC/100 ml on 3/4/02) occurred with the third highest turbidity (18.9 NTU), 48- hour precipitation (1.01 in) and discharge (749 cfs). The second highest discharge (953 cfs on 4/3/03) coincided with the fourth highest turbidity (11.0 NTU), the fifth highest bacteria density (55 FC/100 ml), and nil 48- hour precipitation (0.00 in).

BLUESTONE RIVER TRIBUTARIES

Mountain Creek, site B05

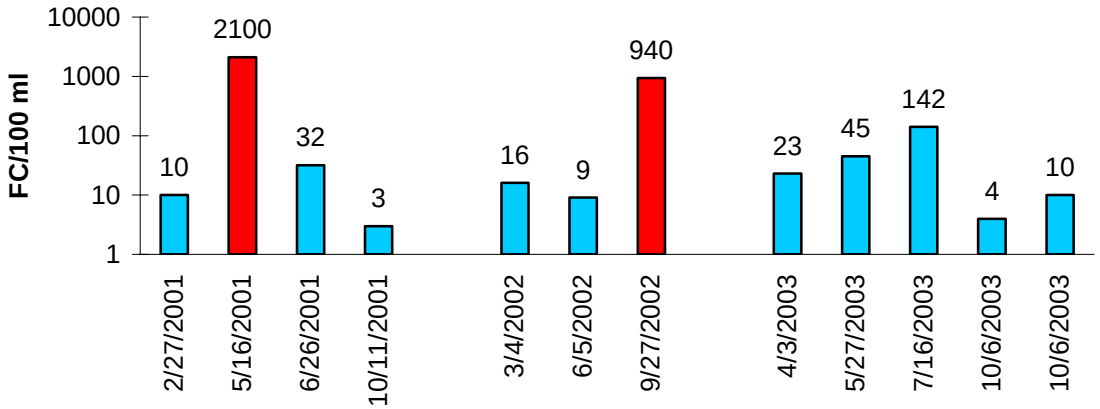
Two of the twelve samples (16.7%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 8).

Since 1991, 10 of 73 samples (13.7%) have exceeded 200 FC/100 ml.

The site is on stream left, near the mouth of the creek in Pipestem State Park. The site is about 0.7 miles upstream of site B04, Bluestone River below Mountain Creek. Mountain Creek enters the Bluestone River 1.2 miles upstream of the Pipestem gage. Typical visitors include hikers, cyclists, picnickers and anglers.

Between 2001 and 2003 parameter values ranged as follows (App. 1): bacteria density 3-2100 FC/100 ml (mean 278, median 20), turbidity 0.17- 103.0 NTU (mean 14.28, median 4.66), 48- hour precipitation 0.00- 1.62 in (mean 0.41, median 0.12), discharge (visual) "low"- "high".

Figure 8. Mountain Creek



The highest bacteria density (2100 FC/100 ml on 5/16/01) coincided with the highest turbidity (103.0 NTU), a "high" discharge and the second highest 48- hour precipitation (1.25 in). The second highest bacteria density (940 FC/100 ml on 9/27/02) coincided with the highest 48- hour precipitation (1.62 in), a "high" discharge and the second highest turbidity (14.9 NTU).

Little Bluestone River, site B02

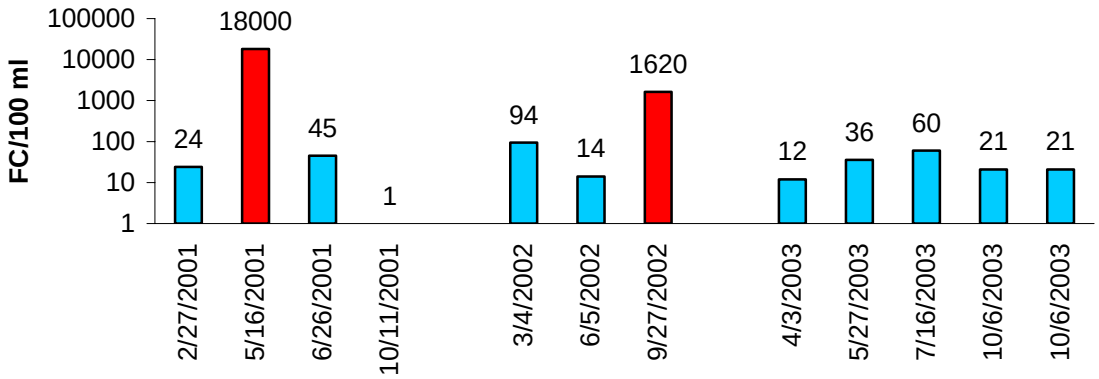
Two of the twelve samples (16.7%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 9).

Since 1991, 12 of 84 samples (14.3%) have exceeded 200 FC/100 ml.

The site is on river right near the mouth of the stream. The Little Bluestone River enters the Bluestone River about 5.4 miles downstream of the Pipestem gage and 2.1 miles upstream of the Bluestone River above Mouth site (B01). Typical visitors include hikers, cyclists, anglers and those on horseback.

Between 2001 and 2003 parameter values ranged as follows (App. 1): bacteria density 1-18000 FC/100 ml (mean 1662, median 30), turbidity 0.28- 129.0 NTU (mean 17.99, median 5.29), 48- hour precipitation 0.00- 1.62 in (mean 0.41, median 0.12), discharge (visual) "low"- "high."

Figure 9. Little Bluestone River



The highest bacteria density (18000 FC/100 ml on 5/16/01) coincided with the highest turbidity (129.0 NTU), a "high" discharge and the second highest 48- hour precipitation (1.25 in). The second highest bacteria density (1620 FC/100 ml on 9/27/02) coincided with the highest 48- hour precipitation (1.62 in), the third highest turbidity (16.9 NTU) and a "normal" discharge. The third highest bacteria density (94 FC/100 ml on 3/4/02) occurred with a "high" discharge, the third highest 48- hour precipitation (1.01 in) and the fourth highest turbidity (10.8 NTU). The second highest turbidity (19.1 NTU on 7/16/03) occurred with the fourth highest bacteria density (60 FC/100 ml), a "normal" discharge and the seventh highest 48- hour precipitation (0.07 in).

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NEW RIVER GORGE NATIONAL RIVER

NEW RIVER MAINSTEM

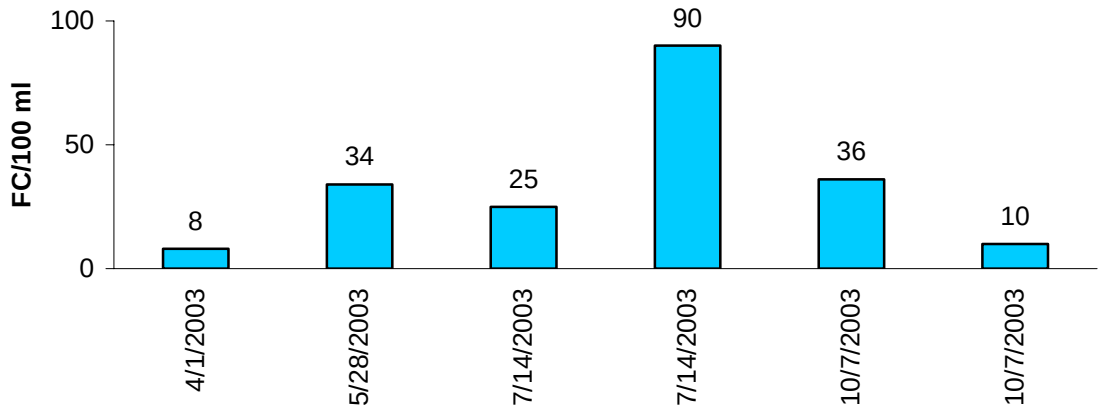
New River below Bluestone Dam, site N33

Monitoring of this site began in 2003. None of the six samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 10).

This site is on river right below the Bluestone Dam tailwaters. It is 1.9 miles upstream of the Hinton gage and 38.3 miles upstream of the Thurmond gage. One intermittent tributary enters the New River just above the sampling site. The Greenbrier River enters the New River 0.6 mile downstream of this site. This site is also 1.1 miles upstream of the New River at Hinton Visitor Center site (N01, see below). Anglers, picnickers and sightseers are typical visitors at this site.

During 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 8- 90 FC/100 ml (mean 34, median 30), turbidity 7.41- 13.2 NTU (mean 9.67, median 9.04), 48- hour precipitation 0.00- 0.32 in (mean 0.16, median 0.15), discharge 3750- 8000 cfs (mean 6363, median 6850).

Figure 10. New River below Bluestone Dam



One of two samples collected on 7/14/03 had the highest bacteria density (90 FC/100 ml) and coincided with the highest turbidity (13.2 NTU), the second highest 48- hour precipitation (0.24 in) and discharge (7000 cfs). The highest 48- hour precipitation (0.32 in on 4/1/03) coincided with the third highest turbidity (8.44 NTU) and discharge (6700 cfs) and the lowest bacteria density (8 FC/100 ml). The highest discharge (8000 cfs on 5/28/03) occurred with the second highest turbidity (9.63 NTU), and the third highest bacteria density (34 FC/100 ml) and 48- hour precipitation (0.06 in).

New River at Hinton Visitor Center, site N01

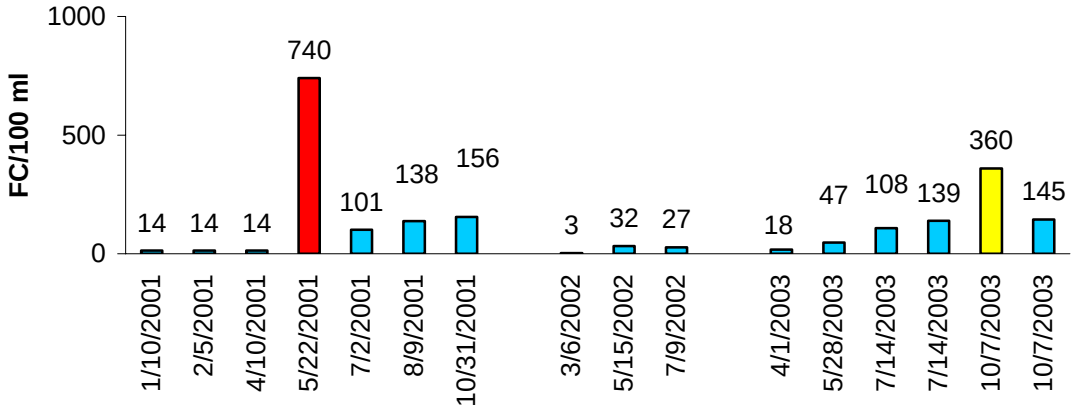
Two of the sixteen samples (12.5%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 11).

Since 1990, 9 of 114 samples (7.9%) have exceeded 200 FC/100 ml.

This site is on river left behind the former National Park Service Hinton Visitor Center on State Route 20. The site is about 1.3 miles below Bluestone Dam, 0.8 miles upstream of the Hinton gage and 37.2 miles upstream of the Thurmond gage. Five tributaries (2 perennial, 3 intermittent) enter the New River between Bluestone Dam and the Hinton gage. This site is about 5.7 miles downstream from Greenbrier River at Willowwood (N34), and 1.1 miles downstream from New River below Bluestone Dam (N33). The Greenbrier River enters New River on river right about 0.6 miles upstream from this site and 1.4 miles upstream of the Hinton gage. For about the first 1¼ miles below their confluence the Greenbrier and New Rivers are separated by several islands that impede mixing between the two rivers. Therefore this site is usually representative of water being discharged from Bluestone Dam. Anglers and sightseers typically visit this site.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 2): bacteria density 3- 740 FC/100 ml (mean 129, median 74), turbidity 0.98- 22.4 NTU (mean 6.31, median 4.31), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.04), discharge 1200- 33000 cfs (mean 7321, median 5100).

Figure 11. New River at Hinton Visitor Center



The highest bacteria density (740 FC/100 ml on 5/22/01) coincided with the highest turbidity (22.4 NTU), 48- hour precipitation (1.10 in) and discharge (33000 cfs). One of two samples collected on 10/7/03 had the second highest bacteria density (360 FC/100 ml - the other 10/7/03 sample had the fourth highest bacteria density) and coincided with the fifth highest turbidity (7.01 NTU), the tenth highest discharge (4200 cfs) and nil 48-hour precipitation (0.00 in). The second highest turbidity (11.4 NTU on 7/14/03) coincided with the third highest discharge (8810 cfs) and 48- hour precipitation (0.24 in) and the fifth and seventh highest bacteria densities (139 and 108 FC/100 ml).

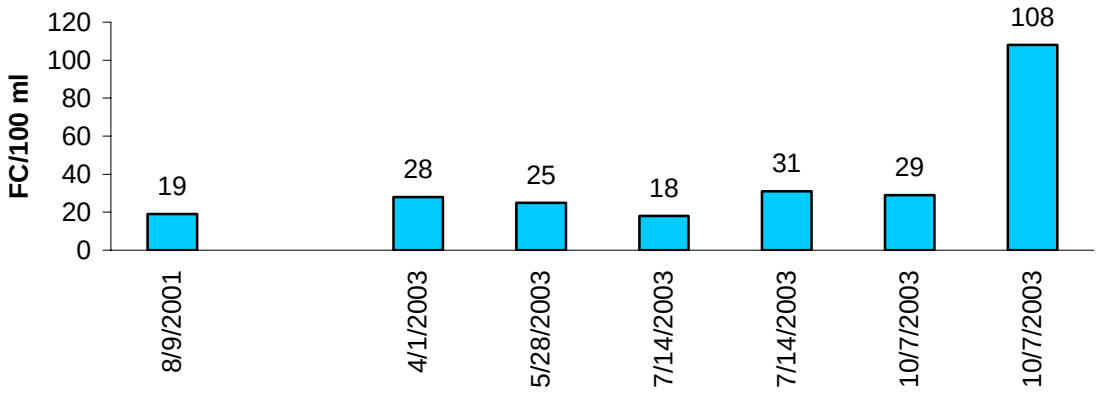
New River at Brooks Falls, site N35

Monitoring of this site began in 2003. Including one sample taken in 2001, none of the seven samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 12).

This site is on river left adjacent to the parking lot at the National Park Service Brooks Falls Day Use Area next to State Route 26 (River Road). This site is 4.0 miles downstream of the Hinton gage and 32.4 miles upstream of the Thurmond gage. There are 14 tributaries (6 perennial and 8 intermittent) between the Hinton gage and this site. This site is about 10.5 miles downstream from Greenbrier River at Willowwood (N34), 5.9 miles downstream from New River below Bluestone Dam (N33), 4.8 miles downstream from New River at Hinton Visitor Center (N01) and 3.9 miles downstream from Madam Creek (N02). Picnickers and sightseers are typical visitors to the site.

One grab sample was collected from this site on 8/9/01. Baseline monitoring began at this site in 2003, with six samples being collected. For these seven samples, parameter values for baseline samples ranged as follows (App. 2): bacteria density 18- 108 FC/100 ml (mean 37, median 28), turbidity 2.97- 10.6 NTU (mean 6.91, median 7.03), 48- hour precipitation 0.00- 0.32 in (mean 0.12, median 0.06), discharge 4200- 10100 cfs (mean 7158, median 8300).

Figure 12. New River at Brooks Falls



Little correlation was noted among parameters at this site. One of two samples collected on 10/7/03 had the highest bacteria density (108 FC/100 ml) and coincided with the median turbidity (5.51 NTU), the fifth highest discharge (4200 cfs) and nil 48- hour precipitation (0.00 in). The other sample collected on this date had bacteria density close to the median for the monitoring period. The highest turbidity (10.6 NTU on 4/1/03) coincided with the highest 48- hour precipitation (0.32 in), the third highest discharge (8300 cfs) and the median bacteria density (28 FC/100 ml). The highest discharge (10100 cfs on 5/28/03) coincided with the third highest turbidity (7.03 NTU) and 48- hour precipitation (0.06 in) and the fifth highest bacteria density (25 FC/100 ml).

New River above Sandstone Falls, site N04

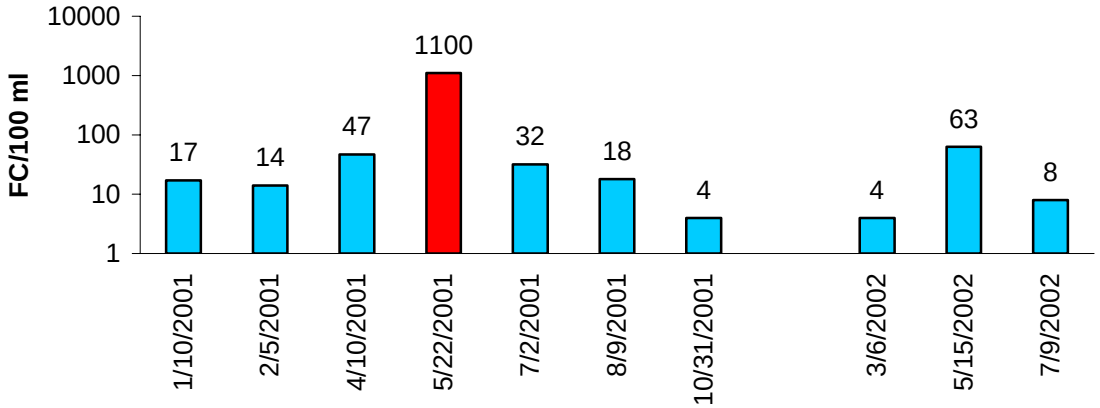
One of the ten samples (10%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 13). This site was discontinued after 2002.

Since 1990, 11 of 107 samples (10.3%) have exceeded 200 FC/100 ml.

This site was formerly known as the New River at Sandstone Falls Parking Lot. The site is on river left upstream of the National Park Service Sandstone Falls parking lot next to State Route 26 (River Road). This site is about 7.9 miles downstream from the Hinton gage and 28.5 miles upstream of the Thurmond gage. There are 24 tributaries (11 perennial and 13 intermittent) between the Hinton gage and this site. This site is about 14.4 miles downstream from Greenbrier River at Willowwood (N34), 9.9 miles downstream from New River below Bluestone Dam (N33), 8.7 miles downstream from New River at Hinton Visitor Center (N01), 7.7 miles downstream from Madam Creek (N02) and 3.9 miles downstream from New River at Brooks Falls (N35). Anglers, swimmers, sightseers and picnickers are typical visitors to this site.

Between 2001 and 2002, parameter values for baseline samples ranged as follows (App. 2): bacteria density 4- 1100 FC/100 ml (mean 131, median 18), turbidity 0.92- 41.9 NTU (mean 6.73, median 3.02), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.01), discharge 1200- 33000 cfs (mean 7109, median 4440).

Figure 13. New River above Sandstone Falls



The highest bacteria density (1100 FC/100 ml on 5/22/01) coincided with the highest turbidity (41.9 NTU), 48- hour precipitation (1.10 in) and discharge (33000 cfs). Sites N01, N02 and N21 also exceeded the fecal coliform standard on 5/22/01. The second highest bacteria density (63 FC/100 ml on 5/15/02) coincided with the second highest 48-hour precipitation (0.16 in), the third highest turbidity (4.47 NTU) and the fourth highest discharge (5700 cfs). The second highest turbidity (4.55 NTU on 4/10/01) occurred with the second highest discharge (8800 cfs), the third highest bacteria density (47 FC/100 ml) and nil 48- hour precipitation (0.00 in).

New River below Sandstone Falls, site N21

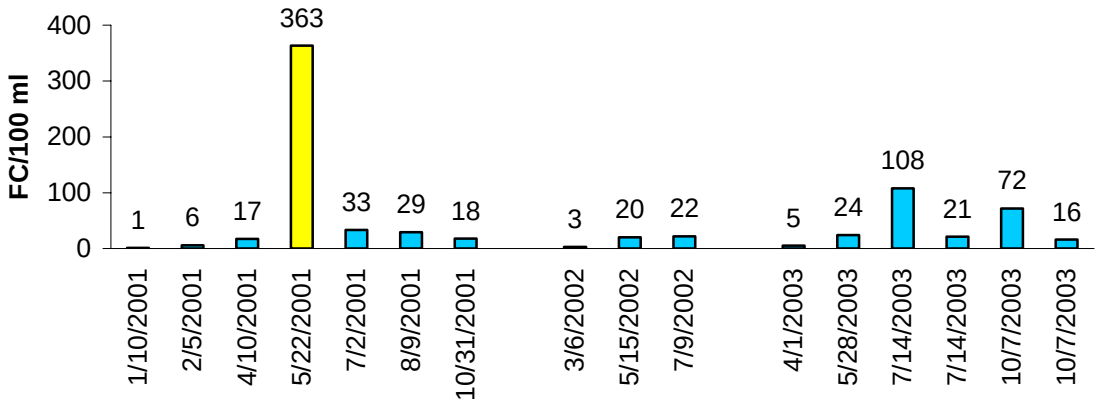
One of the sixteen samples (6%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 14).

Since 1993, 9 of 84 samples (10.7%) have exceeded 200 FC/100 ml.

This site, formerly called New River at Sandstone Falls Boardwalk, is on river left below the main falls at the end of the boardwalk at the NPS Sandstone Falls day- use area off State Route 26 (River Road). The site is about 8.0 miles downstream from the Hinton gage and 28.4 miles upstream of the Thurmond gage. There area 25 tributaries (11 perennial and 14 intermittent) between the Hinton gage and this site. The site provides a spectacular view of the falls and is frequented by sightseers, anglers and picnickers.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 1- 363 FC/100 ml (mean 47, median 21), turbidity 1.03- 24.7 NTU (mean 5.91, median 4.33), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.04), discharge 1200- 33000 cfs (mean 7321, median 5100).

Figure 14. New River below Sandstone Falls



The highest bacteria density (363 FC/100 ml on 5/22/01) coincided with the highest turbidity (24.7 NTU), 48- hour precipitation (1.10 in) and discharge (33000 cfs). No such other direct correlation was noted among the monitored parameters and bacteria densities at this site. The upstream sites New River at Hinton Visitor Center (N01), Madam Creek (N02) and New River above Sandstone Falls (N04) also exceeded the fecal coliform standard on 5/22/01.

The second highest bacteria density (108 FC/100 ml) was noted in one of two samples collected on 7/14/03 and coincided with the second highest turbidity (8.7 NTU), and the third highest 48- hour precipitation (0.24 in) and discharge (8810 cfs). Madam Creek (N02) was the only upstream site to exceed the fecal coliform standard on 7/14/03. Generally elevated turbidity was associated with increased discharge. The third highest turbidity (8.51 NTU on 4/1/03) occurred with the second highest 48- hour precipitation (0.32 in), the fifth highest discharge (8300 cfs) and low bacteria density (5 FC/100 ml).

New River below Laurel Creek, site N29

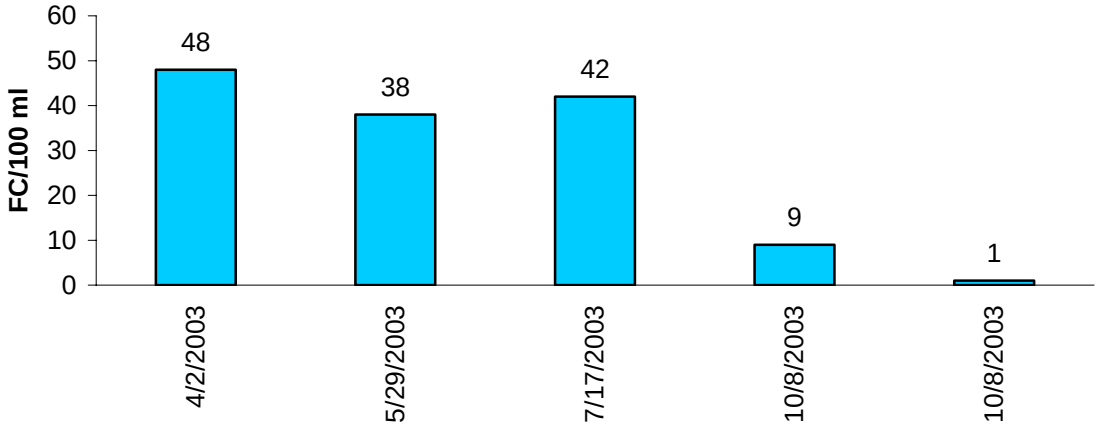
Monitoring of this site began in 2003. None of the five samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 15).

This site is on river left at the National Park Service Grandview Sandbar public access. This site is about 21.9 miles downstream from the Hinton gage and 14.4 miles upstream from the Thurmond gage. Forty- nine tributaries (24 perennial and 25 intermittent) enter the New River between the Hinton gage and this site. Twenty- one tributaries (10 perennial and 11 intermittent) enter the New River between this site and the Thurmond gage. This site is 14.0 miles downstream from New River below Sandstone Falls (N21). Meadow Creek (N06), Glade Creek (N22), Mill Creek (N23) and Laurel Creek (N07) enter the New River between New River below Sandstone Falls and this site. Anglers, boaters and campers are common visitors to this site.

This site replaced New River below Prince (N08), to remove the risk of sampling from the sometimes heavily traveled State Route 41 bridge. It is thought that these sites will have similar water quality because they are separated by only one mile, and no large tributaries enter the New River between these sites.

During 2003 parameter values for baseline samples ranged as follows (App. 2): bacteria density 1- 48 FC/100 ml (mean 28, median 38), turbidity 4.2- 10.1 NTU (mean 7.55, median 7.95), 48- hour precipitation 0.01- 0.39 in (mean 0.15, median 0.11), discharge 4600- 10800 cfs (mean 8950, median 10200).

Figure 15. New River below Laurel Creek



The highest bacteria density (48 FC/100 ml on 4/2/03) coincided with the second highest discharge (10500 cfs), and the third highest turbidity (8.0 NTU) and 48- hour precipitation (0.04 in). The highest turbidity (10.1 NTU on 7/17/03) coincided with the second highest bacteria density (42 FC/100 ml) and 48- hour precipitation (0.17 in), and the third highest discharge (9900 cfs). The highest 48- hour precipitation (0.39 in on 5/29/03) occurred with the highest discharge (10800 cfs), the second highest turbidity (7.91 NTU) and the third highest bacteria density (38 FC/100 ml).

New River below Prince, site N08

None of the seven samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 16). This site was discontinued after 2002.

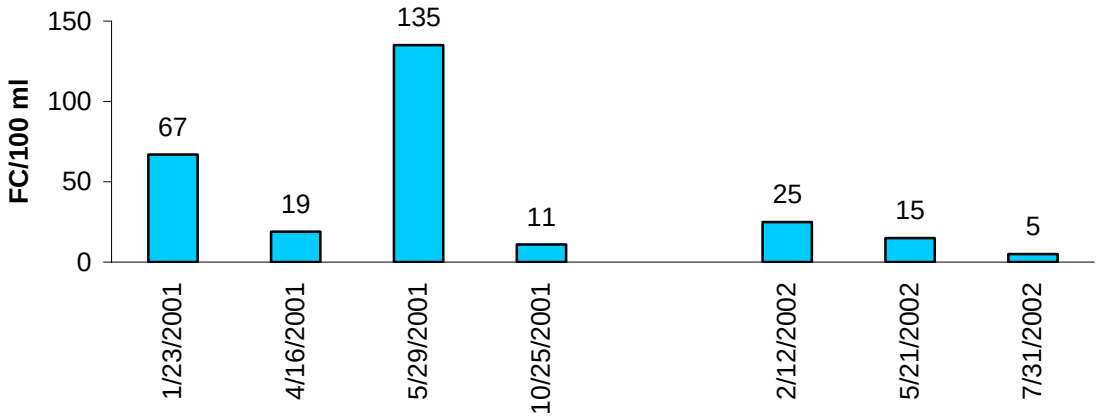
Since 1990, 11 of 107 samples (10.3%) have exceeded 200 FC/100 ml.

This site was formerly known as the New River at Prince. Samples were collected by dropping a stainless steel bucket into the river from the mid- point of the State Route 41 bridge below Prince. Anglers, campers and boaters frequent this section of the river.

This site is about 22.9 miles downstream from the Hinton gage and 13.4 miles upstream from the Thurmond gage. Fifty tributaries (24 perennial and 26 intermittent) enter the New River between the Hinton gage and this site. Twenty tributaries (10 perennial and 10 intermittent) enter the New River between this site and the Thurmond gage. This site is approximately 1 mile downstream from New River below Laurel Creek (N29). Meadow Creek (N06), Glade Creek (N22), Mill Creek (N23) and Laurel Creek (N07) enter the New River upstream of this site.

Between 2001 and 2002, parameter values for baseline samples ranged as follows (App. 2): bacteria density 5- 135 FC/100 ml (mean 40, median 19), turbidity 0.79- 16.6 NTU (mean 8.02, median 4.98), 48- hour precipitation 0.00- 0.56 in (mean 0.21, median 0.02), discharge 1340- 17200 cfs (mean 7289, median 5948).

Figure 16. New River below Prince



The highest bacteria density (135 FC/100 ml on 5/29/01) coincided with the highest turbidity (16.6 NTU), 48- hour (actually 96- hour) precipitation (0.56 in) and discharge (17200 cfs). The second highest bacteria density (67 FC/100 ml on 1/23/01) coincided with the second highest discharge (12315 cfs), the third highest turbidity (13.4 NTU) and nil 48- hour (actually 24- hour) precipitation (0.00 in). The second highest turbidity (14.1 NTU on 7/31/02) occurred with the second highest 48- hour precipitation (0.54 in), the sixth highest discharge (3510 cfs) and the lowest bacteria density (5 FC/100 ml).

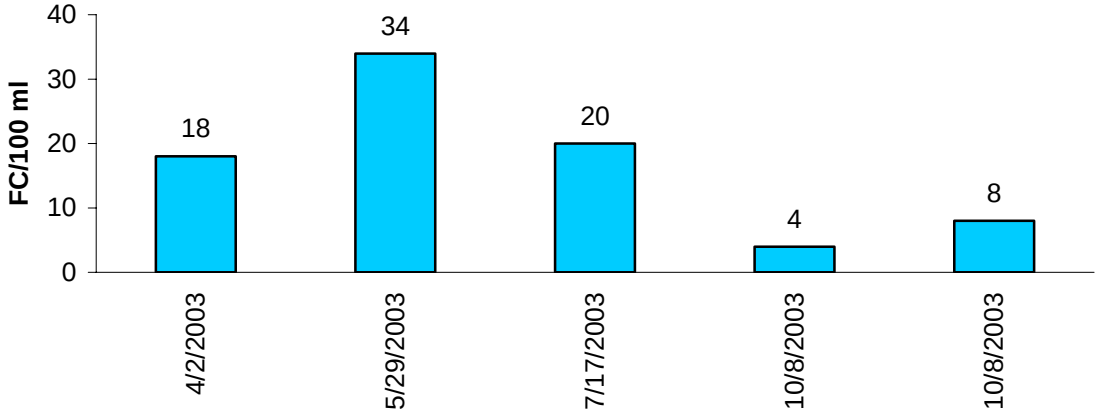
New River below Piney Creek, site N36

Monitoring of this site began in 2003. None of the five samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 17).

This site is on river right at the National Park Service Army Camp public access. This site is about 25.2 miles downstream from the Hinton gage and 11.1 miles upstream from the Thurmond gage. There are 53 tributaries (26 perennial and 27 intermittent) between the Hinton gage and this site, and 17 tributaries (8 perennial and 9 intermittent) between this site and the Thurmond gage. This site is 2.3 miles downstream from New River below Prince (N08) and 3.3 miles downstream from site New River below Laurel Creek (N29). Piney Creek (N09) enters the New River 1 mile upstream from this site on river left. Anglers, boaters and campers are common visitors to the site.

Baseline monitoring began at this site in 2003, with five samples being collected. None of the samples exceeded the state standard (Fig. 17). Parameter values for baseline samples ranged as follows (App. 2): bacteria density 4- 34 FC/100 ml (mean 17, median 18), turbidity 3.83- 9.54 NTU (mean 7.11, median 7.55), 48- hour precipitation 0.01- 0.39 in (mean 0.15, median 0.11), discharge 4600- 10800 (mean 8950, median 10200).

Figure 17. New River below Piney Creek



The highest bacteria density (34 FC/100 ml on 5/29/03) coincided with the highest 48-hour precipitation (0.39 in) and discharge (10800 cfs) and average turbidity (7.12 NTU). The highest turbidity (9.54 NTU on 7/17/03) occurred with the second highest bacteria density (20 FC/100 ml) and 48- hour precipitation (0.17 in) and average discharge (9900 cfs).

New River at Thurmond, site N12

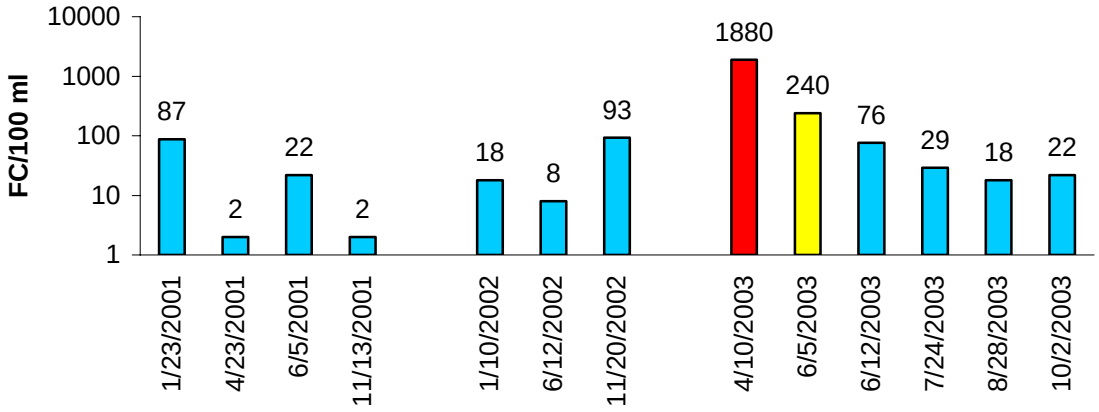
Two of the thirteen samples (15%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 18).

Since 1993, 12 of 113 samples (10.6%) have exceeded 200 FC/100 ml.

This site is on river right downstream from the town of Thurmond. This site is about 0.5 miles downstream of the Thurmond gage and 36.9 miles downstream of the Hinton gage. There are 71 tributaries (35 perennial and 36 intermittent) between the Hinton gage and this site. Only Dunloup Creek enters the New River between the Thurmond gage and this site. This site is 11.7 miles downstream from New River below Piney Creek (N36). Piney Creek (N09) and Dunloup Creek (N11) are major tributaries entering the New River above this site. Boaters and anglers frequent this section of the river.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 2- 1880 FC/100 ml (mean 192, median 22), turbidity 0.71- 45.4 NTU (mean 9.99, median 5.61), 48- hour precipitation 0.00 to 0.70 in (mean 0.20, median 0.12), and discharge 1650- 46500 cfs (mean 11669, median 6200).

Figure 18. New River at Thurmond



The highest bacteria density (1880 FC/100 ml on 4/10/03) coincided with the highest turbidity (45.4 NTU) and discharge (46500 cfs) and the second highest 48- hour precipitation (0.65 in). The second highest bacteria density (240 FC/100 ml on 6/5/03) coincided with the second highest turbidity (19.6 NTU) and discharge (24580 cfs) and the third highest 48- hour (actually 24- hour) precipitation (0.38 in). The highest 48- hour precipitation (0.70 in on 7/24/03) occurred with a low bacteria density (29 FC/100 ml), moderate turbidity (4.89 NTU) and slightly elevated discharge (7530 cfs). Generally elevated turbidity was associated with increased discharge.

New River above Coal Run, site N20

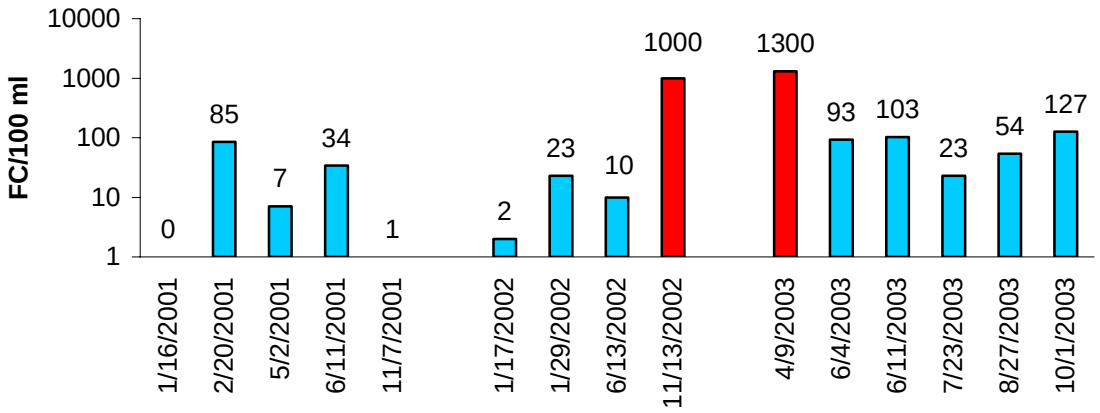
Two of the fifteen samples (13%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 19).

Since 1993, 10 of 96 samples (10.4%) have exceeded 200 FC/100 ml.

This site, formerly called New River at Cunard, is on river left downstream of the National Park Service public access at Cunard. This site is about 7.2 miles downstream from the Thurmond gage. There are 9 tributaries (6 perennial and 3 intermittent) between the Thurmond gage and this site. Dunloup Creek (N11) and Arbuckle Creek (N13) are the closest monitored upstream tributaries. This site is 6.6 miles downstream from New River at Thurmond (N12). Whitewater boaters and anglers are typical visitors to this site.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 1300 FC/100 ml (mean 191, median 34), turbidity 0.65- 46.1 NTU (mean 12.19, median 8.01), 48- hour precipitation 0.00- 0.75 in (mean 0.16, median 0.01), discharge 1620- 39000 cfs (mean 11117, median 7150).

Figure 19. New River above Coal Run



The highest bacteria density (1300 FC/100 ml on 4/9/03) coincided with the highest discharge (39000 cfs), and the second highest turbidity (45.7 NTU) and 48- hour precipitation (0.67 in). The second highest bacteria density (1000 FC/100 ml on 11/13/02) coincided with the highest turbidity (46.1 NTU), the second highest discharge (35000 cfs) and the fifth highest 48- hour (actually 24- hour) precipitation (0.17 in). The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with low bacteria density (23 FC/100 ml), moderate turbidity (4.39 NTU) and slightly elevated discharge (6120 cfs).

New River above Wolf Creek, site N17

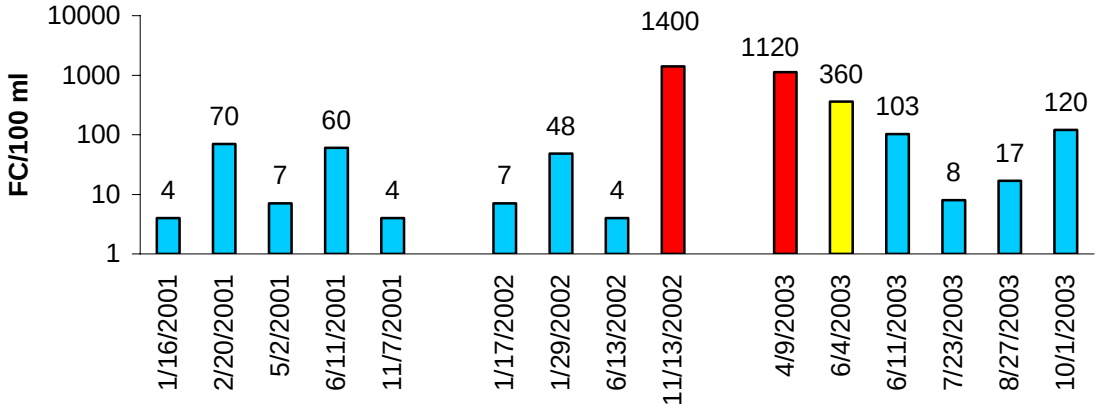
Three of the fifteen samples (20%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 20).

Since 1990, 15 of 115 samples (13.0%) have exceeded 200 FC/100 ml.

This site, formerly called New River at Fayette Station, is on river left upstream of the mouth of Wolf Creek. It is about 13.6 miles downstream of the Thurmond gage, and18 tributaries (13 perennial and 5 intermittent) enter the New River between the Thurmond gage and this site. The site is 6.4 miles downstream of New River above Coal Run (N20). Monitored tributaries Coal Run (N15) and Keeney Creek (N00, N16, and N38) enter the New River between N20 and this site. Anglers, whitewater boaters and swimmers are common visitors to this site.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 2): bacteria density 4- 1400 FC/100 ml (mean 222, median 48), turbidity 0.60- 48.1 NTU (mean 13.05, median 8.97), 48- hour precipitation 0.00- 0.75 in (mean 0.16, median 0.01), discharge 1620- 39000 cfs (mean 11117, median 7150).

Figure 20. New River above Wolf Creek



The highest bacteria density (1400 FC/100 ml on 11/13/02) coincided with the highest turbidity (48.1 NTU), the second highest discharge (35000 cfs) and the fifth highest 48-hour (actually 24- hour) precipitation (0.17 in). The second highest bacteria density (1120 FC/100 ml on 4/9/03) coincided with the highest discharge (39000 cfs), and the second highest turbidity (47.5 NTU) and 48- hour precipitation (0.67 in). The third highest bacteria density (360 FC/100 ml on 6/4/03) coincided with the third highest 48- hour precipitation (0.52 in) and slightly elevated turbidity (8.97 NTU) and discharge (11930 cfs). The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with low bacteria density (8 FC/100 ml), moderate turbidity (3.92 NTU) and a slightly elevated discharge (6120 cfs).

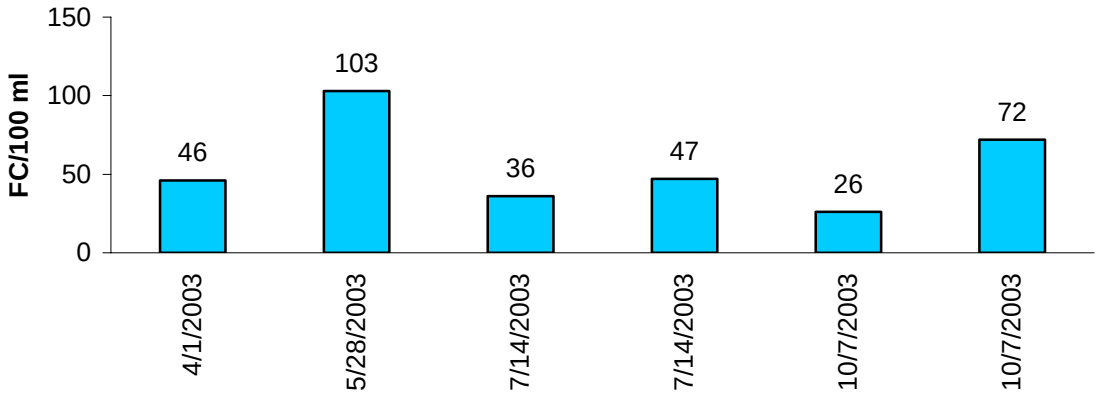
Greenbrier River at Willowwood, site N34

Monitoring of this site began in 2003. None of the six samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 21).

This site is on river left, just upstream of the boat launch at the West Virginia Division of Natural Resources (WVDNR) Willowwood Public Fishing Access Area. This site is about 0.2 mile downstream from the Greenbrier River at Hilldale gage and 6.5 miles upstream of the Hinton gage. No tributaries enter the Greenbrier River between the Hilldale gage and this site. This site is 5.2 miles upstream of the confluence of the Greenbrier and New Rivers and 5.7 miles upstream of New River at Hinton Visitor Center (N01). Boaters and anglers are typical visitors to this site.

During 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 26- 103 FC/100 ml (mean 55, median 47), turbidity 2.25- 6.87 NTU (mean 3.86, median 3.16), 48- hour precipitation 0.00- 0.32 in (mean 0.16, median 0.15), discharge 695- 2970 cfs (mean 1689, median 1545).

Figure 21. Greenbrier River at Willowwood



The highest bacteria density (103 FC/100 ml on 5/28/03) coincided with the highest turbidity (6.87 NTU) and discharge (2970 cfs) and the third highest 48- hour precipitation (0.06 in). The highest 48- hour precipitation (0.32 in on 4/1/03) coincided with the second highest discharge (1670 cfs) and low bacteria density (46 FC/100 ml) and turbidity (2.25 NTU). One of two samples collected on 10/7/03 resulted in the second highest bacteria density (72 FC/100 ml) and coincided with the second highest turbidity (3.17 NTU), and the lowest 48- hour precipitation (0.00 in) and discharge (695 cfs).

Madam Creek, site N02

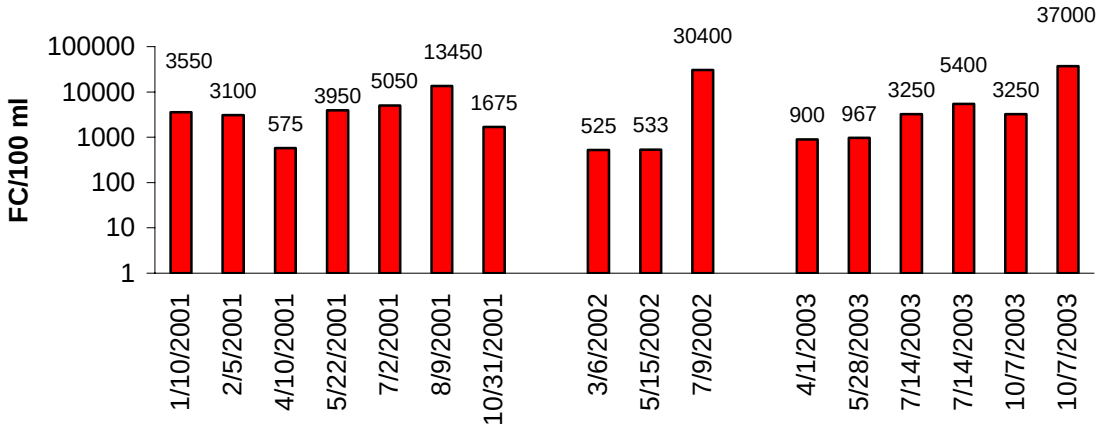
All sixteen samples (100%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 22).

Water quality at this site in terms of fecal coliform bacteria is wholly unsatisfactory for contact recreation. Since 1990, 108 of 115 samples (93.9%) have exceeded 200 FC/100 ml.

This site is on stream left near the mouth of the creek, just downstream of the State Route 26 bridge across the creek. Madam Creek enters the New River about 0.2 miles downstream of the Hinton gage and 36.2 miles upstream of the Thurmond gage. Some anglers occasionally fish in the New River near the mouth of Madam Creek.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 2): bacteria density 525- 37000 FC/100 ml (mean 7098, median 3250), turbidity 0.34- 346.0 NTU (mean 29.33, median 4.33), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.04), discharge (visual) "low" to "high."

Figure 22. Madam Creek



One of two samples collected on 10/7/03 provided the highest bacteria density (37000 FC/100 ml) and coincided with low turbidity (1.24 NTU), "low" discharge and nil 48- hour precipitation (0.00 in). The second highest bacteria density (30400 FC/100 ml on 7/9/02) coincided with moderate turbidity (3.1 NTU), "low" discharge and nil 48- hour precipitation (0.00 in). The third highest bacteria density (13450 FC/100 ml on 8/9/01) coincided with low turbidity (2.42 NTU), "low" discharge and nil 48- hour precipitation (0.00 in). The highest turbidity (346.0 NTU on 5/22/01) coincided with the highest 48- hour precipitation (1.10 in), the only "high" discharge noted during 2001- 2003, and the sixth highest bacteria density (3950 FC/100 ml).

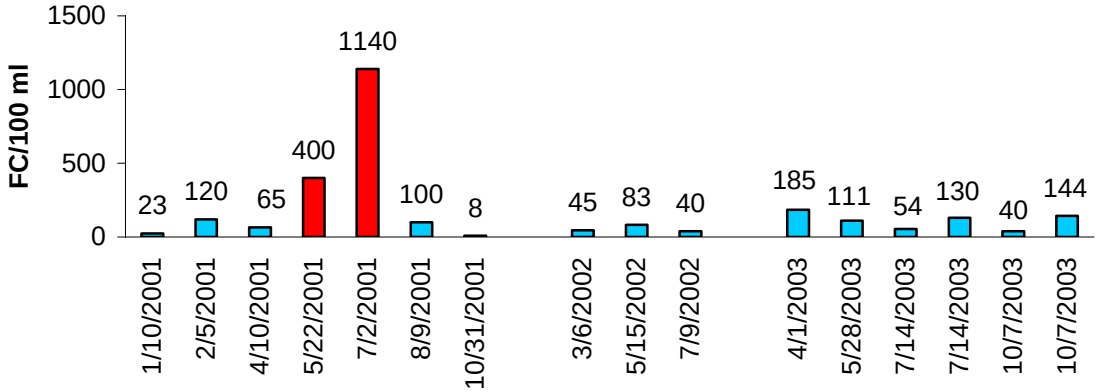
Two of the sixteen samples (12.5%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 23).

Since 1990, 20 of 115 samples (17.4%) have exceeded 200 FC/100 ml.

This site is on stream right near the mouth of the stream, just downstream of a CSX railroad bridge. Lick Creek enters the New River about 9.4 miles downstream of the Hinton gage and 27.0 miles upstream of the Thurmond gage. Anglers and campers are commonly seen in this area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 8- 1140 FC/100 ml (mean 168, median 92), turbidity 0.25- 41.3 NTU (mean 7.46, median 5.12), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.04), discharge 0.21- 321.17 cfs (mean 45.18, median 12.58). A gage reading was not available for five sampling dates, so discharge was categorized visually.

Figure 23. Lick Creek



The highest bacteria density (1140 FC/100 ml on 7/2/01) coincided with the second highest turbidity (12.8 NTU), the sixth highest 48- hour precipitation (0.10 in) and the fifth highest discharge (12.58 cfs). The second highest bacteria density (400 FC/100 ml on 5/22/01) coincided with the highest turbidity (41.3 NTU), 48- hour precipitation (1.10 in) and discharge (321.17 cfs).

Some general trends were noted among the monitored parameters at this site, but direct correlations were not established. The two highest bacteria densities occurred with elevated turbidity, but the highest bacteria density did not occur with the highest turbidity. Forty- eight hour precipitation and discharge were significantly elevated when the second highest bacteria density was noted, but 48- hour precipitation was low and the discharge was moderate when the highest bacteria density occurred.

Meadow Creek, site N06

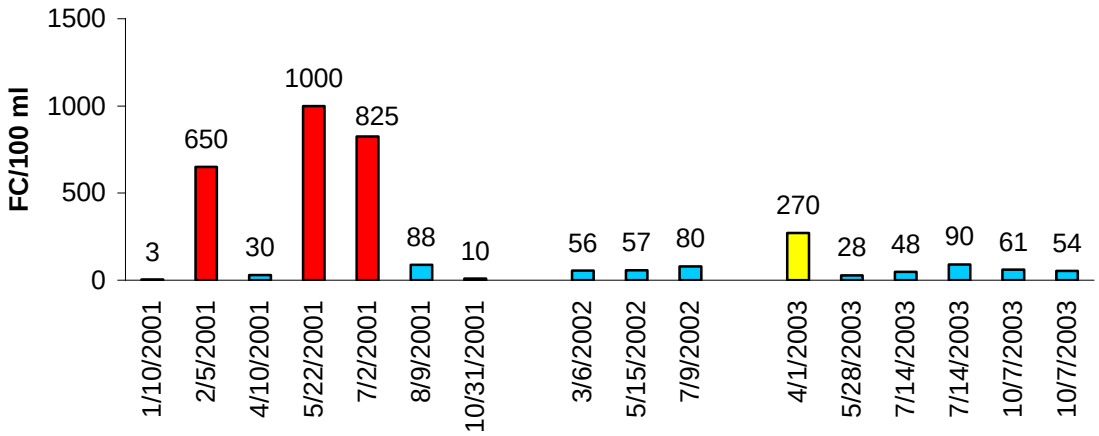
Four of the sixteen samples (25%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 24).

Water quality at this site in terms of fecal coliform bacteria is limited for contact recreation. Since 1990, 25 of 115 samples (21.7%) have exceeded 200 FC/100 ml.

This site is on stream left, near the mouth, and beneath the County Road 7 bridge just north of the community of Meadow Creek. Meadow Creek enters the New River about 12.5 miles downstream of the Hinton gage and 23.9 miles upstream of the Thurmond gage. Local residents commonly visit the site.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 3- 1000 FC/100 ml (mean 209, median 59), turbidity 0.36- 45.3 NTU (mean 9.41, median 3.95), 48- hour precipitation 0.00- 1.10 in (mean 0.15, median 0.04), discharge 1.68- 192.5 cfs (mean 43.19, median 28.8). A gage reading was not available for one sampling date, so discharge was categorized visually.

Figure 24. Meadow Creek



The highest bacteria density (1000 FC/100 ml on 5/22/01) coincided with the highest 48-hour precipitation (1.10 in), and discharge (192.5 cfs) and the second highest turbidity (35.0 NTU). The second highest bacteria density (825 FC/100 ml on 7/2/01) coincided with the highest turbidity (45.3 NTU) and low 48- hour precipitation (0.10 in) and discharge (5.88 cfs). The third highest bacteria density (650 FC/100 ml on 2/5/01) occurred with low turbidity (2.45 NTU), low 48- hour precipitation (0.01 in) and moderate discharge (38.1 cfs). The fourth highest bacteria density (270 FC/100 ml on 4/1/03) occurred with low turbidity (2.51 NTU), the second highest 48- hour precipitation (0.32 in) and moderate discharge (28.8 cfs).

Glade Creek, site N22

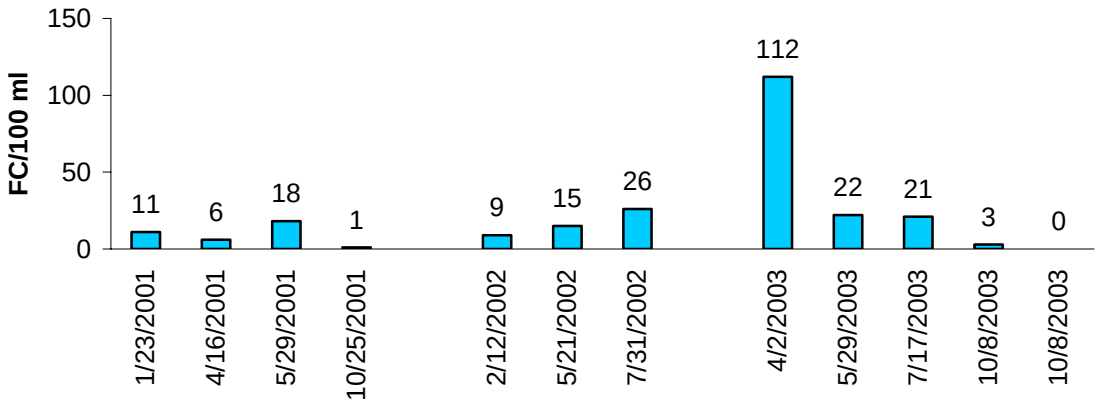
None of the twelve samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 25).

Since 1995, 4 of 44 samples (9.1%) have exceeded 200 FC/100 ml.

This site is on stream left near the mouth of the creek, and adjacent to the National Park Service Glade Creek Trail Head. Glade Creek enters the New River about 17.6 miles downstream of the Hinton gage and 18.8 miles upstream from the Thurmond gage. Anglers, hikers and picnickers are commonly seen at this site.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 112 FC/100 ml (mean 20, median 13), turbidity 0.51- 7.46 NTU (mean 2.87, median 2.39), 48- hour precipitation 0.00- 0.56 in (mean 0.19, median 0.04), discharge (visual) "low" – "high".

Figure 25. Glade Creek



The highest bacteria density (112 FC/100 ml on 4/2/03) coincided with the highest turbidity (7.46 NTU), a "high" discharge and low 48- hour precipitation (0.04 in). The highest 48- hour precipitation (actually 96- hour, 0.56 in on 5/29/01) coincided with a "high" discharge, the second highest turbidity (5.31 NTU) and low bacteria density (18 FC/100 ml). The second highest bacteria density (26 FC/100 ml on 7/31/02) occurred with the second highest 48- hour precipitation (0.54 in), the seventh highest turbidity (2.2 NTU) and a "normal" discharge.

Mill Creek, site N23

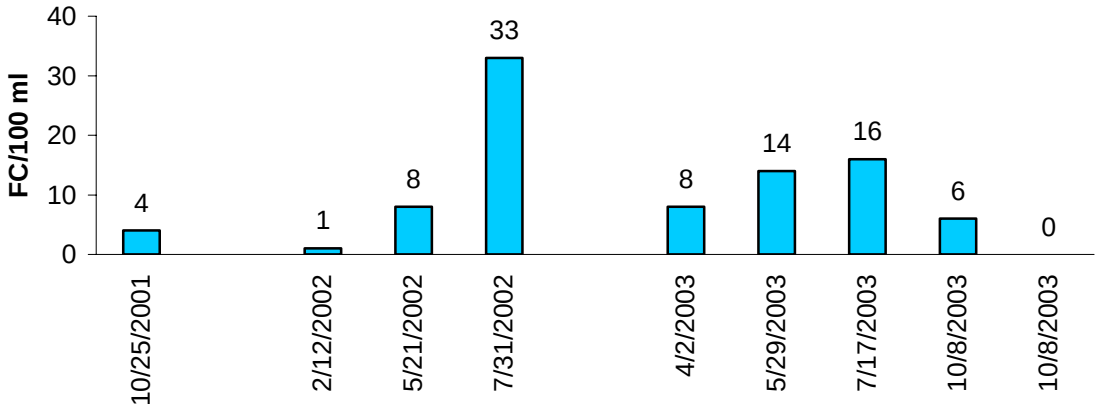
None of the nine samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 26).

Since 1994, 0 of 11 samples (0%) have exceeded 200 FC/100 ml.

This site is on stream left above the Glade Creek Road bridge that crosses Mill Creek. Mill Creek enters the New River 19.7 miles downstream of the Hinton gage and 16.7 miles upstream of the Thurmond gage. Hikers and sightseers frequent this area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 33 FC/100 ml (mean 10, median 8), turbidity 0.58- 8.14 NTU (mean 4.14, median 4.07), 48- hour precipitation 0.00- 0.54 in (mean 0.19, median 0.11), discharge (visual) "low" – "high".

Figure 26. Mill Creek



The highest bacteria density (33 FC/100 ml on 7/31/02) coincided with the highest 48-hour precipitation (0.54 in), the fourth highest turbidity (4.8 NTU) and "low" discharge. The highest turbidity (8.14 NTU on 4/2/03) coincided with the only "high" discharge noted, while bacteria density (8 FC/100 ml) and 48- hour precipitation (0.04 in) remained low. The second highest bacteria density (16 FC/100 ml on 7/17/03) occurred with the second highest turbidity (7.88 NTU), the fourth highest 48- hour precipitation (0.17 in) and a "normal" discharge.

Laurel Creek at Quinnimont, site N07

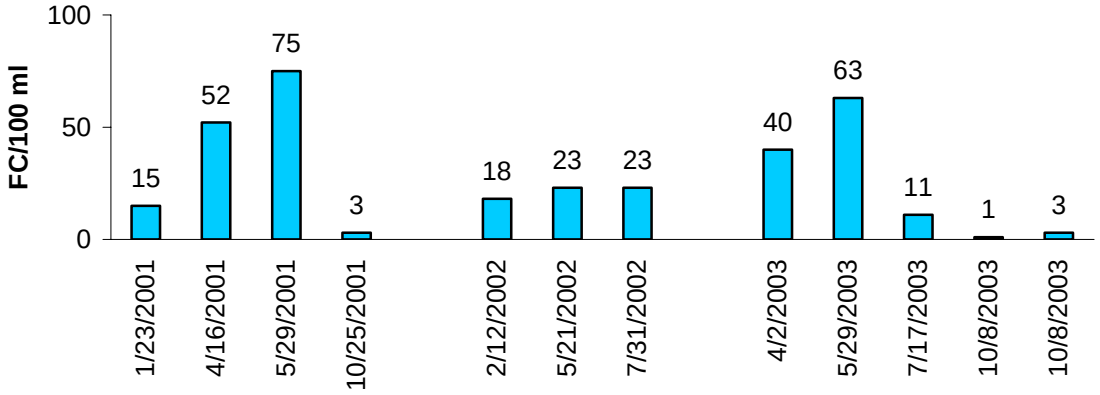
None of the twelve samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 27).

Since 1990, 8 of 112 samples (7.1%) have exceeded 200 FC/100 ml.

This site is near the mouth on stream right just downstream of a railroad bridge adjacent to the CSX Quinnimont railroad yard. Laurel Creek enters the New River about 22.2 miles downstream from the Hinton gage and 14.2 miles upstream from the Thurmond gage. Railroad personnel are the only people commonly seen in the area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 1- 75 FC/100 ml (mean 27, median 21), turbidity 0.25- 5.82 NTU (mean 3.10, median 3.17), 48- hour precipitation 0.00- 0.56 in (mean 0.19, median 0.04), discharge 1.57- 148.0 cfs (mean 47.61, median 43.8). A gage reading was not available for one sampling date, so discharge was categorized visually.

Figure 27. Laurel Creek at Quinnimont



The highest bacteria density (75 FC/100 ml on 5/29/01) coincided with the highest 48-hour (actually 96- hour) precipitation (0.56 in), the second highest turbidity (5.14 NTU) and a "normal" discharge. The highest turbidity (5.82 NTU on 4/2/03) coincided with the highest discharge (148.0 cfs), the fourth highest bacteria density (40 FC/100 ml) and the sixth highest 48- hour precipitation (0.04 in). The two highest discharges (148 cfs on 4/2/03 and 78.6 cfs on 5/21/02) occurred when 48- hour precipitation was low (0.04 in on 4/2/03 and 0.00 in (actually over 24 hrs) on 5/21/02). A localized precipitation event not recorded at the NPS Glen Jean rain gage may explain these high discharges when 48-hour precipitation was low.

Piney Creek at McCreery, site N09

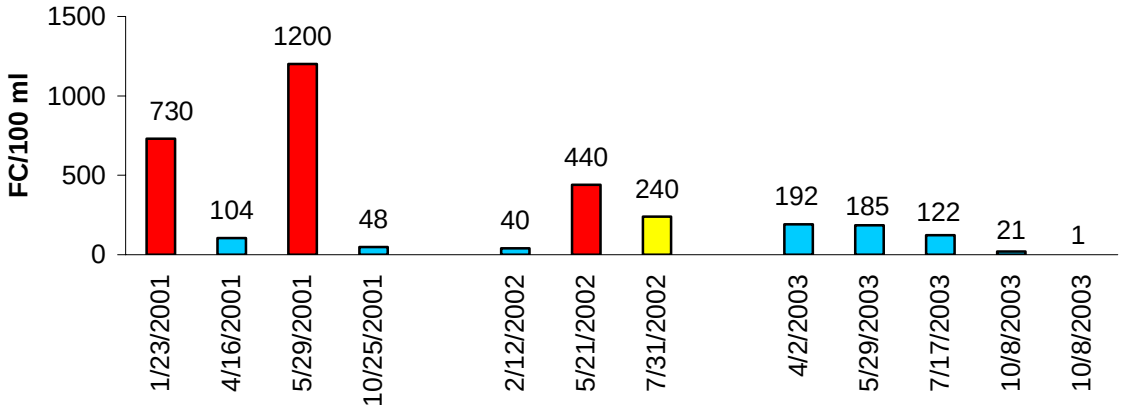
Four of the twelve samples (33%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 28).

Water quality at this site in terms of fecal coliform bacteria is unsatisfactory for contact recreation. Since 1990, 37 of 113 samples (32.7%) have exceeded 200 FC/100 ml.

This site is on stream left near the mouth of Piney Creek, about 200 meters upstream of the State Route 41 bridge. Piney Creek enters the New River on river left just downstream of a National Park Service public access. Piney Creek enters the New River about 25.0 miles downstream from the Hinton gage and 11.4 miles upstream from the Thurmond gage. Rafters, including commercial outfitters use this access, and anglers are commonly seen near the mouth of Piney Creek.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 1- 1200 FC/100 ml (mean 277, median 154), turbidity 0.65- 16.8 NTU (mean 5.41, median 4.5), 48- hour precipitation 0.00- 0.56 in (mean 0.19, median 0.04), discharge 14.8- 302.0 cfs (mean 154.3, median 115.7).

Figure 28. Piney Creek at McCreery



The highest bacteria density (1200 FC/100 ml on 5/29/01) coincided with the highest 48-hour (actually 96- hour) precipitation (0.56 in), and the fourth highest turbidity (6.27 NTU) and discharge (220.13 cfs). The second highest bacteria density (730 FC/100 ml on 1/23/01) coincided with the fifth highest turbidity (5.85 NTU) and discharge (192.9 cfs) and nil 48- hour (actually 24- hour) precipitation (0.00 in). The third highest bacteria density (440 FC/100 ml on 5/21/02) occurred with the second highest discharge (262 cfs), third highest turbidity (6.3 NTU) and nil 48- hour (actually 24- hour) precipitation (0.00 in). The fourth highest bacteria density (240 FC/100 ml on 7/31/02) coincided with the highest turbidity (16.8 NTU), second highest 48- hour precipitation (0.54 in) and eighth highest discharge (97.7 cfs). The highest discharge (302.0 cfs) coincided with the fifth highest bacteria density (192 FC/100 ml), seventh highest turbidity (4.44 NTU) and sixth highest 48- hour precipitation (0.04 in).

Dowdy Creek at McKendree Road, site N26

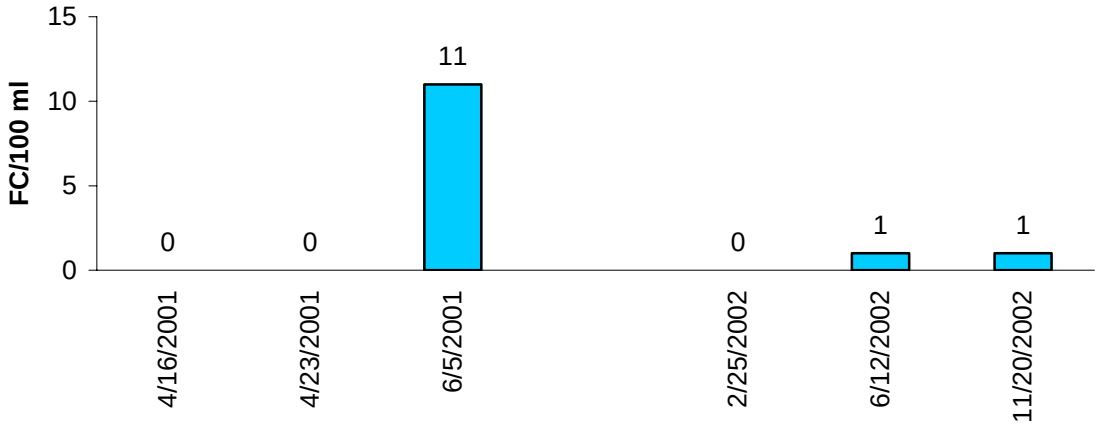
None of the six samples (0%) collected between 2001 and 2002 exceeded the West Virginia standard for contact recreation (Fig. 29). Monitoring of this site was discontinued after 2002

Since 1997, 0 of 16 samples (0%) have exceeded 200 FC/100 ml.

This site is 0.2 miles upstream from the mouth on stream right, just upstream of the McKendree Road (County Route 25) bridge crossing the creek. Dowdy Creek enters the New River about 29.1 miles downstream of the Hinton gage and 7.3 miles upstream of the Thurmond gage. Rafters and anglers are commonly seen near the mouth of Dowdy Creek.

Between 2001 and 2002, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 11 FC/100 ml (mean 2, median 0.5), turbidity 0.41- 8.35 NTU (mean 2.0, median 0.71), 48- hour precipitation 0.00- 0.15 in (mean 0.06, median 0.05), discharge (visual) "low"- "high".

Figure 29. Dowdy Creek at McKendree Road



Bacteria density in Dowdy Creek remained low regardless of turbidity, 48- hour precipitation or discharge. The highest bacteria density (11 FC/100 ml on 6/5/01) coincided with the highest turbidity (8.35 NTU) and 48- hour (actually 24- hour) precipitation (0.15 in) and a "normal" discharge. The only "high" discharge occurred on 11/20/02. Bacteria density (1 FC/100 ml), turbidity (1.19 NTU) and 48- hour precipitation (0.12 in) were all low on this date.

Slater Creek at McKendree Road, site N25

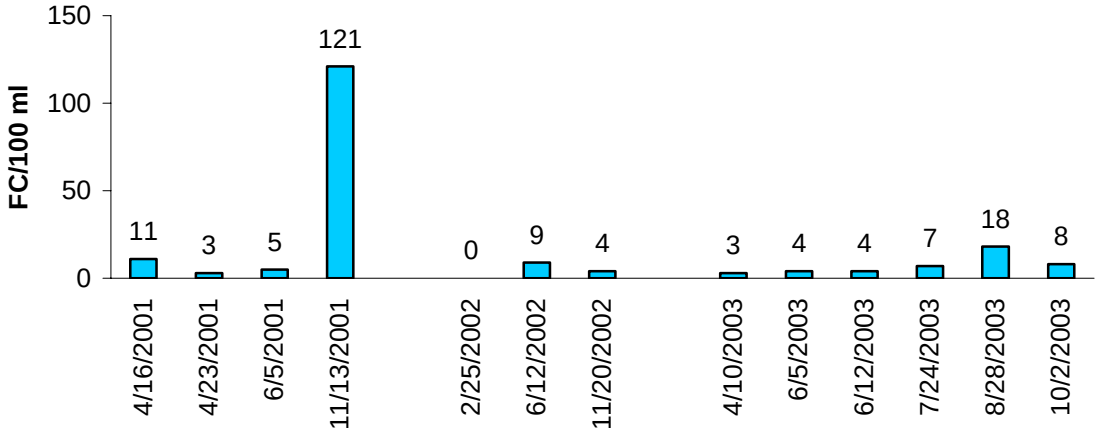
None of the thirteen samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 30).

Since 1997, 0 of 24 samples (0%) have exceeded 200 FC/100 ml.

This site is about 0.53 miles upstream of the mouth on stream right just upstream of the McKendree Road (County Route 25) bridge across the creek. Slater Creek enters the New River at the community of Thayer, about 31.8 miles downstream of the Hinton gage and 4.6 miles upstream of the Thurmond gage. Rafters, anglers and picnickers commonly use the National Park Service day- use area near the mouth of Slater Creek. Some residents of the Thayer area may use Slater Creek for their domestic water supply.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 121 FC/100 ml (mean 15, median 5), turbidity 2.3- 21.4 NTU (mean 6.46, median 5.37), 48- hour precipitation 0.00- 0.70 in (mean 0.20, median 0.12), discharge (visual) "low"- "high."

Figure 30. Slater Creek at McKendree Road



The highest bacteria density (121 FC/100 ml on 11/13/01) coincided with the highest turbidity (21.4 NTU), nil 48- hour precipitation (0.00 in) and "low" discharge. The highest 48- hour precipitation (0.70 in on 7/24/03) coincided with low bacteria density (7 FC/100 ml), moderate turbidity (4.68 NTU) and "normal" discharge. The only "high" discharge was noted on 4/10/03 and coincided with the second highest turbidity (12.7 NTU) and 48- hour precipitation (0.65 in) and a low bacteria density (3 FC/100 ml).

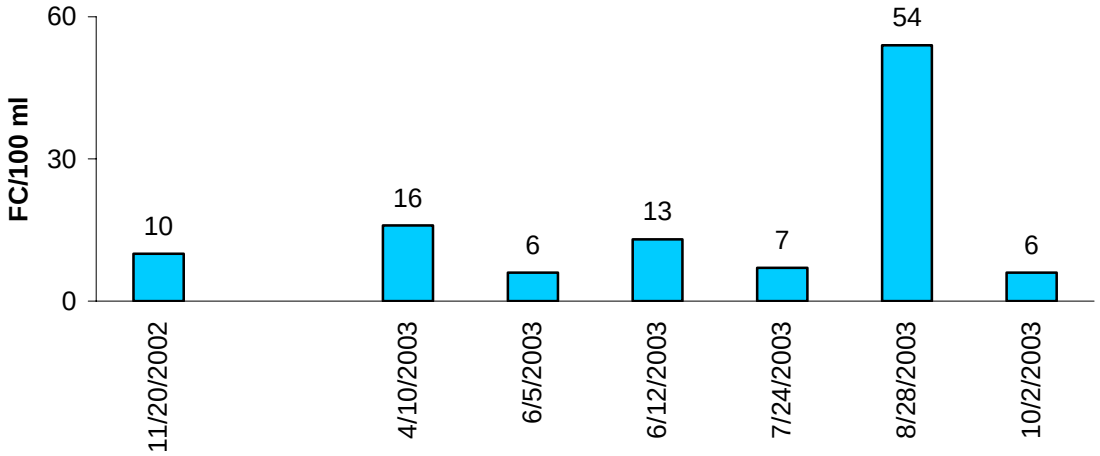
Slater Creek at Mouth, site N31

Monitoring of this site began in 2002. None of the seven samples (0%) exceeded the West Virginia standard for contact recreation (Fig. 31).

This site is located on stream right at the mouth of Slater Creek. Vehicle access is by McKendree Road (County Route 25) to Thayer. Near its mouth, Slater Creek flows through the community of Thayer and a National Park Service public access and day-use area. Rafters, anglers and picnickers are commonly seen in this area.

In 2002, parameter values for baseline samples ranged as follows (App. 2): bacteria density 6- 54 FC/100 ml (mean 16, median 10), turbidity 2.32- 20.8 NTU (mean 6.70, median 4.61), 48- hour precipitation 0.00- 0.70 in (mean 0.34, median 0.30), discharge (visual) "low"- "high."

Figure 31. Slater Creek at Mouth



The highest bacteria density (54 FC/100 ml on 8/28/03) coincided with moderate turbidity (2.96 NTU), nil 48- hour precipitation (0.00 in) and "low" discharge. The highest turbidity (20.8 NTU on 4/10/03) coincided with the second highest bacteria density (16 FC/100 ml) and 48- hour precipitation (0.65 in) and the only "high" discharge noted during the monitoring period. The highest 48- hour precipitation (0.70 in on 7/24/03) occurred with low bacteria density (7 FC/100 ml), moderate turbidity (3.43 NTU) and "normal" discharge.

Buffalo Creek at McKendree Road, site N24

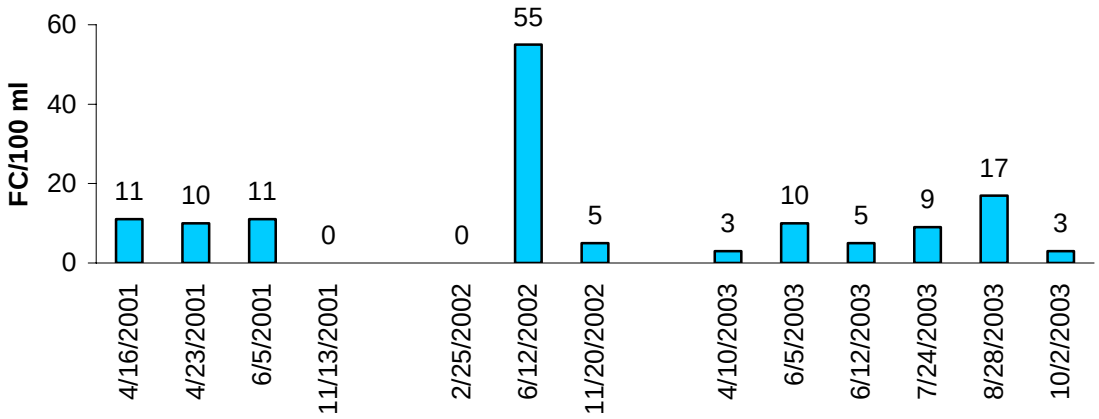
None of the thirteen samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 32).

Since 1997, 0 of 23 samples (0%) have exceeded 200 FC/100 ml.

Prior to the July 2001 floods this site was located on stream right just downstream of the McKendree Road (County Route 25) bridge across the creek. Following the July 2001 floods this site was relocated just upstream of the McKendree Road bridge on stream right. Buffalo Creek enters the New River about 32.6 miles downstream of the Hinton gage and 3.8 miles upstream of the Thurmond gage. Buffalo Creek is designated a "Fly Fishing Only" stream by the West Virginia Division of Natural Resources. Anglers and hikers visit this site. Rafters and anglers visit the mouth of the creek where it enters the New River.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 55 FC/100 ml (mean 11, median 9), turbidity 0.57- 9.33 NTU (mean 4.18, median 3.88), 48- hour precipitation 0.00- 0.70 in (mean 0.20, median 0.12), discharge "low"- "high."

Figure 32. Buffalo Creek at McKendree Road



The highest bacteria density (55 FC/100 ml on 6/12/02) coincided with low turbidity (2.26 NTU), nil 48- hour precipitation (0.00 in) and "low" discharge. The highest turbidity (9.33 NTU on 4/10/03) coincided with the second highest 48- hour precipitation (0.65 in), a "high" discharge and low bacteria density (3 FC/100 ml). The highest 48- hour precipitation (0.70 in on 7/24/03) coincided with moderate turbidity (3.88 NTU), "normal" discharge and low bacteria density (9 FC/100 ml). "High" discharge was noted on two sample dates, 11/20/02 and 4/10/03 (see above). On 11/20/02 the turbidity was moderate (3.71 NTU), while bacteria density (5 FC/100 ml) and 48- hour precipitation (0.12 in) remained low.

Claremont Mine Spring, site N27

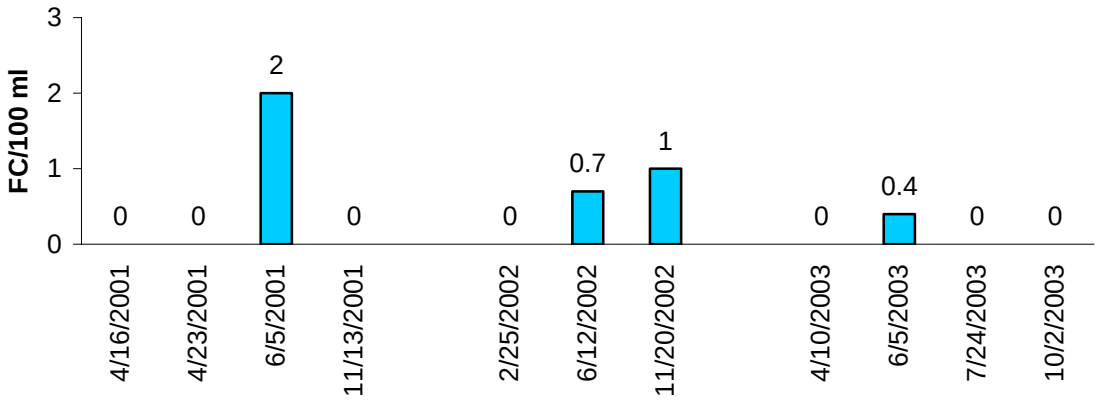
None of the eleven samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 33).

Since 1996, 0 of 21 samples (0%) have exceeded 200 FC/100 ml.

Water at this site exits a poorly reclaimed coal gob pile through a metal pipe next to a ditch along McKendree Road (County Route 25). This water eventually enters the New River via culverts. Samples were collected from the discharge of the metal pipe. It is not known if water leaves the gob pile by other routes. The site is approximately 34.5 miles downstream of the Hinton gage and 1.9 miles upstream of the Thurmond gage.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 2 FC/100 ml (mean 0.4, median 0), turbidity 0.50- 4.09 NTU (mean 2.06, median 1.71), 48- hour precipitation 0.00- 0.70 in (mean 0.21, median 0.12).

Figure 33. Claremont Mine Spring



The highest bacteria density (2 FC/100 ml on 6/5/01) coincided with low turbidity (1.65 NTU) and 48- hour (actually 24- hour – see App. 2) precipitation (0.15 in). The highest turbidity (4.09 NTU on 4/10/03) coincided with the second highest 48- hour precipitation (0.65 in), while bacteria density was 0 FC/100 ml. The highest 48- hour precipitation (0.70 in on 7/24/03) coincided with low turbidity (1.71 NTU) and nil bacteria density. The second highest bacteria density (1 FC/100 ml on 11/20/02) coincided with the second highest turbidity (2.94 NTU) and low 48- hour precipitation (0.12 in).

It is unknown if people use this water for any purpose. The presence of fecal coliform bacteria in some samples indicates that it is unsuitable for human consumption without appropriate treatment.

Dunloup Creek, site N11

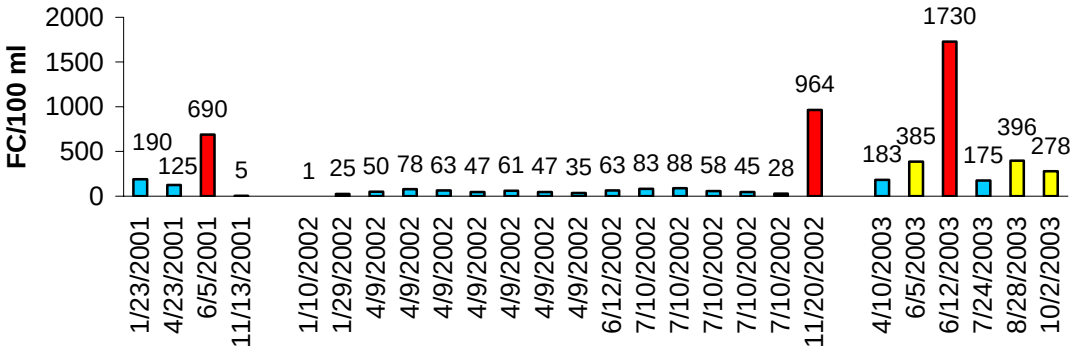
Six of the sixteen (37.5%) dates sampled between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 34).

Since 1990, 59 of 127 samples (46.5%) have exceeded 200 FC/100 ml.

This site is on stream left, just downstream of the County Route 25 bridge near the NPS Thurmond- Minden Trailhead parking area. Anglers visit this stream to pursue put- and- take trout stocked by the West Virginia Division of Natural Resources and a local chapter of Trout Unlimited. Hikers, cyclists and sightseers also visit this area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 1- 1730 FC/100 ml (mean 227, median 71), turbidity 0.47- 14.2 NTU (mean 4.26, median 3.22), 48- hour precipitation 0.00- 0.70 in (mean 0.11, median 0.01), discharge 11.3- 249.0 cfs (mean 69.95, median 49.75). Samples collected on 4/9/02 (mean = 54 FC/100ml) and 7/10/02 (mean = 60 FC/100 ml) were collected every ½ hour to document variations in bacteria density in relation to other monitored parameters.

Figure 34. Dunloup Creek



The highest bacteria density (1730 FC/100 ml on 6/12/03) coincided with the third highest turbidity (9.11 NTU), fourth highest 48- hour precipitation (0.30 in) and seventh highest discharge (99.4 cfs). The second highest bacteria density (964 FC/100 ml on 11/20/02) coincided with moderate turbidity (3.28 NTU) and discharge (89.4 cfs) and low 48- hour precipitation (0.12 in). The third highest bacteria density (690 FC/100 ml on 6/5/01) occurred with moderate turbidity (7.22 NTU) and discharge (55.78 cfs) and low 48- hour (actually 24) precipitation (0.15 in).

The highest turbidity (14.2 NTU on 4/10/03) coincided with the highest discharge (249.0 cfs), second highest 48- hour precipitation (0.65 in) and eighth highest bacteria density (183 FC/100 ml). The second highest turbidity (11.7 NTU on 6/5/03) occurred with the second highest discharge (128.0 cfs), the third highest 48- hour precipitation (0.38 in) and the fifth highest bacteria density (385 FC/100 ml). The highest 48- hour precipitation (0.70 in on 7/24/03) coincided with elevated bacteria density (175 FC/100 ml), and moderate turbidity (5.95 NTU) and discharge (43.3 cfs).

Arbuckle Creek, site N31

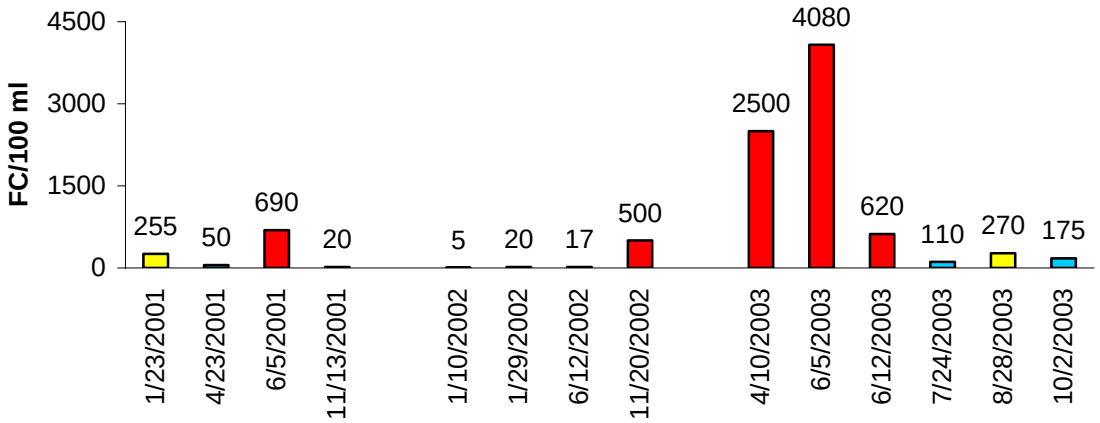
Seven of the fourteen samples (50%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 35).

Since 1990, 65 of 113 samples (57.5%) have exceeded 200 FC/100 ml.

Prior to the July 2001 floods the samples were taken from stream right underneath the Thurmond- Minden Trail bridge that crosses the creek near its mouth. After the floods the site was moved to stream left, just downstream of the bridge. The floods also resulted in relocation of the staff gage further upstream near the community of Minden. Arbuckle Creek enters the New River approximately 37.2 miles downstream of the Hinton gage and 0.8 miles downstream of the Thurmond gage. Anglers, hikers and mountain bikers commonly visit this area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 5- 4080 FC/100 ml (mean 665, median 215), turbidity 0.41- 7.92 NTU (mean 3.70, median 3.28), 48- hour precipitation 0.00- 0.70 in (mean 0.19, median 0.11), discharge 2.0- 23.5 cfs (mean 10.45, median 10.66). Gage readings were not available for four sample dates, so discharge was categorized visually.

Figure 35. Arbuckle Creek



The highest bacteria density (4080 FC/100 ml on 6/5/03) coincided with the highest turbidity (7.92 NTU) and discharge (23.5 cfs) and third highest 48- hour precipitation (0.38 in). The second highest bacteria density (2500 FC/100 ml on 4/10/03) coincided with the second highest 48- hour precipitation (0.65 in) and discharge (19.4 cfs) and fifth highest turbidity (4.78 NTU). The third highest bacteria density (690 FC/100 ml on 6/5/01) coincided with the third highest turbidity (6.33 NTU) and sixth highest discharge (9.2 cfs) and 48- hour (actually 24- hour) precipitation (0.15 in). The fourth highest bacteria density (620 FC/100 ml on 6/12/03) coincided with the second highest turbidity (7.32 NTU), third highest discharge (11.9 cfs) and fourth highest 48- hour precipitation (0.30 in). The highest 48- hour precipitation (0.70 in on 7/24/03) coincided with slightly elevated bacteria (110 FC/100 ml) and turbidity (4.51 NTU) and low discharge (2.0 cfs).

Coal Run, site N15

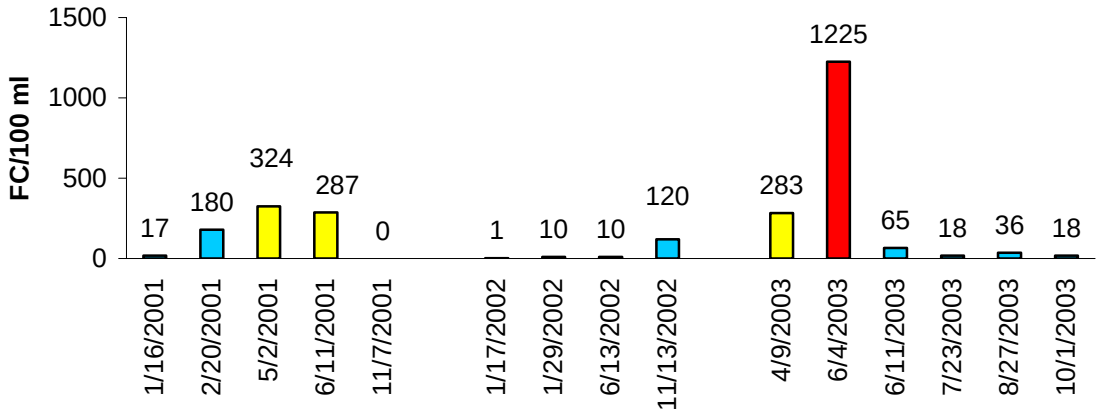
Four of the fifteen samples (27%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 36).

Since 1990, 43 of 114 samples (37.7%) have exceeded 200 FC/100 ml.

The site is on stream left underneath an old railroad trestle across Coal Run near its mouth, just off the National Park Service Cunard to Kaymoor Trail. Anglers and hikers are commonly seen in this area.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 1225 FC/100 ml (mean 173, median 36), turbidity 0.35- 13.2 NTU (mean 4.45, median 4.01), 48- hour precipitation 0.00- 0.75 in (mean 0.16, median 0.01), discharge (visual) "low"- "normal".

Figure 36. Coal Run



High bacteria densities noted during 2001- 2003 generally coincided with elevated turbidity. The highest bacteria density (1225 FC/100 ml on 6/4/03) coincided with the highest turbidity (13.2 NTU), the third highest 48- hour precipitation (0.52 in) and "normal" discharge. The second highest bacteria density (324 FC/100 ml on 5/2/01) coincided with the fourth highest turbidity (7.02 NTU), low 48- hour precipitation (0.08 in) and "low" discharge. The second highest turbidity (9.72 NTU on 4/9/03) coincided with the second highest 48- hour precipitation (0.67 in), the fourth highest bacteria density (283 FC/100 ml) and "normal" discharge. The third highest bacterial density (287 FC/100 ml on 6/11/01) occurred with the third highest turbidity (7.10 NTU), "normal" discharge and nil 48- hour precipitation (0.00 in). The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with moderate turbidity (4.22 NTU), low bacteria density (18 FC/100 ml) and "low" discharge.

Keeney Creek above Winona, site N00

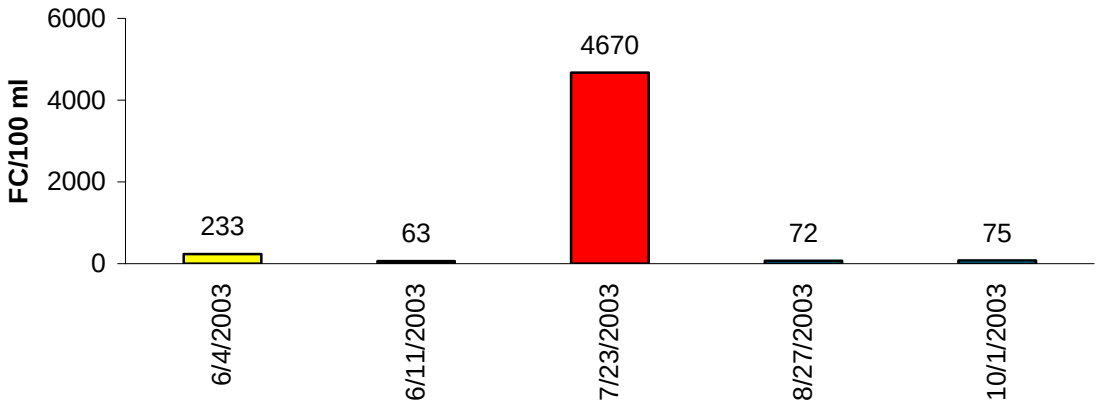
Monitoring of this site began in 2003. Two of the five samples (40%) exceeded the West Virginia standard for contact recreation (Fig. 37).

This site is on stream right just downstream of a County Route 82 bridge about 0.8 mile downstream of the community of Divide. Keeney Creek enters the New River approximately 46.1 miles downstream of the Hinton gage and 9.7 miles downstream of the Thurmond gage. Local residents are often seen near the creek.

This site was added to the monitoring program in 2003 to compare water quality above and below the community of Winona. This site is the most upstream of three Keeney Creek monitoring sites. This site is 2.2 miles upstream of Keeney Creek at Winona (N16) and 3.3 miles upstream of Keeney Creek below Winona (N38).

During 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 63- 4670 FC/100 ml (mean 1023, median 75), turbidity 0.93- 20.8 NTU (mean 5.71, median 2.35), 48- hour precipitation 0.00- 0.75 in (mean 0.30, median 0.24), discharge (visual) "low"- "high".

Figure 37. Keeney Creek above Winona



The highest bacteria density (4670 FC/100 ml on 7/23/03) coincided with the highest 48-hour precipitation (0.75 in), the third highest turbidity (2.35 NTU) and "low" discharge. The second highest bacteria density (233 FC/100 ml on 6/4/03) coincided with the highest turbidity (20.8 NTU), the second highest 48- hour precipitation (0.52 in) and the only "high" discharge noted at this site in 2003.

Keeney Creek at Winona, site N16

All fourteen samples (100%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 38).

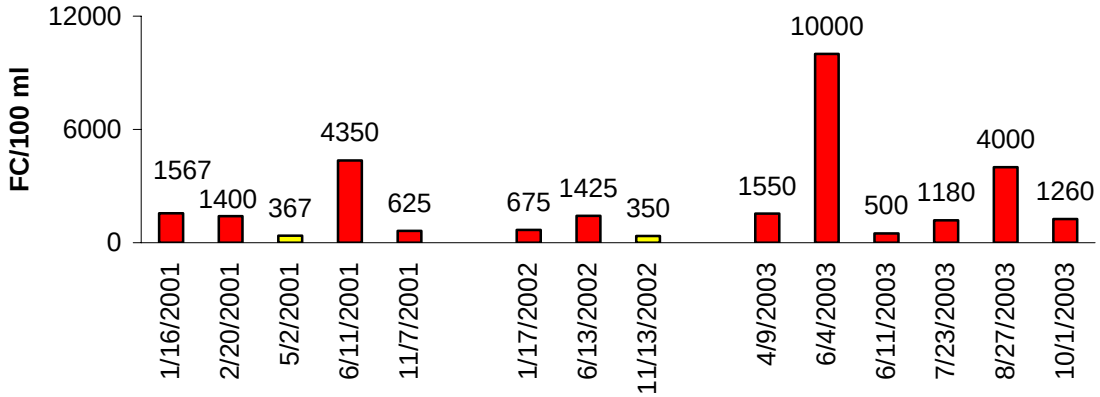
Water quality at this site in terms of fecal coliform bacteria is totally unsatisfactory for contact recreation. Since 1990, 109 of 114 samples (95.6%) have exceeded 200 FC/100 ml.

This site is on stream left, just downstream of a bridge across the creek in the lower end of the community of Winona. Nearby residents are often seen near the creek, minnow traps and toys are commonly seen in and near the creek at the sampling site.

This site has been monitored since 1990 and is the mid- point of three sites currently located on Keeney Creek. This site is 2.2 miles downstream from site Keeney Creek above Winona (N00), and 1.1 miles upstream from site Keeney Creek below Winona (N38).

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 350- 10000 FC/100 ml (mean 2089, median 1330), turbidity 0.19- 21.4 NTU (mean 3.92, median 2.51), 48- hour precipitation 0.00- 0.75 in (mean 0.17, median 0.01), discharge (visual) "low"- "high". On 11/13/02 "48- hour precipitation" occurred over 24 hours.

Figure 38. Keeney Creek at Winona



Bacteria density in Keeney Creek was high regardless of turbidity, 48- hour precipitation or discharge. The highest bacteria density (10000 FC/100 ml on 6/4/03) coincided with the highest turbidity (21.4 NTU), the third highest 48- hour precipitation (0.52 in) and "high" discharge. The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with the ninth highest bacteria density (1180 FC/100 ml), moderate turbidity (2.82 NTU) and "low" discharge. The second highest bacteria density (4350 FC/100 ml on 6/11/01) coincided with moderate turbidity (2.69 NTU), "normal" discharge and nil 48- hour precipitation (0.00 in).

Keeney Creek below Winona, site N38

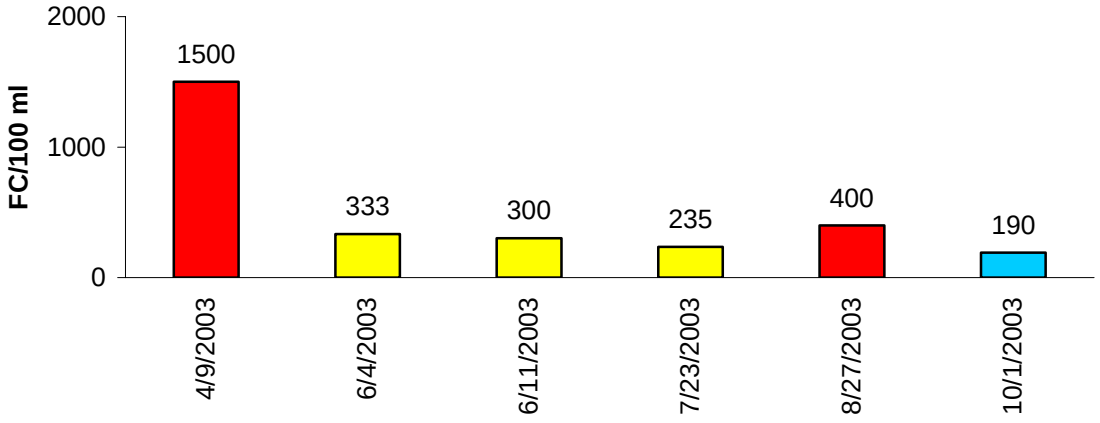
Monitoring of this site began in 2003. Five of the six samples (83%) exceeded the West Virginia standard for contact recreation (Fig. 39).

This site is inside the National Park Service boundary and about 1.1 miles downstream from the community of Winona. This site is located on stream right, on the upstream side of a roadway bridge that crosses the creek. Vehicle access is by Keeney Creek Road (County Route 85) to a recently upgraded section of this road which follows the creek from Winona almost to its mouth. Nearby residents are often seen near the creek.

This site was added to the monitoring schedule in 2003 to allow comparisons of the water quality above and below the community of Winona. This site is the lowermost point of three monitoring sites currently located on Keeney Creek. This site is 3.3 miles downstream of Keeney Creek above Winona (N00) and 1.1 miles downstream of Keeney Creek at Winona (N16).

During 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 190- 1500 FC/100 ml (mean 493, median 317), turbidity 1.54- 19.3 NTU (mean 6.10, median 3.94), 48- hour precipitation 0.00- 0.75 in (mean 0.36, median 0.38), discharge (visual) "low"- "high".

Figure 39. Keeney Creek below Winona



The highest bacteria density (1500 FC/100 ml on 4/9/03) coincided with the second highest turbidity (5.39 NTU) and 48- hour precipitation (0.67 in) and "high" discharge. The highest turbidity (19.3 NTU on 6/4/03) coincided with the third highest bacteria density (333 FC/100 ml) and 48- hour precipitation (0.52 in) and "high" discharge. The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with the fifth highest bacteria density (235 FC/100 ml), the fourth highest turbidity (2.88 NTU) and "low" discharge.

Wolf Creek, site N18

Three of the fifteen samples (20%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 40).

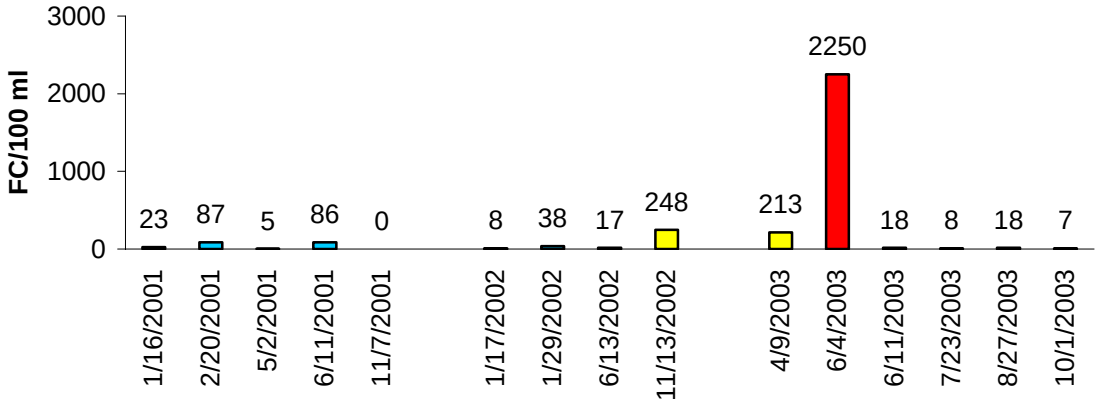
Since 1990, 29 of 115 samples (25.2%) have exceeded 200 FC/100 ml.

Before the July 2001 floods this site was on stream right at the mouth of Wolf Creek near the Fayette Station river access parking area off Fayette Station Road (County Route 82). As a result of channel movement caused by the floods, the sampling site was moved to stream right, just downstream of the bridge for the upper Fayette Station parking area. The 2001 floods also resulted in the staff gage being relocated a little further upstream, just above the first Fayette Station Road bridge.

Wolf Creek enters the New River about 50.1 miles downstream of the Hinton gage and 13.7 miles downstream of the Thurmond gage.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 2250 FC/100 ml (mean 202, median 18), turbidity 0.42- 51.1 NTU (mean 7.51, median 4.45), 48- hour precipitation 0.00- 0.75 in (mean 0.16, median 0.01), discharge 1.4- 77.61 cfs. Discharge was categorized visually for two sample dates.

Figure 40. Wolf Creek



The highest bacteria density (2250 FC/100 ml on 6/4/03) coincided with the highest turbidity (51.1 NTU), the third highest 48- hour precipitation (0.52 in) and "high" discharge. This was probably the highest discharge observed at this site during 2001-2203, as the stage reading (1.64 feet) exceeded the values available in the rating table. The second highest bacteria density (248 FC/100 ml on 11/13/02) coincided with the second highest discharge (77.61 cfs), third highest turbidity (8.56 NTU) and low 48- hour (actually 24- hour) precipitation (0.17 in). The third highest bacteria density (213 FC/100 ml on 4/9/03) coincided with the second highest turbidity (11.4 NTU) and 48- hour precipitation (0.67 in), and the third highest discharge (72.7 cfs). The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with low bacteria density (8 FC/100 ml), moderate turbidity (4.66 NTU) and low discharge (4 cfs).

Ajax Mine Spring, site N28

None of the thirteen samples (0%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 41).

Water quality at this site in terms of fecal coliform bacteria is usually satisfactory for contact recreation. Since 1995, none of the 51 samples (0.0%) have exceeded 200 FC/100 ml.

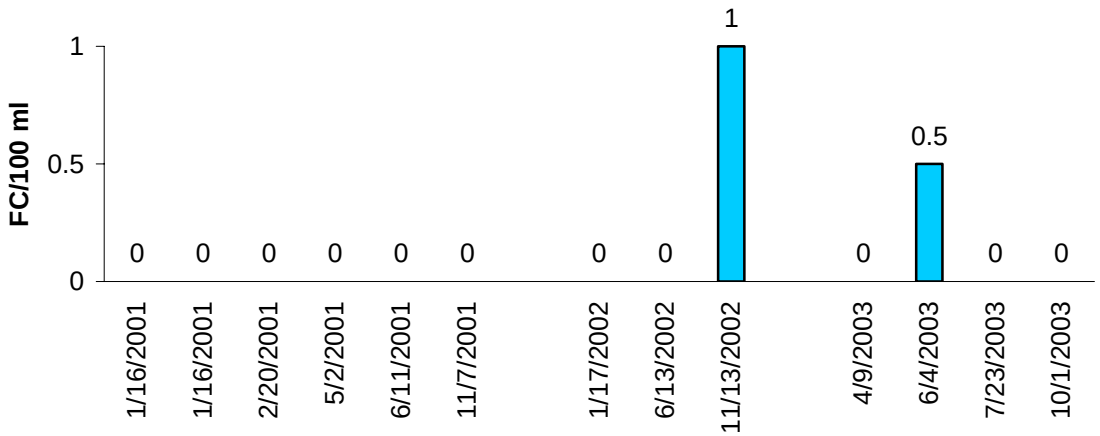
The presence of fecal coliforms in two samples indicates that this water is not suitable for human domestic use without treatment.

This site is on Fayette Station Road (County Route 82), on a steep slope on the north side of New River Gorge. The water originates from the former Ajax Mine. Discharge of this water source is not known. A sizable, but unknown, number of area residents collect water from this site for household use. During dry periods this may be the only water reliably available to area residents that normally depend on wells and cisterns. Water flows continuously from a large hose into a ditch along Fayette Station Road, and eventually to the New River.

Water can be collected from three small (faucet sized) spigots, and one larger spigot with an attached hose about three inches in diameter. Samples were usually taken from the large hose, but came from one of the smaller spigots if the hose was in use at the time of sample collection.

Between 2001 and 2003, parameter values for baseline samples ranged as follows (App. 2): bacteria density 0- 1 FC/100 ml (mean 0.1, median 0), turbidity 0.07- 0.75 NTU (mean 0.30, median 0.27), 48- hour precipitation 0.00- 0.75 in (mean 0.19, median 0.01).

Figure 41. Ajax Mine Spring



Fecal coliforms were noted in two samples. The presence of fecal coliforms in these samples indicates that this water is unsuitable for human consumption without treatment.

Marr Branch, site N19

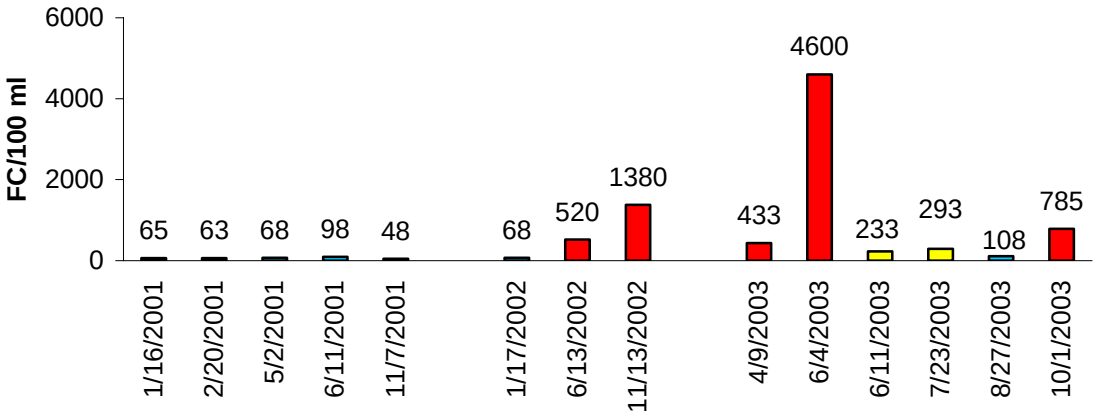
Seven of the fourteen samples (50%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 42).

Since 1990, 80 of 113 samples (70.8%) have exceeded 200 FC/100 ml.

This site is on stream right just off Fayette Station Road (County Route 82) below the Rivers Inc. complex. Guests of Rivers Inc. are sometimes seen at this site. Marr Branch enters the New River 50.9 miles downstream of the Hinton gage and 14.5 miles downstream of the Thurmond gage. Anglers and rafters are common visitors near Marr Branch's confluence with the New River.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 2): bacteria density 48- 4600 FC/100 ml (mean 626, median 171), turbidity 0.62- 33.5 NTU (mean 6.32, median 4.02), 48- hour precipitation 0.00- 0.75 in (mean 0.17, median 0.01), discharge 0.77- 34.0 cfs (mean 5.79, median 2.44).

Figure 42. Marr Branch



The highest bacteria density (4600 FC/100 ml on 6/4/03) coincided with the highest turbidity (33.5 NTU) and discharge (34.0 cfs) and the third highest 48- hour precipitation (0.52 in). The second highest bacteria density (1380 FC/100 ml on 11/13/02) coincided with the third highest discharge (8.28 cfs), the fourth highest turbidity (5.47 NTU) and low 48- hour (actually 24- hour) precipitation (0.17 in). The lowest bacteria density (48 FC/100 ml on 11/7/01) coincided with the lowest turbidity (0.62 NTU), the fifth lowest discharge (1.7 cfs) and nil 48- hour precipitation (0.00 in).

The second highest turbidity (11.5 NTU on 4/9/03) coincided with the second highest 48- hour precipitation (0.67 in) and discharge (13.8 cfs) and the fifth highest bacteria density (433 FC/100 ml). The highest 48- hour precipitation (0.75 in on 7/23/03) coincided with the sixth highest bacteria density (293 FC/100 ml) and turbidity (5.23 NTU) and the lowest discharge (0.77 cfs).

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GAULEY RIVER NATIONAL RECREATION AREA

GAULEY RIVER MAINSTEM

Gauley River below Summersville Dam, site G01

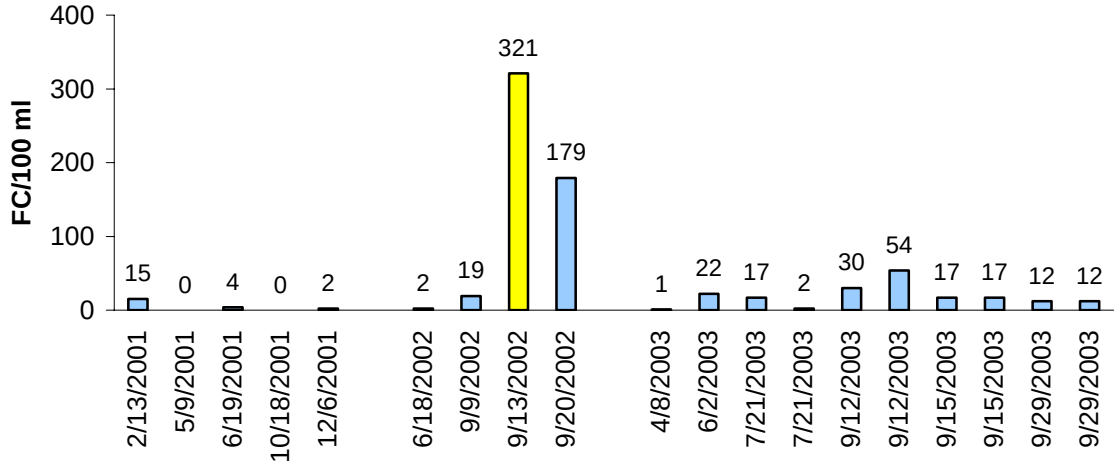
One of the nineteen samples (5%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 43).

Since 1991, 3 of 107 samples (2.8%) have exceeded 200 FC/100 ml.

The sampling site is on river right just below Summersville Dam, and is about 600 feet upstream of the Summersville Dam gage. No streams enter the Gauley River between the sampling site and the gage. Typical visitors include boaters, anglers, campers and sightseers.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 3): bacteria density 0- 321 FC/100 ml (mean 38, median 15), turbidity 1.67- 5.88 NTU (mean 3.59, median 3.76), 48- hour precipitation 0.00- 0.92 in (mean 0.20, median 0.02), discharge 120- 4200 cfs (mean 1677, median 1960).

Figure 43. Gauley River below Summersville Dam



Little correlation occurred between major parameters at this site. The highest bacteria density (321 FC/100 ml on 9/13/02) coincided with the fifth lowest turbidity (2.76 NTU), nil 48- hour precipitation (0.00 in), and the sixth highest discharge (2420 cfs). The second highest bacteria density (179 FC/100 ml on 9/20/02) occurred with the sixth lowest turbidity (2.90 NTU), the fifth highest discharge (2460 cfs) and nil 48- hour precipitation (0.00 in). The highest turbidity (5.88 NTU on 12/6/01) coincided with the third lowest bacteria density (2 FC/100 ml), nil 48- hour precipitation (0.00 in), and the lowest discharge (120 cfs). The highest 48- hour precipitation (0.92 in on 6/2/03) coincided with the highest discharge (4200 cfs), the fourth highest turbidity (4.54 NTU) and the fifth highest bacteria density (22 FC/100 ml).

Gauley River above Mason Branch, site G06

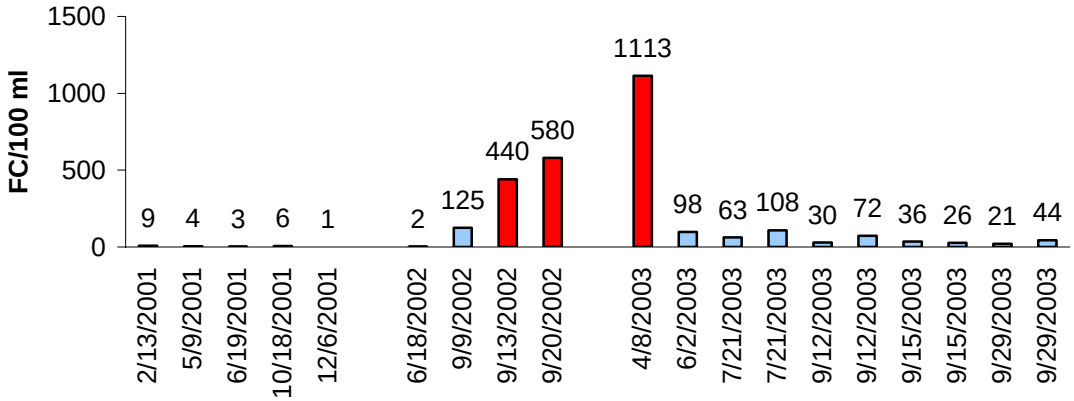
Three of the nineteen samples (16%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 44).

Since 1996, 4 of 43 samples (9.3%) have exceeded 200 FC/100 ml.

The sampling site is on river right upstream of a Gauley River access at the mouth of Mason Branch, and is about 8.6 miles downstream of the Summersville Dam gage. Ten tributaries (six perennial and four intermittent) enter the Gauley River between the gage and this site. Typical visitors include boaters, anglers and campers.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 3): bacteria density 1- 1113 FC/100 ml (mean 146, median 36), turbidity 1.31- 40.6 NTU (mean 6.89, median 4.47), 48- hour precipitation 0.00- 0.92 in (mean 0.20, median 0.02), discharge 153- 6000 cfs (mean 2080, median 2428).

Figure 44. Gauley River above Mason Branch



The highest bacteria density (1113 FC/100 ml on 4/8/03) coincided with the highest turbidity (40.6 NTU), the second highest 48- hour precipitation (0.85 in) and the fifth highest discharge (2732 cfs). The highest 48- hour precipitation (0.92 in on 6/2/03) coincided with the highest discharge (6000 cfs), while bacteria density (98 FC/100 ml) and turbidity (6.34 NTU) were moderately elevated.

Gauley River above Swiss, site G04

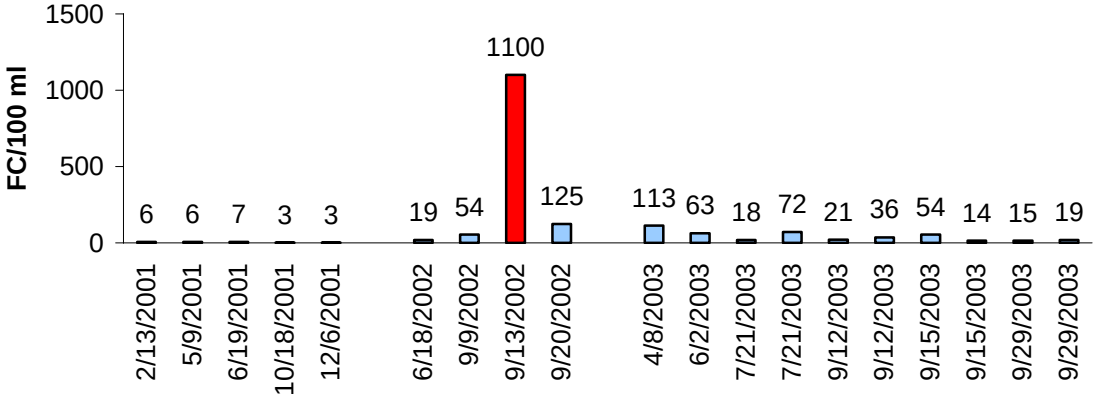
One of the nineteen samples (5%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 45).

Since 1991, 6 of 105 samples (5.7%) have exceeded 200 FC/100 ml.

The sampling site is on river right, upstream of the community of Swiss and just upstream from the mouth of Laurel Creek. The site is about 14.1 miles downstream from the Summersville Dam gage. There are 44 tributaries (17 perennial and 27 intermittent) between the gage and the site. The area is popular for swimming, angling and camping.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 3): bacteria density 3- 1100 FC/100 ml (mean 92, median 19), turbidity 0.62- 17.6 NTU (mean 4.47, median 3.66), 48- hour precipitation 0.00- 0.92 in (mean 0.20, median 0.02), discharge 153- 8120 cfs (mean 2015, median 1640).

Figure 45. Gauley River above Swiss



Only moderate correlation occurred between bacteria density and the other parameters at this site. The highest bacteria density (1100 FC/100 ml on 9/13/02) coincided with the sixth lowest turbidity (2.70 NTU) and the ninth lowest discharge (1780 cfs) and nil 48-hour precipitation (0.00 in). The highest turbidity (17.6 NTU on 4/8/03) coincided with the second highest 48- hour precipitation (0.85 in), and the third highest bacteria density (113 FC/100 ml) and discharge (3290 cfs). The highest 48- hour precipitation (0.92 in on 6/2/03) coincided with the highest discharge (8120 cfs), the third highest turbidity (6.97 NTU) and the fifth highest bacteria density (63 FC/100 ml).

GAULEY RIVER TRIBUTARIES

Meadow River, site G05

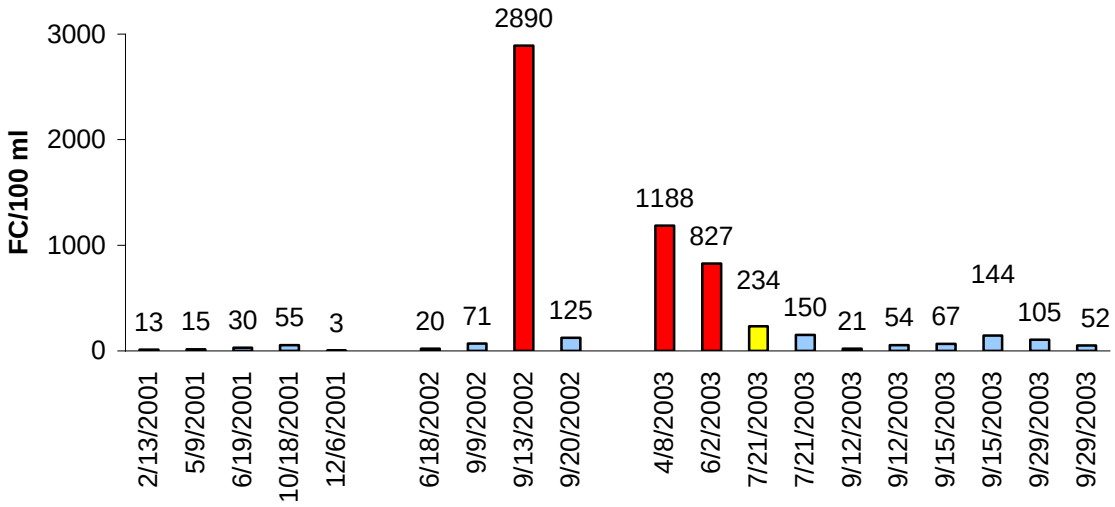
Four of the nineteen samples (21%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 46).

Since 1991, 7 of 81 samples (8.6%) have exceeded 200 FC/100 ml.

The sampling site is on river right upstream of Anglins Creek and the Wilderness Public Service District water treatment plant. This site is about 8.9 miles upstream of the Meadow River gage. Fourteen tributaries (11 perennial and 3 intermittent) enter the Meadow River between this site and the gage. Meadow River enters the Gauley River about 4.9 miles downstream from the Summersville Dam gage. Anglers are the primary visitors to this site, which is outside the Gauley River National Recreation Area boundary.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 3): bacteria density 3- 2890 FC/100 ml (mean 319, median 67), turbidity 0.60- 41.8 NTU (mean 6.96, median 2.07), 48- hour precipitation 0.00- 0.92 in (mean 0.20, median 0.02), discharge 7.7- 2540 cfs (mean 433, median 145).

Figure 46. Meadow River



The second highest bacteria density (1188 FC/100 ml on 4/8/03) coincided with the highest turbidity (41.8 NTU) and discharge (2540 cfs) and the second highest 48- hour precipitation (0.85 in). The third highest bacteria density (827 FC/100 ml on 6/2/03) coincided with the highest 48- hour precipitation (0.92 in), the second highest discharge (1800 cfs), and the third highest turbidity (12.4 NTU). The fourth and fifth highest bacteria densities (234 FC/100 ml and 150 FC/100 ml, both collected on 7/21/03) coincided with the second highest turbidity (25.1 NTU) and the third highest discharge (539 cfs), but nil 48- hour precipitation (0.00 in). However, the highest bacteria density (2890 FC/100 ml on 9/13/02) coincided with the second lowest turbidity (0.83 NTU), the lowest discharge (7.7 cfs) and nil 48- hour precipitation (0.00 in).

Peters Creek at ford, site G07

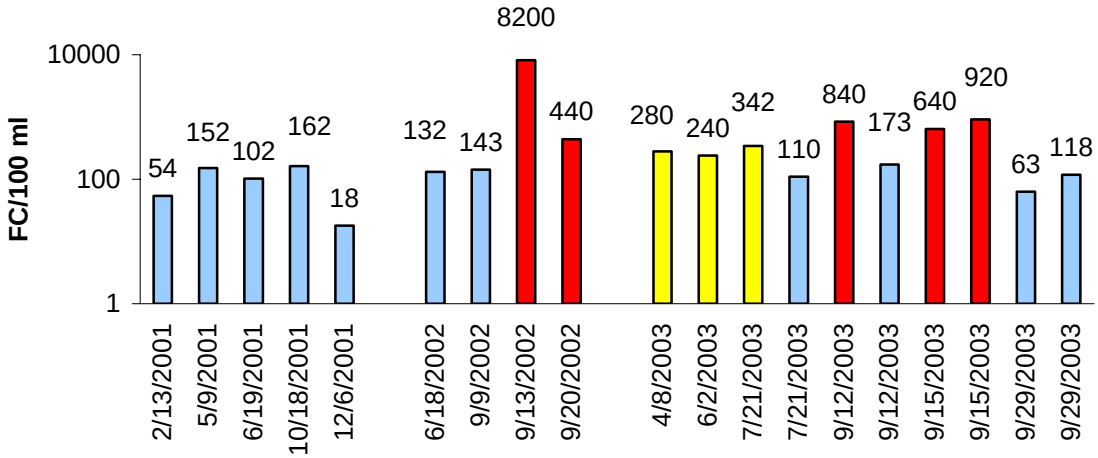
Eight of the nineteen samples (42%) collected between 2001 and 2003 exceeded the West Virginia standard for contact recreation (Fig. 47).

Since 1996, 15 of 46 samples (32.6%) have exceeded 200 FC/100 ml.

The sampling site is on stream left about 1.5 miles upstream from the mouth of the creek. Peters Creek enters the Gauley River about 6.5 miles downstream from the Summersville Dam gage. Four wheel drive enthusiasts are typical visitors to the sample site, while anglers, campers and boaters are typical visitors at the mouth of Peters Creek.

Between 2001 and 2003 parameter values for baseline samples ranged as follows (App. 3): bacteria density 18- 8200 FC/100 ml (mean 691, median 162), turbidity 0.64- 12.0 NTU (mean 3.64, median 1.98), 48- hour precipitation 0.00- 0.92 in (mean 0.20, median 0.02), discharge (visual) "low"- "high".

Figure 47. Peters Creek at ford



The highest bacteria density (8200 FC/100 ml on 9/13/02) coincided with low turbidity (1.96 NTU), "low" discharge and nil 48- hour precipitation (0.00 in). The highest turbidity (12.0 NTU on 4/8/03) coincided with a "high" discharge, the second highest 48- hour precipitation (0.85 in) and the seventh highest bacteria density (280 FC/100 ml). The greatest 48- hour precipitation (0.92 in on 6/2/03) coincided with a "high" discharge, the third highest turbidity (8.35 NTU) and the eighth highest bacteria density (240 FC/100 ml). A "high" discharge was noted on only two sample dates (4/8/03 and 6/2/03), and coincided with the two highest 48- hour precipitation values. Bacteria density and turbidity were elevated for these dates.

The second (920 FC/100 ml) and fourth (640 FC/100 ml) highest bacteria densities came from the two 9/15/03 samples, and coincided with the second highest turbidity (10.8 NTU), low 48- hour precipitation (0.03 in) and "low" discharge.

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2001 FLOOD WATER QUALITY

Initial sampling (Table 1) of still relatively easily accessible parts of the Fayette Station area on July 16 showed all sites within the state standard. Data from July 17 revealed some causes for concern in the Thurmond and McKendree Road areas. An intermittent stream crossing McKendree road had a pH under 7.0 (slightly acid). This area of New River Gorge was intensively mined for coal before the park was created, and although most of the coal was considered low- sulfur, some seams did contain more sulfur and would be more prone to create acid mine drainage. Only two of the thirteen (15.4%) samples exceeded 200FC/100ml, with one other site being just below this state standard (3 out of 13 = 23.1%). High fecal coliform densities were found in Arbuckle Creek and the New River in the vicinity of Dunloup and Arbuckle Creeks. Dunloup and Arbuckle Creeks frequently have high fecal coliform bacteria densities (see pages 51- 52).

Table 1. Selected water quality characteristics for sites sampled in the New River watershed within New River Gorge National River on July 16 and 17, 2001. Forty-eight hour precipitation was 0.00 inches for both days. FC = fecal coliforms, < = "less than". Codes for clarity (visual classification) are C = clear, MI = milky and MR = murky.

Site	Date	FC/100 ml	Clarity	pH
	7/16/01			
New River above Wolf Creek		<20	MI	8.2
Wolf Creek		<20	C	7.8
Marr Branch at RR tracks		89	MI	7.4
New River below Marr Branch		<20	MI	8.2
	7/17/01			
Buffalo Creek at McKendree Rd.		<20	MI	7.5
Unnamed trib. #2 on McKendree Rd.		<20	MI	7.6
Unnamed trib. #1 on McKendree Rd.		54	C	6.3
New River above Dunloup Creek		54	MR	8.4
Dunloup Creek		54	MI	8.2
New River below Dunloup Creek		321	MI	8.1
New River above Arbuckle Creek		54	MI	8.4
Arbuckle Creek		400	MI	7.9
New River below Arbuckle Creek		196	MI	8.0

Sampling the length of the flood- affected section of New River Gorge on July 18- 20 (Fig. 48) found 7 of 44 sample sites to exceed 200 FC/100ml, and two other sites were just under the state standard (196 FC/ml). Significant rainfall (0.80 in) over July 17- 18 may have contributed to high fecal coliform densities noted on July 18- 20. Seven of the nine high bacteria density samples over July 18- 20 came from tributaries, and the other two were from New River sites immediately downstream of one or more of these tributaries. Tributaries with high bacteria density generally drain watersheds with sizable populations. The exception was Dowdy Creek (196 FC/100ml) that drains an uninhabited watershed. Follow- up samples taken from three locations along Dowdy Creek on July 23 had bacteria densities below 20 FC/100ml. Bats noted roosting in a

railroad culvert adjacent to the sample site may have been a source of fecal material on July 18.

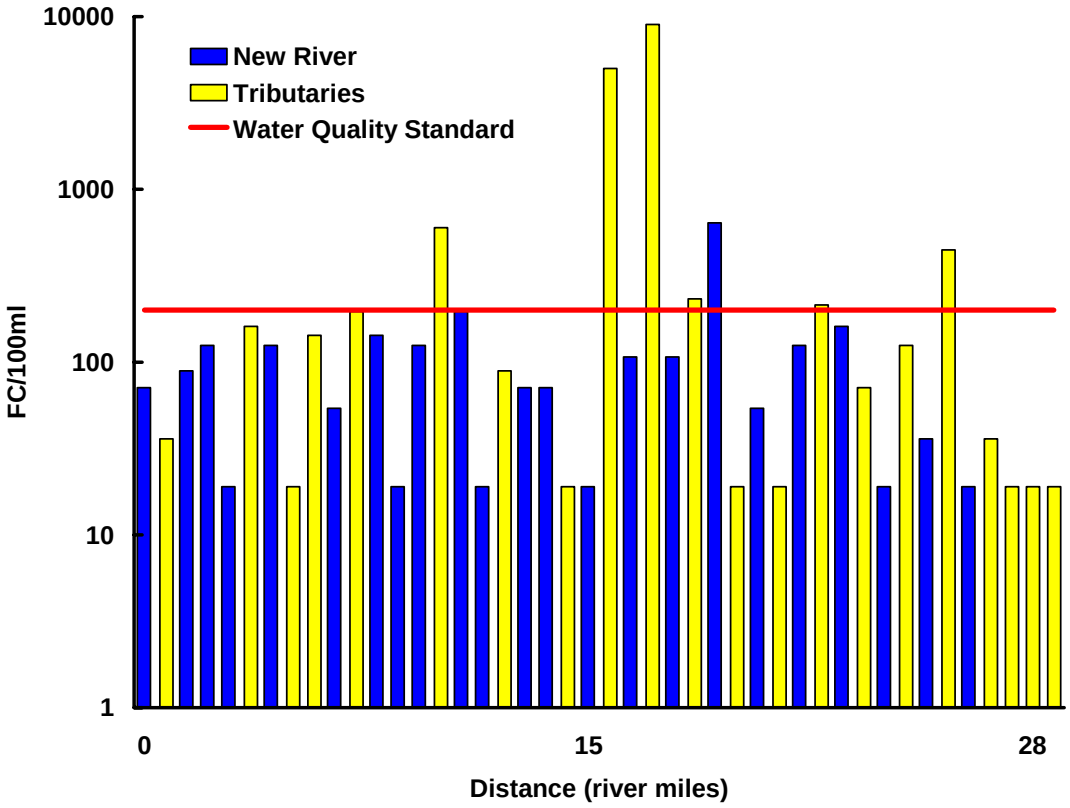

Figure 48. Fecal coliform bacteria densities at New River (blue) and tributary (yellow) sites on July 18–20, 2001. Mile 0 is on the New River just upstream of Laurel Creek at Quinnimont and Mile 28.5 (end) is Fern Creek. Note that bacteria density is on a logarithmic scale and that the scale on the distance axis is not linear.

Fecal coliform density at the mouth of Dunloup Creek on July 19 was 5,000 FC/100ml. On July 17 at our regular sampling site about one mile upstream the density was only 54 FC/100ml. On July 23 we sampled Dunloup Creek at several sites within the park boundary to see if bacteria density had a longitudinal pattern. Bacteria density generally decreased downstream (Fig. 49), with a spike just above its confluence with the New River. This spike may fall within the range of sample- to- sample variation, but given the distinctive downstream trend noted on July 23, it is possible that the data spike represents an actual increase in fecal coliform bacteria density. There are several potential explanations for such an increase. One possibility would be a failure of one or more septic systems in this area, including one operated by the National Park Service. Contamination could also be leaching from historical development in the Dun Glen area that pre- dates establishment of New River Gorge National River. Other possibilities include wildlife, dogs, and improper sanitation from visitors to this part of the park.

Following 5.3 inches of rain over the prior 48 hours, a trial of the storm- event type monitoring began on July 27. The trial covered New River Gorge between Piney Creek and Marr Branch (Fig. 50). All samples collected July 27 exceeded the West Virginia standard, with only one site (Slater Creek at McKendree Road – not shown on Fig. 50 as

it was not sampled again during this effort) being less than 4,000 FC/100ml. Another 1.51 inches of rain fell before the next samples were taken on July 30. All of these samples exceeded 1,200 FC/100ml. By August 4, only two New River sites (Stonecliff and Dun Glen boat launch) and three tributaries (Piney, Dunloup, and Arbuckle Creeks) still exceeded the standard, with Arbuckle Creek being exceptionally high (13,500 FC/100ml). No samples collected from New River sites on August 8 exceeded the West Virginia standard, but all tributaries except Wolf Creek still exceeded the state standard.

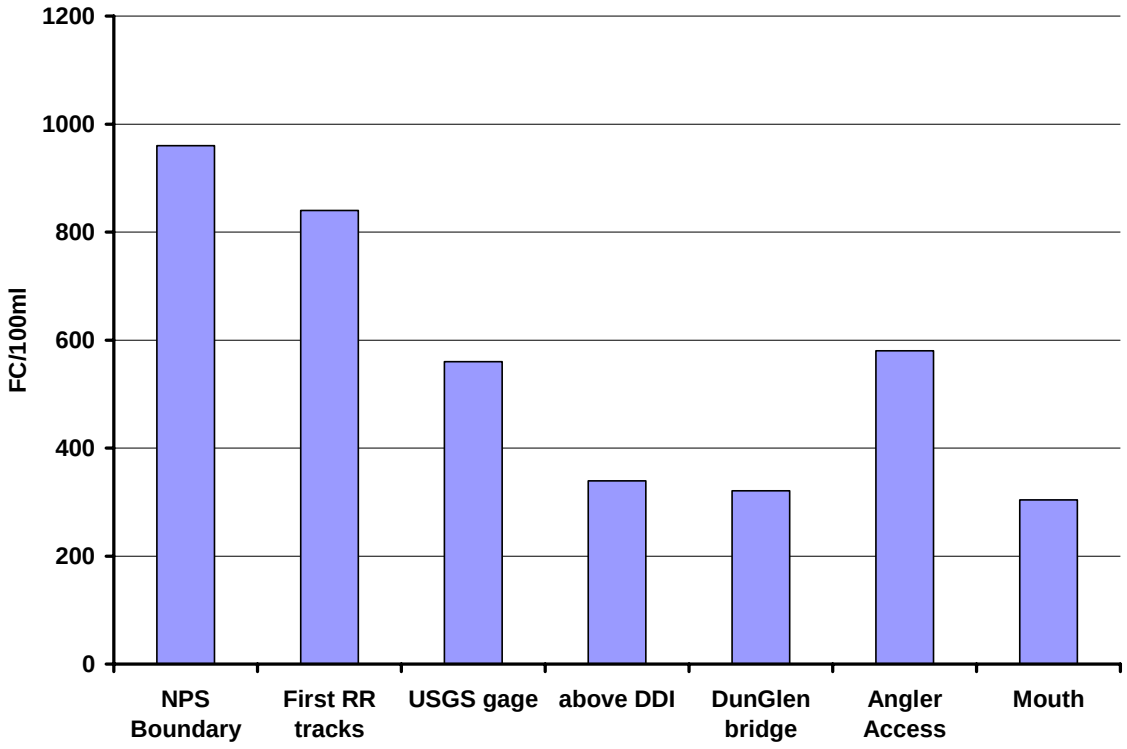

Figure 49. Fecal coliform density on July 23, 2001 along Dunloup Creek. Distance from NPS boundary to mouth is about 3.75 miles. Distance between sample sites is not uniform.

The rainfall of July 29 was a regional storm that also caused flooding in the Gauley River watershed. From August 1 – 4 we monitored our regular Gauley River National Recreation Area sites to assess post- flood water quality in this watershed (Fig. 51). All samples taken on August 1 exceeded the state standard, and all Gauley River sites had bacteria densities over 800 FC/100ml. By August 4 only the Meadow River and the most downstream Gauley River site exceeded the standard. Peter's Creek was not sampled on August 4 because the August 1 sample was near the state standard (232 FC/100ml).

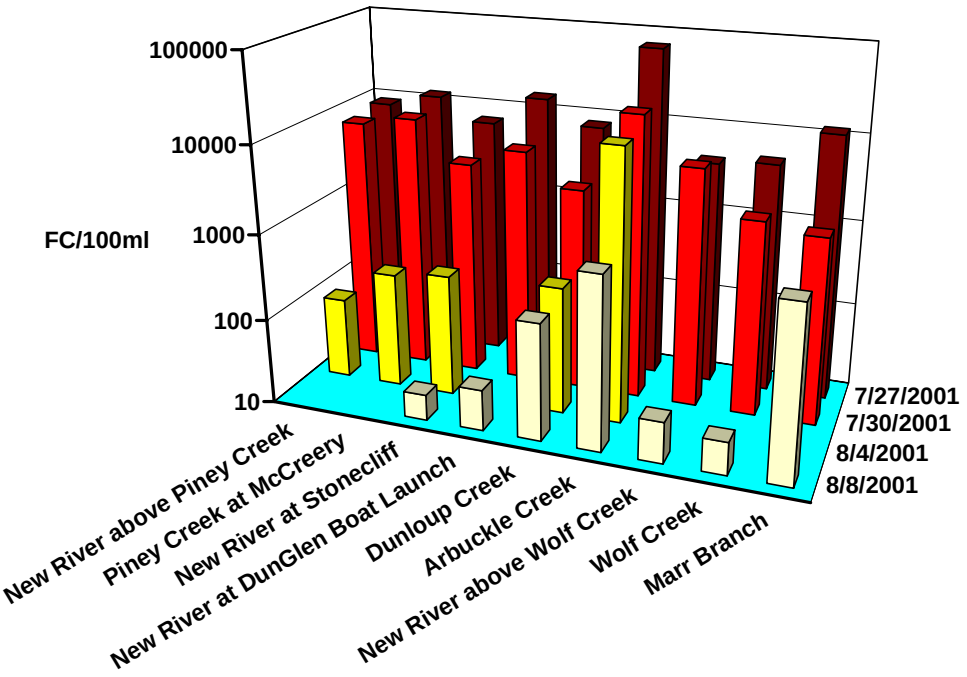

Figure 50. Fecal coliform densities in the New River and tributaries following rain events of July 26 and 29, 2001. Note logarithmic scale on bacteria density axis.

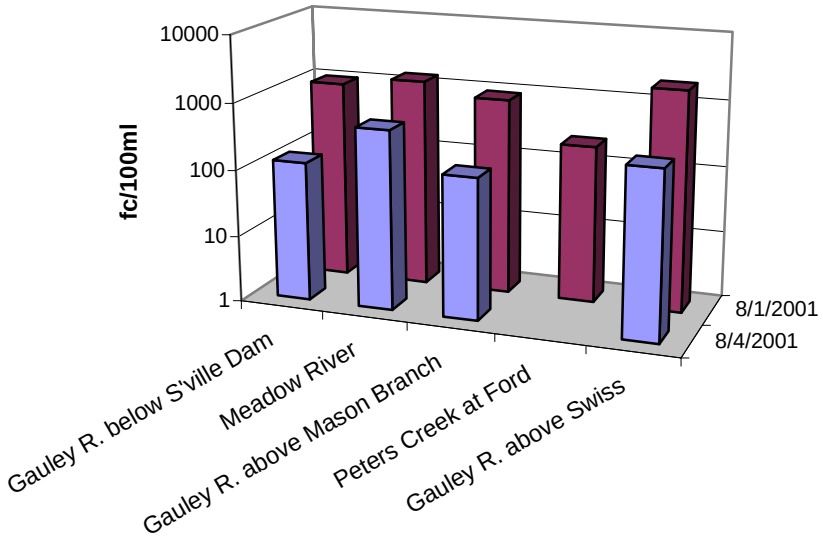

Figure 51. Fecal coliform densities in Gauley River National Recreation Area after the storm event of July 29, 2001. Note logarithmic scale on bacteria density axis.

On August 4, 2001 samples were collected at three New River and one Gauley River site to compare fecal coliform densities between stream bank and mid- river zones. There was no consistent pattern between shore and mid- channel sites, with only small

differences between the two classes of samples (Table 2). These differences are consistent with between- sample variation in grab sampling.

Table 2. Fecal coliform bacteria density (FC/100ml) of shore samples versus mid-channel samples for August 4, 2001 at four sites on the New and Gauley Rivers.

Site	Shore	Mid-channel
New River above Piney Creek	107	89
New River at Dun Glen boat ramp	268	143
New River above Wolf Creek	71	161
Gauley River above Mason Branch	125	143

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DISCUSSION

BASELINE MONITORING

Bluestone National Scenic River

Four of the eleven (36%) baseline monitoring sample dates from Bluestone National Scenic River had bacteria densities that exceeded 200 FC/100ml during 2001- 2003 (Figs. 5- 9). Two of these dates occurred in 2001, two in 2002, and none in 2003. Between 1998 and 2000, only one of the nine (11%) sample dates had sites with bacteria densities exceeding the state standard (Wilson and Purvis 2003). The greater proportion of samples exceeding the standard in 2001- 2003 is probably due to higher discharge and precipitation in 2001- 2003 as compared to 1998- 2000. During 1998- 2000, mean discharge for the Bluestone River at Pipestem gage on sample dates was 214 cfs (Wilson and Purvis 2003), while during 2001- 2003 it was 439 cfs (App. 1).

High fecal coliform densities in the Bluestone River on 9/27/02 coincided with the greatest 48- hour precipitation (1.62 in). Discharge (394 cfs) was only the sixth highest for a sampling date during 2001- 2003, but this was still relatively high, as daily mean discharge for the Bluestone River during September 2002 was 91 cfs (Ward *et al*. 2003). Also, the Bluestone River was still rising from recent rainfall at the time of sample collection (9/27/02). Mean discharge for 9/25/02 was 81 cfs, for 9/26/02 was 368 cfs, and for 9/27/02 was 469 cfs (Ward *et al*. 2003). High fecal coliform densities are common during increasing flows (Bohn and Buckhouse 1985, Purvis and Wilson 1999).

The high fecal coliform densities in the Bluestone River on 9/27/02 also coincided with the second highest turbidity (52 – 116 NTU) for each site. Fecal coliform bacteria in streams are often associated with sediment particles that are reflected in turbidity measurements, thus higher turbidity measurements tend to reflect higher densities of fecal coliform bacteria (e.g. Wilson and Purvis 2003).

Water quality in Bluestone National Scenic River in terms of fecal coliform bacteria appears to be marginal for water contact recreation. Historically, all five sites have exceeded the West Virginia standard for contact recreation for between 10 and 15% of their sample dates. High densities of fecal coliform bacteria generally coincided with high discharge and turbidity following recent rainfall (Hebner 1991a, Sullivan 1993a,c. Wilson and Purvis 2003). Water quality appears to be acceptable for contact recreation during low flow periods when fecal coliform bacteria densities are generally below the West Virginia standard

Potential sources of fecal contamination include residences in the developed area around Bluefield and Princeton, livestock, and wildlife. Travel time between the developed areas and Bluestone National Scenic River may be sufficient to allow some fecal bacteria to die or be deposited before reaching the park.

New River Gorge National River

General conditions

Water quality varied considerably during 2001- 2003 in New River Gorge National River. This is not surprising given the variety of streams and the size and areal extent of the park. Some sites never or rarely exceeded the West Virginia standard for contact recreation, some sites exceeded the standard for all samples, and other sites were intermediate.

Five mainstem sites (New River at Hinton Visitor Center, New River above Sandstone Falls, New River at Thurmond, New River above Coal Run, and New River above Wolf Creek) exceeded the West Virginia standard for contact recreation on at least 10% (but less than 25%) of their sample dates. All other mainstem sites exceeded the West Virginia standard on less than 10% of the sample dates.

Among tributary sites, Madam Creek and Keeney Creek at Winona exceeded the standard for every sample, indicating chronic pollution in these streams. (Note that three sites were sampled on Keeney Creek beginning in 2003. This will be discussed later.) Other tributary sites that often exceeded the West Virginia standard for contact recreation include Lick Creek, Meadow Creek, Piney Creek, Dunloup Creek, Arbuckle Creek, Coal Run, Wolf Creek, and Marr Branch. Of these sites, Lick Creek exceeded the standard more than 10% and less than 25% of the time, while the other sites exceeded the standard at least 25% of the time. Sites that rarely exceeded the standard include Glade Creek, Mill Creek, Laurel Creek, Dowdy Creek, Slater Creek, and Buffalo Creek, and the two mine springs; Claremont and Ajax.

River Sections

Because not all samples could be collected on a given day, the following discussion is broken into sections for two reaches of the New River. The upper section runs from Bluestone Dam to below Meadow Creek, and includes tributaries from the Greenbrier River to Meadow Creek. The lower section runs from above Glade Creek to the downstream end of the park, and includes tributaries from Glade Creek to Marr Branch. No monitoring occurred in the reach between Meadow Creek and Glade Creek.

Upper Section

As noted above, Madam Creek exceeded the state standard for each sample. Since monitoring began in 1990, Madam Creek has exceeded 200 FC/100 ml on over 90% of the sample dates. The Madam Creek watershed has a sizable number of individual residences adjacent to the stream, and was not served by a sewer system until after the period of monitoring covered by this report. Whether by seepage from ineffective septic systems or direct discharge of untreated sewage ("straight piping"), most

dwellings in this area are direct contributors to sewage pollution of Madam Creek. Children have been observed playing in Madam Creek, and some anglers fish the area near its discharge into the New River. While this stream is outside the park boundary, it is only a short distance upstream. The magnitude and frequency of sewage pollution in Madam Creek dictates that the National Park Service continue to monitor its water quality because of the potential threat to park visitors. The City of Hinton recently extended sewage collection service into Madam Creek, and future monitoring may help judge the effectiveness of providing sewage treatment in this watershed.

High fecal coliform bacteria densities occurred in this section on 5/22/01 at all sites monitored. All sites exceeded 400 FC/100 ml except New River below Sandstone Falls (363 FC/100ml - still the highest bacteria density recorded for the site in 2001- 2003). This date had the highest 48- hour precipitation, discharge and turbidity for each of these sites on a 2001- 2003 monitoring date.

The New River at Hinton Visitor Center also exceeded the state standard on 10/7/03 (based on the mean, 252.5 FC/100ml, of two samples). Other than Madam Creek, no other site in this section exceeded the standard on that date. Discharge was low on 10/7/03, with no precipitation in the prior 48 hours, although turbidity was moderate. This site is downstream of a number of businesses that line the New River in this area. It is possible that one or more of these facilities could have been the source of the high bacteria density on this date. At the New River discharge on this date (4200 cfs), it is possible that any sewage discharge would not have been well mixed until further downstream, but would have hugged the shore past the Visitor Center.

Bacteria densities were also relatively high (but within the standard) at the two downstream New River sites on 10/7/03. New River at Brooks Falls (mean of two samples = 68.5 FC/100ml) had the highest density for that site in 2001- 2003 (site added in 2002, only two years of data included. New River below Sandstone Falls (mean of two samples = 44 FC/100ml) had the third highest density of 2001- 2003. New River above Sandstone Falls was discontinued after 2002, so no data is available for this site on 10/7/03.

Relating the relatively high bacteria densities at the downstream sites on 10/7/03 to the high density noted at the Hinton Visitor Center is problematic because heavily polluted Madam Creek enters the New River about 1.0 miles below the Hinton Visitor Center and about 3.8 miles above the Brooks Falls site and 7.8 miles above the Sandstone Falls site. However, it can be shown that the fecal coliform densities at these two downstream New River sites are probably due to the high density at the Hinton Visitor (Table 3). Multiplying the discharge (volume/time) at each site by the bacteria density (number/volume) at that site estimates the total bacteria load (number/time) at that site. The total of these loads divided into the load for each site estimates the relative contribution of each site to fecal coliform density in the New River below Madam

Creek. Dividing the sum of the products by the discharge provides an estimate of the bacteria density in the New River below Madam Creek.

By this analysis, 91% of the fecal coliform bacteria measured at the downstream sites (Brooks Falls and Sandstone Falls) are attributable to the New River, with 3.5% attributable to the Greenbrier River, and 5.5% attributable to Madam Creek. Note that even though the Greenbrier River enters the New River above this point, mixing of the Greenbrier River's water with the New River's water does not occur until below this point (see page 26). Using the arithmetic mean (20,115 FC/100 ml) instead of the geometric mean (10,966 FC/100ml) for the Madam Creek data produces a slightly higher contribution from this stream (9.9%) and a slightly higher estimate of bacteria in the New River below Madam Creek (241.8 FC/100ml), but the evidence remains that most (86.8%) of the bacteria noted at the downstream sites can be attributed to the bacteria noted at the Hinton Visitor Center site.

Table 3. Comparison of bacteria densities and discharge at upstream New River Gorge National River water quality monitoring sites on October 7, 2003.

Site	Discharge (cfs)[1]	Fecal Coliforms (FC/100 ml)[2]	Estimated Load[3]	Load Proportion
Greenbrier River at Willowwood	695	49.0	34,055	3.5%
New River at Hinton Visitor Center	3500	252.5	883,750	91.0%
Madam Creek	5	10,966.0	54,830	5.5%
Total			972,635	
New River below Madam Creek	4200	231.6		
New River at Brooks Falls	4200	68.5		
New River below Sandstone Falls	4200	44.0		

1. Discharge for Madam Creek is estimated, discharge for New River below Madam Creek based on USGS Hinton gage, discharge for Greenbrier River at Willowwood based on USGS Greenbrier River gage, and discharge for New River at Hinton Visitor Center site based on subtraction.
2. Fecal coliform density for Madam Creek based on geometric mean of two samples. Fecal coliform density for Greenbrier River at Willowwood, New River at Hinton Visitor Center, New River at Brooks Falls, and New River at Sandstone Falls based on arithmetic mean of two samples. Fecal coliform density for "*New River below Madam Creek*" based on calculations described in text, and assumes complete mixing of waters from the three upstream sources, which may not occur.
3. A true load would require standardization of the two volume units (milliliters and cubic feet). There are about 28,320 ml in a cubic foot.

Other potential sources of fecal contamination measured at the downstream sites include small tributaries that enter the New River between Madam Creek and Brooks Falls (Brier Branch, Tug Creek, Big Branch, and Collins Hollow) and on down to Sandstone Falls (Owens Branch, Jerrys Hollow, Kates Branch, Mill Branch, and Fall Branch). Watersheds for most of these streams are sparsely populated and are probably not major sources of fecal contamination.

More densely populated areas are more likely to contribute fecal material to the downstream sites. Such areas include the community of Brooklin just downstream of the mouth of Madam Creek on river left, a sizable concentration of permanent and

summer residences on river left across from the mouth of Tug Creek, another such community on river right near Bass Lake, the community of Brooks on river right, and another community of mixed permanent and seasonal dwellings on river left in the Brooks Island area between Brooks Falls and Sandstone Falls.

Sizable reductions in bacteria density occurred between the upstream area and the downstream sites on 10/7/03. Bacteria density at Brooks Falls (68.5 FC/100ml) was 29.6%, and density below Sandstone Falls (44.0 FC/100 ml) was 19.0%, of that calculated for New River below Madam Creek (231.6 FC/100 ml). Travel distance and time of travel probably allowed for deposition and die- off of bacteria between the upstream and downstream areas. The rates and relative contribution of these factors cannot be determined, nor do we have adequate information on the contribution of the other potential sources noted above to fecal coliforms in this stretch of river.

According to Appel and Moles (1987), a discharge of 4200 cfs in this reach of the New River will result in an average current velocity of about 1.3 mph (Fig. 52). Therefore from the New River below Madam Creek it would take about 3 hours to reach the Brooks Falls site (3.8 miles), and about 6 hours to reach the Sandstone Falls site (7.8 miles).

Lick Creek (1,140 FC/100ml) exceeded the West Virginia standard on 7/22/01. This coincided with high turbidities but low precipitation (0.10 in) and discharge (12.58 cfs).

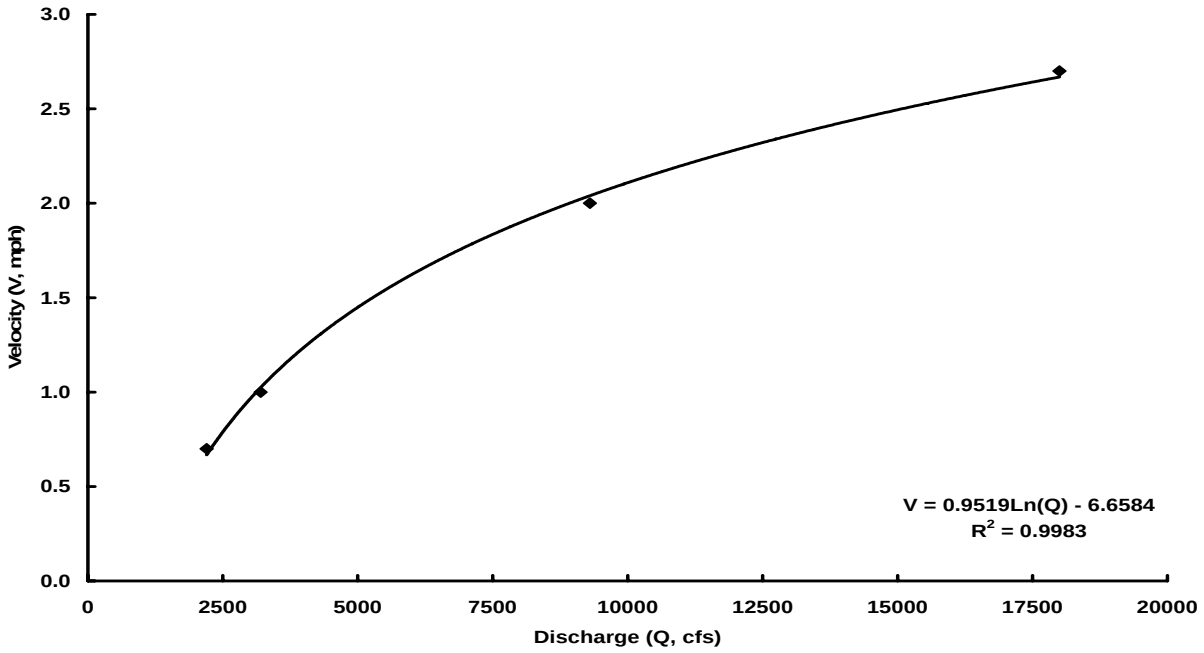

Figure 52. Relationship between discharge and velocity for the New River between Bluestone Dam and the Mary Draper Ingles Bridge on Interstate 64 in West Virginia. Logarithmic equation with intercept set to 0,0 based on data in Appel and Moles (1987).

Livestock operations are potential sources of fecal contamination in this stream. Since 1990, monitoring of Lick Creek has shown it to exceed the West Virginia standard more than 10% but less than 25% of the time. While this is a better status than the streams that exceed the standard more often, it is not as good as those streams that rarely exceed the standard.

Meadow Creek (825 FC/100 ml) also exceeded the West Virginia standard on 7/22/01 while discharge was low (5.88 cfs). The communities of Meadow Bridge (above the park boundary) and Meadow Creek (at the creeks' mouth) are potential sources of fecal contamination in this watershed, although travel time at low discharge may limit the influence of Meadow Bridge at this downstream sample site.

Addition of monitoring sites on the Greenbrier River, New River below Bluestone Dam, and New River at Brooks Falls, combined with the discontinuation of the New River at Hinton Visitor Center and New River above Sandstone Falls sites provided us with a more effective monitoring network in this section.

Lower Section

Three New River sites exceeded 200 FC/100 ml in 2001- 2003. New River at Thurmond and New River above Coal Run exceeded the West Virginia standard two times each, while New River above Wolf Creek exceeded the standard three times.

Six tributary sites exceeded 200 FC/100 ml during 2001- 2003. Piney Creek exceeded the standard four times and two other dates were at least 185 FC/100ml. Dunloup Creek exceeded the standard six times and three other dates were at least 175 FC/100ml. Arbuckle Creek exceeded the standard seven times with another date of 175 FC/100ml. Coal Run exceeded the standard four times with another date of 180 FC/100ml. Keeney Creek exceeded the standard all fourteen times it was monitored. Wolf Creek exceeded the standard three times. Marr Branch exceeded the standard six times.

Because sites in this section generally were not all sampled on the same date, the kinds of evaluations shown for the upper section are limited. Future sampling schedules may be changed so that the relative contributions of tributary streams to the New River can be evaluated in this section. The storm event monitoring protocol, testing during the latter stages of the 2001 floods, provides additional opportunities for this kind of evaluation (see pages 67- 71 and 86- 87).

On January 23, 2001, all existing sites between Laurel Creek and Arbuckle Creek were sampled (Fig. 53). Note the increase in bacteria density for the New River between Prince and Thurmond due to the inflow of bacteria- laden water from Piney and Dunloup Creeks.

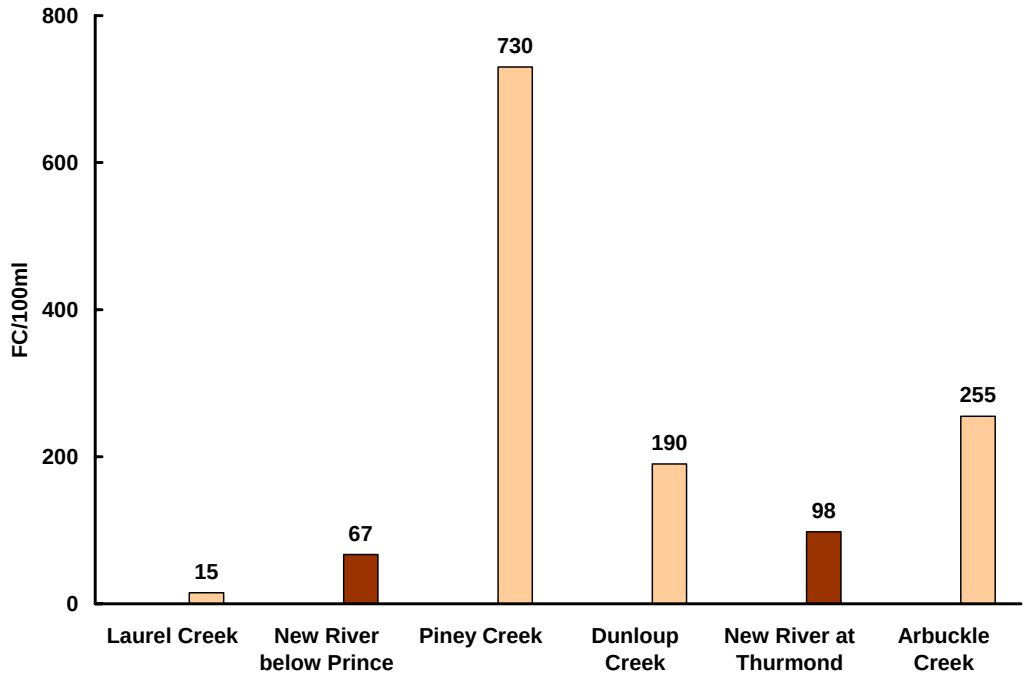

Figure 53. Densities of fecal coliform bacteria in the New River (dark bars) and tributaries (light bars) between Laurel Creek and Arbuckle Creek on 23 January 2001.

During 2003, sites from Dunloup Creek to Marr Branch were sampled on successive dates, thus allowing some evaluation of trends in this reach (Fig. 54). This is confounded somewhat by having sampled the downstream sites (New River above Coal Run – Marr Branch) on the day before the upstream sites (Dunloup Creek – Arbuckle Creek). Notice that even though streams with bacteria- laden water are entering the New River, that fecal coliform bacteria density in the New River generally remains at about the same level. Similar to the loading analysis presented for the upper section, this is probably due to the relatively small discharge of water from the tributary streams as compared to the much larger discharge of the New River.

Fayette County, acting through a Water Quality Coalition, has developed a plan to provide "sewer equivalency" for the community of Winona in the Keeney Creek watershed. This plan includes a mix of individual and cluster systems, and should alleviate what is considered to be the largest source of sewage pollution in Keeney Creek. Planning and design are complete, and application for funding will be submitted when the rate structure is finalized.

To support the above effort, the National Park Service began sampling two additional sites along Keeney Creek in 2003 as part of an attempt to better define fecal coliform dynamics in this stream. It was surprising to note that the generally high bacteria densities found at the Keeney Creek at Winona site, and typical of our monitoring history (e.g. Wilson and Purvis 2003) were considerably reduced downstream (Fig. 55).

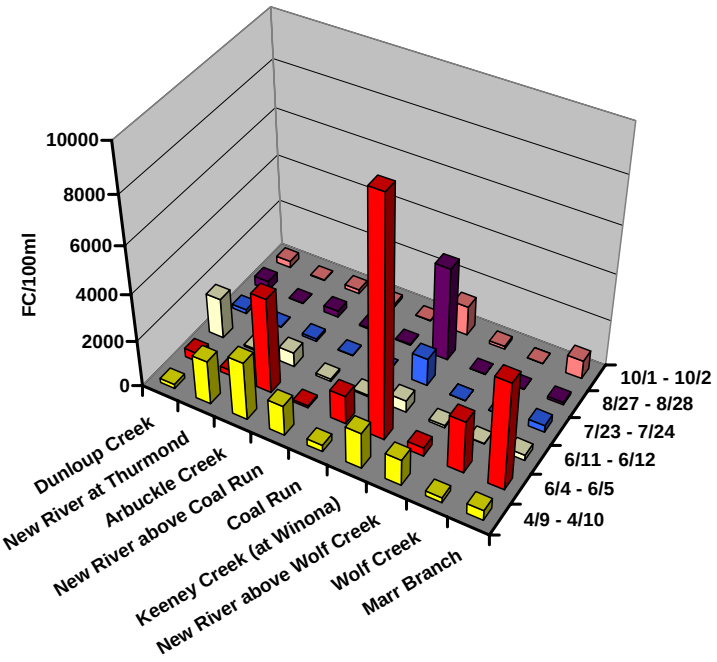

Figure 54. Densities of fecal coliform bacteria (vertical axis) in the New River and tributaries between Dunloup Creek and Marr Branch (bottom axis) on 2003 monitoring dates (right axis).

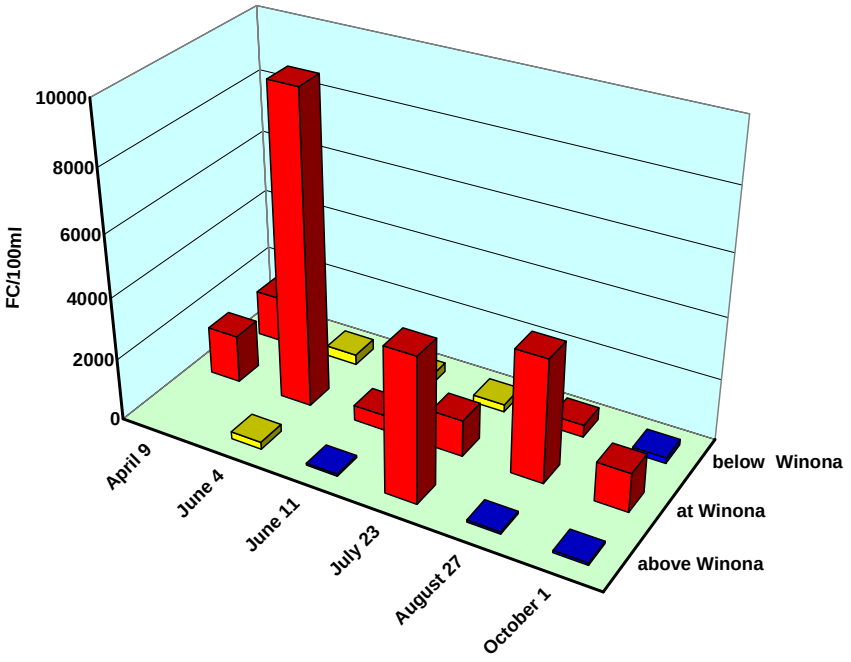

Figure 55. Fecal coliform bacteria densities (vertical axis) at three sites along Keeney Creek (right axis) during 2003 (front axis). Blue bars represent samples that had bacteria densities less than 200 FC/100ml, yellow bars exceeded 200 FC/100ml but were less than 400FC/100ml, while red bars exceeded 400 FC/100ml.

The high bacteria densities noted for the “at Winona” site are probably due to the density of residences, and their proximity to Keeney Creek, in the community of Winona. Upstream of Winona there are fewer residences (including a cluster in the community of Lookout near the watershed divide), but few right on the stream, along with farmland and forest above the “at Winona” site.

The decrease in bacteria densities noted downstream of Winona was a surprise. This decrease could be due to bacteria death, settling onto the stream bed, or becoming airborne as an aerosol in steep, turbulent reaches. Further investigation would be required to resolve this question.

Gauley River National Recreation Area

One to six of the fifteen (6.7 – 40%) baseline monitoring sampling dates from each of the five Gauley River National Recreation Area sites exceeded the West Virginia standard for contact recreation during 2001- 2003. For two of the mainstem Gauley River sites (Gauley River below Summersville Dam and Gauley River above Swiss) only one date exceeded the standard, while the third mainstem site (Gauley River above Mason Branch) exceeded the standard on three dates (20%). Three dates from the Meadow River site also exceeded the standard, with one other date approaching the standard (192 FC/100ml). Six sample dates from the Peters Creek site exceeded the standard. Note that duplicate or split samples were collected on four dates in 2003 (7/21, 9/12, 9/15, and 9/29), and geometric means for the two values on a given date were used to determine whether the site exceeded the standard. Based on arithmetic, rather than geometric, means, one other date (7/21/03) for Peters Creek exceeded the standard, for a total of seven of the fifteen sample dates (46.7%).

For the three years prior to this reporting period (1998- 2000), none of the ten sample dates (0%) from the three Gauley River mainstem sites and the Meadow River site exceeded 200 FC/100ml, while two of the sample dates (20%) from Peters Creek exceeding this standard (Wilson and Purvis 2003).

Previous monitoring suggested a relationship between discharge and fecal coliform density (Purvis and Wilson 1999, Wilson and Purvis 2003), so the greater percentage of sample dates exceeding the standard in 2001- 2003 may be due to increased discharge caused by increased precipitation (Table 4). For example, during 1998- 2000, mean discharge at the Summersville Dam gage on sampling dates was 575 cubic feet per second (cfs), while during 2001- 2003 it was 1,677 cfs. Similarly, mean discharge for the unregulated Meadow River on sampling dates during 1998- 2000 was 232 cfs, while during 2001- 2003 it was 433 cfs.

Table 4. Comparison of recent variation in annual precipitation (ppt) in inches (in) at National Park Service headquarters in Glen Jean (data in park files) and annual daily mean discharge (Q) in cubic feet per second (cfs) for both calendar years (CY) and water years (WY) for the USGS gage Meadow River near Mount Lookout, WV (03190400). Discharge information based on Ward *et al*. 1998, 1999, 2000, 2001, 2002, 2003, 2004 and 2005. Water years run from October 1 of the prior year to September 30 of the listed year.

Year	CY ppt (in)	WY ppt (in)	CY Q (cfs)	WY Q (cfs)
1997	36.28	39.12	486	700
1998	39.99	37.21	789	795
1999	33.68	34.02	491	438
2000	39.91	42.98	641	664
2001	44.21	43.95	597	636
2002	47.07	38.20	697	461
2003	55.53	54.84	1,125	1,055

Some extreme values occurred during 2001 – 2003 (Ward *et al.* 2005). For example, over the period of record (1966 – 2004) for the Meadow River gage, water year 2003 saw the highest annual mean discharge, with maximum monthly means occurring in June, September, and November of 2003. The same pattern was noted for the Belva gage. The maximum discharge ever recorded for both of these gages occurred on November 19, 2003. For the Meadow River gage, maximum monthly means also occurred in February 1998, and July 2001, while monthly minimums occurred in June 1999, November and December 2001, and February 2002. For the Belva gage, another monthly maximum occurred in July 2001, while monthly minimums occurred in February 2002, March 2000, and July 1999.

Another possible explanation for the increased occurrence of high fecal coliform densities is changes in the operation of Summersville Dam. The dam was modified to produce hydropower, and this capacity became operational during June of 2001. Construction- related erosion or changes in the operational release schedule of Summersville Dam may have increased sediment inputs to the Gauley River. Turbidities were higher during 2001- 2003 than during 1998- 2000 (Table 5). However, turbidity usually increases with increased discharge, so these increased turbidities may be another function of the increased precipitation between 2001 and 2003.

Table 5. Geometric mean turbidities (NTU) measured on water quality sampling dates in Gauley River National Recreation Area at each of five sites during two reporting periods. Number of samples (n) noted for each reporting period.

Site / Year	1998-2000 (n=10)	2001-2003 (n = 15)
Gauley River below Summersville Dam	2.49	3.33
Gauley River above Mason Branch	2.02	4.32
Gauley River above Swiss	1.98	3.23
Meadow River	1.78	2.80
Peters Creek	2.20	2.54

All five sites exceeded 200 FC/100ml on 9/13/2002, and for all sites except Gauley River above Mason Branch, this was the highest fecal coliform density noted during the three years. It is intriguing that the other parameters that usually show a positive relationship with high fecal coliform densities were low to moderate on that date. There had been no precipitation in the 48 hours preceding the sampling, and probably for some time before that. This is indicated by records for the Meadow River gage (Ward *et al.* 2003). Daily mean discharge had been steadily decreasing since 8/31/02, and on 9/13/2002 was 5.3 cfs. The only lower value during the 2002 water year (October 2001 – September 2002) was 5.1 cfs on the following day (9/14/2002). Discharge was also "low" in Peters Creek. Discharge from Summersville Dam was increased for the annual "Gauley

Season." Daily mean discharge at the Summersville Dam gage on 9/13/2002 was 1410 cfs, up from a daily mean of 781 cfs on 9/12/02. Turbidity was low to moderate for this date on all Gauley River National Recreation Area sites during 2001- 2003, ranging from the second lowest (Meadow River) to the ninth lowest (Gauley River above Mason Branch) of the fifteen sample dates.

It is difficult to provide a fully satisfactory explanation for this seemingly anomalous data. One possibility is that the samples were somehow contaminated. This could have occurred by incomplete sterilization of collection bottles, or by cross- contamination in the field or laboratory. Samples from this date were analyzed an outside laboratories (App. 3), so another possibility is that sample reports were mixed with those of samples from another client. It is also possible that the varying releases from Summersville Dam for Gauley Season may have mobilized bacteria- contaminated sediments in Summersville Lake, but we would expect higher turbidities to be noted along with the higher bacteria densities, and this would not explain the high bacteria densities in Meadow River and Peters Creek. Another possibility is that waters of Summersville Lake were contaminated by sewage from boats being removed from the lake prior to winter, but again, this would not explain the high bacteria densities in the tributary streams.

Another set of high bacteria densities but low values for parameters normally associated with high bacteria densities were also collected on 9/20/02. Gauley River above Mason Branch and Peters Creek exceeded 200 FC/100ml on 9/20/02, Gauley River below Summersville Dam was just below the standard (179 FC/100 ml: but still the second highest fecal coliform density recorded during the three years), and bacteria densities in Meadow River and at Gauley River above Swiss were also somewhat high (both sites at 125 FC/100ml). This was another "Gauley Season" date with no precipitation in the previous 48 hours. Information from these two dates suggests that water quality dynamics during Gauley Season may differ from those occurring under normal rainfall and Summersville Dam release schedules, and bears further investigation.

Bacteria densities were high on 4/8/03 at Gauley River above Mason Branch (1113 FC/100ml), Meadow River (1188 FC/100ml), and Peters Creek (280 FC/100ml). This date had the highest fecal coliform density noted during the three years for Gauley River above Mason Branch and the second highest density for Meadow River. Bacteria density was also relatively high (113 FC/100ml – third highest during the three years), at Gauley River above Swiss. In contrast, very few bacteria were collected at Gauley River below Summersville Dam (1 FC/100ml). These data coincided with the second highest 48- hour precipitation, the fifth highest discharge in the Gauley River and the highest discharge in the Meadow River, and the highest turbidities at all Gauley River National Recreation area sites except Gauley River below Summersville Dam. Since Meadow River enters the Gauley River between the Summersville Dam and Mason Branch sites, these data suggest that the Meadow River watershed was a significant contributor to the fecal contamination noted in the Gauley River on 4/8/03.

Based on the West Virginia standard, Gauley River water quality generally seems acceptable for water contact recreation. This is especially true at the more upstream end of the park. Here, water quality is controlled by releases from Summersville Dam. Confluence of the Meadow River may contribute additional fecal contaminated water, especially during periods of high discharge from Meadow River. The confluence of Peters Creek may contribute an even greater concentration of fecal contaminated water, but the relatively low discharge of Peters Creek may limit the effect to the area close to its mouth. By the time the Gauley River reaches the Swiss area, water quality is again good, often rivaling that of the Summersville Dam tailwaters.

2001 FLOOD MONITORING

The 2001 floods can be separated into two periods. The first floods began on July 8, and among the three parks were concentrated in New River Gorge National River between Laurel Creek (Quinnimont) and Marr Branch. Other areas of southern West Virginia outside of the three parks also experienced severe flooding from this storm system. Reliable rain gage estimates from affected watersheds are lacking for this flood, but informal "bucket surveys" of local residents indicate that as much as 11 inches of rain may have fallen on some areas in less than 12 hours. The second period began on July 27, and occurred in both New River Gorge National River and Gauley River National Recreation Area. Soils still relatively saturated from the earlier rainfall produced rapid runoff and more flooding from at least 5.3 inches of rainfall before July 27, with an additional 1.5 inches falling before July 30.

Due to damage to the park laboratory, and related supplies and equipment, there was an 8 – 12 day delay in sampling following the first flood. Because of this delay, it is extremely likely that we missed the peaks of fecal coliform bacteria density in many or most sampled streams. As a result, only 17 out of 72 samples (23.6%) exceeded 200 FC/100ml, with four other samples (5.6%) being 196 FC/100ml. Low fecal coliform densities may also have been due to dilution of fecal material in large volumes of water, and scouring that transported septic material far from its source (see front cover). Nevertheless, sampling indicated fecal contamination in both tributary streams and in the New River in areas under the influence of inflow from contaminated tributaries. These results are consistent with a storm localized in the New River Gorge area.

Water quality monitoring following the first flood was designed to get a rough idea of what had happened and was still happening as a result of this extreme event. In the aftermath of the first flood, a storm- event monitoring protocol was developed to more effectively monitor such high flow events. The protocol was designed to follow bacteria levels at storm- affected sites until bacteria levels dropped to the contact recreation water quality standard.

During the second period of flooding, the trial of this monitoring effort clearly showed a decrease in bacteria density with time (and falling discharge) at a given site for both New River Gorge National River (Fig. 50) and Gauley River National Recreation Area (Fig. 51). The time required for bacteria densities to drop back to acceptable levels will vary depending on the size, areal extent, and duration of a storm event, the volume of fecal material delivered to the drainage network, and the timing and routing of water and fecal contamination through watersheds and their drainage networks. Following the trial or the protocol we began using it to monitor other storm events. This information will be presented and evaluated in later reports.

According to stream gaging records of the U. S. Geological Survey (Ward *et al*. 2004, 2005), the second period of flooding produced a record daily mean flow of 32,000 cfs

for the Gauley River above Belva (with a peak discharge of 47,200 cfs), and the maximum peak flow for the Meadow River near Mount Lookout (20,600 cfs). The maximum peak flow for the Meadow River was eclipsed on November 19, 2003 (27,200 cfs), a date that also saw a new maximum peak flow for the Belva gage (47,800 cfs).

Concern about potential health risks to park visitors participating in water- contact recreation (e.g. swimming, whitewater boating, angling) following the floods, the National Park Service issued a press release to express these concerns. Some commercial river outfitters wondered whether contaminated water contributed by tributaries remained close to the shoreline downstream of a tributary's confluence with the master stream. Our initial evaluation of this concern indicates that there is no difference between bank and mid- channel sites (Table 2).

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Appendix 1. Bluestone National Scenic River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Bluestone River below Mountain Creek	2/27/01	6.9	12.7	8.7	166.5	3.98	413	0.14	6	1
Bluestone River below Mountain Creek	5/16/01	14.4	9.41	7.5	150.1	233	1170	1.25	4600	
Bluestone River below Mountain Creek	6/26/01	20.8	8.9	8.5	306.4	3.01	149	0.12	265	1
Bluestone River below Mountain Creek	10/11/01	10.6	11.51	8.7	303.2	0.81	42	0.00	35	
Bluestone River below Mountain Creek	3/4/02	8.6	12.03	8.4	153.3	15.7	749	1.01	300	1
Bluestone River below Mountain Creek	6/5/02	24.7	9.28	8.7	320.3	4.7	131	0.00	50	
Bluestone River below Mountain Creek	9/27/02	17.8	8.58	8	227.2	52	394	1.62	26000	2
Bluestone River below Mountain Creek	4/3/03	10.7	11.06	8	156.6	10.5	953	0.00	134	
Bluestone River below Mountain Creek	5/27/03	14.4	9.42	8	155.9	8.35	478	0.25	30	1
Bluestone River below Mountain Creek	7/16/03	18.4	8.51	7.7	98.6	8.43	244	0.07	34	
Bluestone River below Mountain Creek	10/6/03	11.6	10.48	8.2	235	1.76	101	0.01	15	3
Bluestone River below Mountain Creek	10/6/03	11.6	10.48	8.2	235	1.76	101	0.01	20	3, 5
Bluestone River above Little Bluestone River	2/27/01	6.5	12.37	8.1	173.3	3.65	413	0.14	8	1, 4
Bluestone River above Little Bluestone River	5/16/01	15.2	8.92	7.5	164.9	282	1170	1.25	4000	
Bluestone River above Little Bluestone River	6/26/01	21.2	8.1	8.3	301.1	4.08	149	0.12	36	
Bluestone River above Little Bluestone River	10/11/01	11.3	8.9	8.8	303.5	0.97	42	0.00	5	1
Bluestone River above Little Bluestone River	3/4/02	7.8	11.58	8	157.5	18.5	749	1.01	424	1
Bluestone River above Little Bluestone River	6/5/02	23.7	7.09	8	312	2.01	131	0.00	28	
Bluestone River above Little Bluestone River	9/27/02	17	8.5	7.8	204	105	394	1.62	55000	2
Bluestone River above Little Bluestone River	4/3/03	11.2	11.14	8.2	157.9	10.6	953	0.00	91	
Bluestone River above Little Bluestone River	5/27/03	15.3	9.22	7.9	167	8.52	478	0.25	17	1
Bluestone River above Little Bluestone River	7/16/03	22.8	6.76	8.1	254.5	9.67	244	0.07	88	
Bluestone River above Little Bluestone River	10/6/03	11.9	9.74	8	233.6	2.47	101	0.01	43	1, 3, 5
Bluestone River above Little Bluestone River	10/6/03	11.9	9.74	8	233.6	2.47	101	0.01	11	1, 3
Bluestone River above Mouth	2/27/01	6.2	12.33	7.9	155.9	3.5	413	0.14	11	1
Bluestone River above Mouth	5/16/01	15	8.72	7.3	139.2	604	1170	1.25	14000	1
Bluestone River above Mouth	6/26/01	22.6	9.33	7.5	297.3	2.68	149	0.12	37	
Bluestone River above Mouth	10/11/01	13	12.36	9.1	317.3	0.55	42	0.00	7	1
Bluestone River above Mouth	3/4/02	7.3	11.03	7.6	146.4	18.9	749	1.01	368	1
Bluestone River above Mouth	6/5/02	24.4	7.55	8.4	305	1.84	131	0.00	25	
Bluestone River above Mouth	9/27/02	16.8	8.85	7.8	178.7	116	394	1.62	44000	2
Bluestone River above Mouth	4/3/03	12	10.84	8.1	154.9	11	953	0.00	55	
Bluestone River above Mouth	5/27/03	15.6	9.78	8	157.7	8.23	478	0.25	7	1
Bluestone River above Mouth	7/16/03	23.3	8.84	8.4	217.7	9.98	244	0.07	56	
Bluestone River above Mouth	10/6/03	13.4	11.34	8.7	214.2	1.31	101	0.01	5	1, 3
Bluestone River above Mouth	10/6/03	13.4	11.34	8.7	214.2	1.31	101	0.01	20	1, 3, 5
Mountain Creek	2/27/01	5	12.35	7.1	102.5	2.94	H	0.14	10	1
Mountain Creek	5/16/01	12.8	10.17	7.3	95.5	103	H	1.25	2100	
Mountain Creek	6/26/01	17.6	8.67	7.7	219.4	1.76	L	0.12	32	
Mountain Creek	10/11/01	8.9	10.66	7.8	225.2	0.17	L	0.00	3	1
Mountain Creek	3/4/02	8.1	11.18	7.4	99.5	9	H	1.01	16	1
Mountain Creek	6/5/02	21	8.05	7.8	200.9	0.8	L	0.00	9	1
Mountain Creek	9/27/02	17.2	8.94	7.7	114.1	14.9	H	1.62	940	2
Mountain Creek	4/3/03	8.1	11.13	7.4	109.2	4.66	H	0.00	23	1
Mountain Creek	5/27/03	11.8	9.91	7.5	86.4	4.81	N	0.25	45	1
Mountain Creek	7/16/03	22.6	8.13	8.3	254.2	14.2	N	0.07	142	
Mountain Creek	10/6/03	10.2	10.52	7.4	117.2	0.88	N	0.01	4	1, 3, 5
Mountain Creek	10/6/03	10.2	10.52	7.4	117.2	0.88	N	0.01	10	1, 3

Appendix 1. Bluestone National Scenic River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Little Bluestone River	2/27/01	4.6	12.73	7.3	45	4.16	N	0.14	24	1
Little Bluestone River	5/16/01	13.8	9.79	7.4	64.1	129	H	1.25	18000	1
Little Bluestone River	6/26/01	18.4	8.8	8.1	98.4	2.84	L	0.12	45	
Little Bluestone River	10/11/01	10.2	8.38	7.8	148.9	0.28	L	0.00	1	1
Little Bluestone River	3/4/02	7.3	11.32	7.7	47.6	10.8	H	1.01	94	
Little Bluestone River	6/5/02	21	8.09	7.9	113.1	1.3	L	0.00	14	1
Little Bluestone River	9/27/02	16.9	9.05	7.6	79.3	16.9	N	1.62	1620	2
Little Bluestone River	4/3/03	9.9	11.12	7.7	45.3	5.29	H	0.00	12	1
Little Bluestone River	5/27/03	12.6	10	7.8	56.7	6.97	N	0.25	36	1
Little Bluestone River	7/16/03	18.8	8.54	7.7	64.8	19.1	N	0.07	60	1
Little Bluestone River	10/6/03	10.5	10.02	7.8	72.9	1.3	L	0.01	21	3, 7
Little Bluestone River	10/6/03	10.5	10.02	7.8	72.9	1.3	L	0.01	21	3, 5, 7

Key to Comments:
1: FC/100 ml is an estimate
2: Analyzed at AnaLabs
3: Actual 48hr precip is a trace
4: Used 50 ml count
5: Analyzed at REIC
7: Conductivity recorded as 7.29 on field sheet

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
New River below Bluestone Dam	4/1/03	9.4	11.64	8.01	128.4	8.44	6700	0.32	8	1
New River below Bluestone Dam	5/28/03	17.6	9.14	7.89	147.8	9.63	8000	0.06	34	
New River below Bluestone Dam	7/14/03	23.4	8.22	7.92	175.2	13.2	7000	0.24	25	
New River below Bluestone Dam	7/14/03	23.4	8.22	7.92	175.2	13.2	7000	0.24	90	2
New River below Bluestone Dam	10/7/03	15.3	9.85	7.89	154.2	7.41	3750	0.00	36	2
New River below Bluestone Dam	10/7/03	15.3	9.85	7.89	154.2	7.41	3750	0.00	10	1
New River at Hinton Visitor Center	1/10/01	1.5	15.6	9.2	119.8	0.98	1660	0.13	14	
New River at Hinton Visitor Center	2/5/01	5.3	13.25	8.9	132	3.12	4500	0.01	14	1, 3, 4
New River at Hinton Visitor Center	4/10/01	15.5	9.55	7.9	130.6	4.94	8800	0.00	14	1
New River at Hinton Visitor Center	5/22/01	18.3	9.34	7.3	131.2	22.4	33000	1.10	740	
New River at Hinton Visitor Center	7/2/01	26.5	7.67		209.2	3.03	3800	0.10	101	1, 8
New River at Hinton Visitor Center	8/9/01	26.9	7.26	7.9	194.6	3.36	4380	0.00	138	1
New River at Hinton Visitor Center	10/31/01	12.9		8.5	186.7	2.27	1200	0.00	156	1, 9
New River at Hinton Visitor Center	3/6/02	4.8	13.2	8.2	131.6	3.68	5900	0.01	3	1, 4
New River at Hinton Visitor Center	5/15/02	19.2	8.92	8	168.9	6.47	5700	0.16	32	1
New River at Hinton Visitor Center	7/9/02	27.3	6.15	7.83	227.5	2.53	2150	0.00	27	
New River at Hinton Visitor Center	4/1/03	9.5	11.53	8	126.6	9.64	8300	0.32	18	1
New River at Hinton Visitor Center	5/28/03	17.9	9.13	7.91	145.9	7.46	10100	0.06	47	
New River at Hinton Visitor Center	7/14/03	23.7	8.34	7.96	175.1	11.4	8810	0.24	108	1,2
New River at Hinton Visitor Center	7/14/03	23.7	8.34	7.96	175.1	11.4	8810	0.24	139	1
New River at Hinton Visitor Center	10/7/03	15.4	9.46	7.89	154	7.01	4200	0.00	360	2
New River at Hinton Visitor Center	10/7/03	15.4	9.46	7.89	154	7.01	4200	0.00	145	1
New River at Brooks Falls	8/9/01	26.6	7.68	8.1	194.3	2.97	4380	0.00	19	1
New River at Brooks Falls	4/1/03	9.8	12.3	8.3	125.6	10.6	8300	0.32	28	1
New River at Brooks Falls	5/28/03	18.2	9.74	8.1	146	7.03	10100	0.06	25	
New River at Brooks Falls	7/14/03	24.4	8.96	8.19	175.6	8.44	8810	0.24	18	2
New River at Brooks Falls	7/14/03	24.4	8.96	8.19	175.6	8.44	8810	0.24	31	
New River at Brooks Falls	10/7/03	15.4	9.45	8.01	153.8	5.51	4200	0.00	29	
New River at Brooks Falls	10/7/03	15.4	9.45	8.01	153.8	5.51	4200	0.00	108	2
New River above Sandstone Falls	1/10/01	0.2	15.69	9.3	111.1	1.03	1660	0.13	17	10
New River above Sandstone Falls	2/5/01	4.4	13.74	8.8	114.9	3.03	4500	0.01	14	1, 4
New River above Sandstone Falls	4/10/01	16.4	10.07	8.2	121.8	4.55	8800	0.00	47	
New River above Sandstone Falls	5/22/01	17.9	8.72	7	120.7	41.9	33000	1.10	1100	
New River above Sandstone Falls	7/2/01	27.1	8.25		193.3	3.01	3800	0.10	32	
New River above Sandstone Falls	8/9/01	27.2	10.08	8.9	191.3	2.47	4380	0.00	18	1, 11
New River above Sandstone Falls	10/31/01	13.6	14.05	9.4	182.1	0.92	1200	0.00	4	1, 12
New River above Sandstone Falls	3/6/02	5.6	13.16	8.4	121.9	3.3	5900	0.01	4	1, 4
New River above Sandstone Falls	5/15/02	18.6	10.3	8.56	156.8	4.47	5700	0.16	63	
New River above Sandstone Falls	7/9/02	28.7	9.08	8.67	220	2.64	2150	0.00	8	1
New River below Sandstone Falls	1/10/01	0.2	14.84	8.7	111.8	2.8	1660	0.13	1	1, 13
New River below Sandstone Falls	2/5/01	4.4	13.9	8.4	107.1	3.12	4500	0.01	6	1, 3, 4
New River below Sandstone Falls	4/10/01	16.4	9.26	8.4	122.5	4.95	8800	0.00	17	1
New River below Sandstone Falls	5/22/01	18.3	9.1	7.9	125.9	24.7	33000	1.10	363	
New River below Sandstone Falls	7/2/01	26.4	7.54		203.3	3.71	3800	0.10	33	
New River below Sandstone Falls	8/9/01	7.1	8.41	8.6	188.1	3.33	4380	0.00	29	
New River below Sandstone Falls	10/31/01	13.1	10.62	9.2	183.3	1.03	1200	0.00	18	
New River below Sandstone Falls	3/6/02	5.1	13	8.3	116.8	3.08	5900	0.01	3	1, 3
New River below Sandstone Falls	5/15/02	18.2	8.91	8.35	150.2	5.08	5700	0.16	20	1
New River below Sandstone Falls	7/9/02	28.3	7.07	8.27	220.4	2.67	2150	0.00	22	

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
New River below Sandstone Falls	4/1/03	9.9	11.58	8.49	123	8.51	8300	0.32	5	1
New River below Sandstone Falls	5/28/03	18.1	9.02	8.22	143.2	5.93	10100	0.06	24	15
New River below Sandstone Falls	7/14/03	24.7	7.78	8.64	174.1	8.7	8810	0.24	108	2
New River below Sandstone Falls	7/14/03	24.7	7.78	8.64	174.1	8.7	8810	0.24	21	
New River below Sandstone Falls	10/7/03	15.5	9.86	8.25	150.4	5.06	4200	0.00	72	2
New River below Sandstone Falls	10/7/03	15.5	9.86	8.25	150.4	5.06	4200	0.00	16	16
New River below Laurel Creek	4/2/03	9.6	11.73	7.94	116.3	8	10500	0.04	48	1
New River below Laurel Creek	5/29/03	17	8.56	7.84	132.7	7.91	10800	0.39	38	1, 4
New River below Laurel Creek	7/17/03	23.8	6.98	7.73	152.7	10.1	9900	0.17	42	17
New River below Laurel Creek	10/8/03	16.1	9.08	8.03	149.5	4.2	4600	0.01	9	1, 3
New River below Laurel Creek	10/8/03	16.1	9.08	8.03	149.5	4.2	4600	0.01	1	2, 3
New River below Prince	1/23/01	1.9	13.84	7.7	95.1	13.4	12315	0.00	67	1, 18
New River below Prince	4/16/01	14.1	9.54	7.3	116.8	4.98	5948	0.02	19	1, 19
New River below Prince	5/29/01	16.2	9.45	7.4	115.5	16.6	17200	0.56	135	20
New River below Prince	10/25/01	15.8	9.53	8.5	204	0.79	1340	0.38	11	
New River below Prince	2/12/02	3.9	13.57	8.1	114.1	2.92	4580	0.01	25	18, 21
New River below Prince	5/21/02	14	9.52	8.08	114.9	3.35	6130	0.00	15	1, 18, 22
New River below Prince	7/31/02	26	7.96	7.89	181.7	14.1	3510	0.54	5	1
New River below Piney Creek	4/2/03	10.2	11.57	8.14	118	7.98	10500	0.04	18	1
New River below Piney Creek	5/29/03	17.2	9.07	7.95	133	7.12	10800	0.39	34	
New River below Piney Creek	7/17/03	24.2	7.7	7.95	154.3	9.54	9900	0.17	20	
New River below Piney Creek	10/8/03	16.1	9.36	8.15	149.4	3.83	4600	0.01	4	2, 3
New River below Piney Creek	10/8/03	16.1	9.36	8.15	149.4	3.83	4600	0.01	8	1, 3
New River at Thurmond	1/23/01	1.8	12.83	7.8	89.1	17.3	12315	0.00	87	18
New River at Thurmond	4/23/01	15	9.88	8	136.3	5.61	4286	0.09	2	1, 20
New River at Thurmond	6/5/01	19.5	8.59	7.9	162.9	3.78	5720	0.15	22	18
New River at Thurmond	11/13/01	9.7	11.11	8.6	185.2	0.71	1690	0.00	2	1
New River at Thurmond	1/10/02	1.3	14.72	8.2	116.7	1.07	1650	0.00	18	23
New River at Thurmond	6/12/02	26.3	6.82	7.99	201.1	3.03	2690	0.00	8	1
New River at Thurmond	11/20/02	8.5	11.31	7.84	101.2	9.08	18200	0.12	93	
New River at Thurmond	4/10/03	9.2	11.24	7.77	84.4	45.4	46500	0.65	1880	1
New River at Thurmond	6/5/03	16.6	8.72	7.8	110.3	19.6	24580	0.38	240	
New River at Thurmond	6/12/03	20	8.16	7.64	116.4	6.75	15730	0.30	76	
New River at Thurmond	7/24/03	24.8	7.03	8.21	188.7	4.89	7530	0.70	29	
New River at Thurmond	8/28/03	26.2	6.53	7.85	186	3.38	4610	0.00	18	2
New River at Thurmond	10/2/03	15.4	8.96	8.01	138.8	9.28	6200	0.24	22	1
New River above Coal Run	1/16/01	1.6	13.65	8.2	121	0.92	2015	0.00	0	26
New River above Coal Run	2/20/01	5.7	12.12	7.9	107.9	13.6	13200	0.00	85	1, 27
New River above Coal Run	5/2/01	19.3	8.94	8.4	170.3	2.42	2440	0.08	7	1
New River above Coal Run	6/11/01	22.2	8.19	8.14	160	6.98	8849	0.00	34	1
New River above Coal Run	11/7/01	10.7	9.93	8.4	184.6	0.65	1620	0.00	1	1, 28
New River above Coal Run	1/17/02	3.5	13.55	8.5	135	1	2500	0.00	2	1
New River above Coal Run	1/29/02	5.9	11.52	8	91.4	11.4	N	0.01	23	1, 3, 29
New River above Coal Run	6/13/02	26.4	6.87	7.75	215.7	8.01	2050	0.01	10	1, 30
New River above Coal Run	11/13/02	11.9	9.71	7.82	117.6	46.1	35000	0.17	1000	18, 31

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
New River above Coal Run	4/9/03	9.9	10.55	7.51	89.4	45.7	39000	0.67	1300	1
New River above Coal Run	6/4/03	17	8.84	7.79	134.4	8.64	11930	0.52	93	32
New River above Coal Run	6/11/03	19.2	8.26	7.7	110.2	10.4	22600	0.00	103	
New River above Coal Run	7/23/03	25.2	7.28	8.02	185.3	4.39	6120	0.75	23	1
New River above Coal Run	8/27/03	26.4	7.26	8.02	177.8	3.54	4990	0.00	54	2
New River above Coal Run	10/1/03	17	8.21	7.84	144.8	19.2	7290	0.24	127	
New River above Wolf Creek	1/16/01	1.2	14.65	7.9	113	0.78	2015	0.00	4	1, 34
New River above Wolf Creek	2/20/01	6	12.21	7.8	107.3	17.2	13200	0.00	70	1, 27
New River above Wolf Creek	5/2/01	18.8	9.33	8.2	167.4	2.7	2440	0.08	7	1
New River above Wolf Creek	6/11/01	21.4	8.69	8	156.5	12.2	8849	0.00	60	
New River above Wolf Creek	11/7/01	11.1	8.63	8.3	186.6	0.6	1620	0.00	4	1, 28, 35
New River above Wolf Creek	1/17/02	3.5	11.04	8.3	135.3	0.93	2500	0.00	7	1
New River above Wolf Creek	1/29/02	5.9	13.74	7.8	91.4	10.1	7150	0.01	48	1, 3, 29
New River above Wolf Creek	6/13/02	26.6	7.43	7.84	216.2	2.95	2050	0.01	4	1
New River above Wolf Creek	11/13/02	11.9	10.84	7.48	117.4	48.1	35000	0.17	1400	18, 31
New River above Wolf Creek	4/9/03	10	11.07	7.59	89.7	47.5	39000	0.67	1120	
New River above Wolf Creek	6/4/03	16.9	9.16	7.76	131.6	8.97	11930	0.52	360	1
New River above Wolf Creek	6/11/03	19.4	8.36	7.7	111.5	11.7	22600	0.00	103	
New River above Wolf Creek	7/23/03	25.5	7.26	8.08	185.1	3.92	6120	0.75	8	1
New River above Wolf Creek	8/27/03	26.7	6.59	7.85	186.1	3.81	4990	0.00	17	2, 36
New River above Wolf Creek	10/1/03	17.2	8.85	7.76	144.4	24.3	7290	0.24	120	
Greenbrier River at Willowwood	4/1/03	6.6	12.05	7.79	80	2.25	1670	0.32	46	
Greenbrier River at Willowwood	5/28/03	15	9.68	7.91	105.6	6.87	2970	0.06	103	
Greenbrier River at Willowwood	7/14/03	23	7.45	8.18	137.4	3.14	1420	0.24	36	2
Greenbrier River at Willowwood	7/14/03	23	7.45	8.18	137.4	3.14	1420	0.24	47	
Greenbrier River at Willowwood	10/7/03	13.4	8.57	8.02	123.8	3.17	695	0.00	26	
Greenbrier River at Willowwood	10/7/03	13.4	8.57	8.02	123.8	3.17	695	0.00	72	2
Madam Creek	1/10/01	0.2	14.76	8.1	88.3	1	L	0.13	3550	1, 37
Madam Creek	2/5/01	1.4	13.9	8.2	61.3	4.14	N	0.01	3100	1, 3
Madam Creek	4/10/01	16	8.83	7.7	81.8	11.8	N	0.00	575	
Madam Creek	5/22/01	14.3	9.76	7	64.6	346	H	1.10	3950	1
Madam Creek	7/2/01	23	8.12		196.9	3.68	L	0.10	5050	1
Madam Creek	8/9/01	22.1	8.16	8.2	130.8	2.42	L	0.00	13450	1
Madam Creek	10/31/01	6.8	8.13	8.1	203.3	0.34	L	0.00	1675	1, 38
Madam Creek	3/6/02	0.8	14.4	8.1	50.7	5.02	N	0.01	525	3
Madam Creek	5/15/02	12.1	9.79	8.08	86	4.51	N	0.16	533	
Madam Creek	7/9/02	23.1	7.26	7.83	205.1	3.1	L	0.00	30400	1
Madam Creek	4/1/03	5.5	12.59	7.92	72.3	8.63	N	0.32	900	1
Madam Creek	5/28/03	13.3	9.75	7.94	85.3	8.87	N	0.06	967	
Madam Creek	7/14/03	19.7	8.47	8.14	109.4	9.83	N	0.24	3250	1
Madam Creek	7/14/03	19.7	8.47	8.14	109.4	9.83	N	0.24	5400	1, 2
Madam Creek	10/7/03	12.5	10.19	8.26	117.3	1.24	L	0.00	3250	1
Madam Creek	10/7/03	12.5	10.19	8.26	117.3	1.24	L	0.00	37000	2
Lick Creek	1/10/01	0.1	14.8	8.1	164.2	0.47	L	0.13	23	40
Lick Creek	2/5/01	1.7	14.02	8	97.3	4.07	21.8	0.01	120	3
Lick Creek	4/10/01	14.2	9.31	7.8	110.8	9.32	H	0.00	65	
Lick Creek	5/22/01	14.8	9.51	7.5	88.8	41.3	321.17	1.10	400	1
Lick Creek	7/2/01	21.4	8.05	8.3	246.2	12.8	12.58	0.10	1140	
Lick Creek	8/9/01	23.3	7.94	8.2	227.2	1.68	4.52	0.00	100	
Lick Creek	10/31/01	6.6	11.58	8.1	291.7	0.25	1.39	0.00	8	1

Appendix 3. Gauley River National Recreation Area

Site	Date	Water Temperature (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precipitation (inches)	Fecal Coliform / 100 ml	Comments
Gauley River below Summersville Dam	2/13/01	3.1	13.7	7	43.6	3.76	1960	0.06	15	
Gauley River below Summersville Dam	5/9/01	6.2	12.26	6.9	43.3	1.95	347	0.02	0	53
Gauley River below Summersville Dam	6/19/01	14.7	9.68	7.1	52.5	3.3	400	0.00	4	1
Gauley River below Summersville Dam	10/18/01	18	8.95	7.5	103.9	4.33	563	0.27	0	1
Gauley River below Summersville Dam	12/6/01	11	10.31	7.4	108.8	5.88	120	0.00	2	1, 85
Gauley River below Summersville Dam	6/18/02	13.2	9.87	7.62	52.2	1.67	473	0.68	2	1, 86
Gauley River below Summersville Dam	9/9/02	20.1	6.26	6.48	77	2.23	2580	0.00	19	2, 87, 88
Gauley River below Summersville Dam	9/13/02	20.5	5.8	6.55	75.4	2.76	2420	0.00	321	2
Gauley River below Summersville Dam	9/20/02	21.2	5.47	6.31	77.9	2.9	2460	0.00	179	2
Gauley River below Summersville Dam	4/8/03	7.9	11.6	7.27	41.4	4.06	192	0.85	1	1
Gauley River below Summersville Dam	6/2/03	13.6	8.91	7.04	46	4.54	4200	0.92	22	
Gauley River below Summersville Dam	7/21/03	15.8	9.28	6.64	51.4	1.82	786	0.00	17	2, 6, 36
Gauley River below Summersville Dam	7/21/03	15.8	9.28	6.64	51.4	1.82	786	0.00	2	6, 36
Gauley River below Summersville Dam	9/12/03	19.2	8.96	6.81	54.4	5.8	2870	0.00	30	89
Gauley River below Summersville Dam	9/12/03	19.2	8.96	6.81	54.4	5.8	2870	0.00	54	2, 89
Gauley River below Summersville Dam	9/15/03	19.6	8.36	6.7	57.5	4.57	2890	0.03	17	36
Gauley River below Summersville Dam	9/15/03	19.6	8.36	6.7	57.5	4.57	2890	0.03	17	2, 36
Gauley River below Summersville Dam	9/29/03	18.4	8.66	6.88	60.4	4.29	2890	0.10	12	5, 6, 90
Gauley River below Summersville Dam	9/29/03	18.4	8.66	6.88	60.4	4.29	2890	0.10	12	6, 90
Gauley River above Mason Branch	2/13/01	3.4	13.39	7.3	46.9	3.27	1864	0.06	9	1, 28
Gauley River above Mason Branch	5/9/01	10.2	10.68	6.9	60.1	1.79	482	0.02	4	1
Gauley River above Mason Branch	6/19/01	17	9.26	7.2	66.8	3.47	545	0.00	3	1
Gauley River above Mason Branch	10/18/01	15.9	8.43	7.7	108.3	2.43	632	0.27	6	1
Gauley River above Mason Branch	12/6/01	8.8	11.12	7.9	112.3	1.31	153	0.00	1	1
Gauley River above Mason Branch	6/18/02	16	9.27	7.68	71.4	1.45	548	0.68	2	1
Gauley River above Mason Branch	9/9/02	20.3	9.32	7.48	75.2	2.87	2592	0.00	125	2
Gauley River above Mason Branch	9/13/02	20.5	8.63	7.59	75.2	4.52	2428	0.00	440	2
Gauley River above Mason Branch	9/20/02	21.7	8.24	7.55	77.1	5.61	2479	0.00	580	2, 91
Gauley River above Mason Branch	4/8/03	8.6	11.66	7.24	46.7	40.6	2732	0.85	1113	
Gauley River above Mason Branch	6/2/03	13.5	10.81	7.12	46	6.34	6000	0.92	98	
Gauley River above Mason Branch	7/21/03	18	9.22	7.32	61.3	14.2	1325	0.00	63	6
Gauley River above Mason Branch	7/21/03	18	9.22	7.32	61.3	14.2	1325	0.00	108	2, 6
Gauley River above Mason Branch	9/12/03	19	9.04	7.31	56.3	6.27	3083	0.00	30	6
Gauley River above Mason Branch	9/12/03	19	9.04	7.31	56.3	6.27	3083	0.00	72	2, 6
Gauley River above Mason Branch	9/15/03	19.8	8.84	7.28	59.8	4.83	3038	0.03	36	2
Gauley River above Mason Branch	9/15/03	19.8	8.84	7.28	59.8	4.83	3038	0.03	26	
Gauley River above Mason Branch	9/29/03	17.9	8.91	7.35	62.3	4.47	3305	0.10	21	5
Gauley River above Mason Branch	9/29/03	17.9	8.91	7.35	62.3	4.47	3305	0.10	44	
Gauley River above Swiss	2/13/01	3.8	13.17	7.2	48.4	3.77	2110	0.06	6	1, 28
Gauley River above Swiss	5/9/01	13.8	9.94	7.1	70.5	1.89	619	0.02	6	1, 28
Gauley River above Swiss	6/19/01	20.8	8.75	7.14	81.5	2	767	0.00	7	1, 28
Gauley River above Swiss	10/18/01	15.5	8.41	7.8	114.1	1.62	709	0.27	3	1, 28, 92
Gauley River above Swiss	12/6/01	8.6	11.18	8	123.2	0.62	153	0.00	3	1, 28
Gauley River above Swiss	6/18/02	19.2	7.97	7.5	98.7	3.66	544	0.68	19	1, 93
Gauley River above Swiss	9/9/02	22.5	8.04	7.63	82.1	1.67	1320	0.00	54	2, 88, 94, 95
Gauley River above Swiss	9/13/02	20.7	8.65	7.8	76.2	2.7	1780	0.00	1100	2, 94
Gauley River above Swiss	9/20/02	24.1	7.44	7.68	83.6	1.62	747	0.00	125	2, 96

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Lick Creek	3/6/02	0.9	14.41	8.1	87.9	5.84	22.2	0.01	45	1, 3
Lick Creek	5/15/02	11.8	10.05	7.91	111.8	5.25	20	0.16	83	
Lick Creek	7/9/02	22	7.43	7.98	327.2	1.76	0.21	0.00	40	
Lick Creek	4/1/03	4.8	13.1	7.75	118	4.98	N	0.32	185	41
Lick Creek	5/28/03	13.7	9.51	7.93	118.3	5.63	N	0.06	111	41
Lick Creek	7/14/03	18.7	8.71	8.04	142.7	7.73	N	0.24	54	2, 41
Lick Creek	7/14/03	18.7	8.71	8.04	142.7	7.73	N	0.24	130	41
Lick Creek	10/7/03	12.4	9.76	7.9	110.9	3.39	2.74	0.00	40	1
Lick Creek	10/7/03	12.4	9.76	7.9	110.9	3.39	2.74	0.00	144	2
Meadow Creek	1/10/01	0.1	15.02	7.5	73.7	1.31	L	0.13	3	40, 42, 43
Meadow Creek	2/5/01	1.7	13.98	7.5	53.5	2.45	38.1	0.01	650	1, 3
Meadow Creek	4/10/01	13.3	10.06	7.4	67	5.49	53.8	0.00	30	1
Meadow Creek	5/22/01	14.8	9.69	7.4	66.3	35	192.5	1.10	1000	
Meadow Creek	7/2/01	18.9	8.82	7.9	131.7	45.3	5.88	0.10	825	
Meadow Creek	8/9/01	20	8.15	7.9	123.8	3.76	18.8	0.00	88	
Meadow Creek	10/31/01	6.1	12.31	8.1	151.7	0.36	1.68	0.00	10	1, 44
Meadow Creek	3/6/02	0.9	14.5	7.6	49.7	3.02	64.2	0.01	56	1, 3, 45
Meadow Creek	5/15/02	10.6	10.65	7.58	64.3	8.28	86.6	0.16	57	1
Meadow Creek	7/9/02	20.6	7.6	7.91	174.6	4.13	1.68	0.00	80	
Meadow Creek	4/1/03	4.2	13.15	7.43	72.3	2.51	28.8	0.32	270	1
Meadow Creek	5/28/03	12.3	10.42	7.65	75.6	7.33	33	0.06	28	1
Meadow Creek	7/14/03	17.2	9.08	7.68	82.5	10.5	28.4	0.24	48	
Meadow Creek	7/14/03	17.2	9.08	7.68	82.5	10.5	28.4	0.24	90	2
Meadow Creek	10/7/03	11.1	10.21	7.7	99.3	2.28	8.15	0.00	61	
Meadow Creek	10/7/03	11.1	10.21	7.7	99.3	2.28	8.15	0.00	54	2
Glade Creek	1/23/01	0.3	14.43	7.6	80.5	2.39	N	0.00	11	18, 19, 46
Glade Creek	4/16/01	10.2	10.85	7	96.6	1.61	N	0.02	6	1, 19, 47
Glade Creek	5/29/01	14.2	9.77	6.95	103.1	5.31	H	0.56	18	1, 20
Glade Creek	10/25/01	12.4	9.84	7.6	164.4	0.57	L	0.38	1	1
Glade Creek	2/12/02	1	15.94	7.39	82.5	2.69	N	0.01	9	18
Glade Creek	5/21/02	9	10.72	7.06	69	1.97	N	0.00	15	18, 22
Glade Creek	7/31/02	21.8	8.8	7.09	143.5	2.2	N	0.54	26	
Glade Creek	4/2/03	8.1	11.58	7.08	79.6	7.46	H	0.04	112	
Glade Creek	5/29/03	13.6	9.64	7.17	86.9	3.76	N	0.39	22	
Glade Creek	7/17/03	18.7	8.58	7.25	90.4	3.06	N	0.17	21	
Glade Creek	10/8/03	11.3	10.49	7.33	90.2	0.51	L	0.01	3	1, 3, 48
Glade Creek	10/8/03	11.3	10.49	7.33	90.2	0.51	L	0.01	0	2, 3, 48
Mill Creek	10/25/01	11.7	9.8	7.3	77.6	1.02	L	0.38	4	1
Mill Creek	2/12/02	1.4	15.66	7.4	40.7	0.58	N	0.01	1	1, 18
Mill Creek	5/21/02	8.6	11.3	7.41	22.1	3.34	N	0.00	8	1, 18, 22
Mill Creek	7/31/02	19.6	9.37	7.26	83	4.8	L	0.54	33	
Mill Creek	4/2/03	8	11.86	7.27	44.1	8.14	H	0.04	8	1
Mill Creek	5/29/03	12.3	10.09	7.24	50.7	5.48	N	0.39	14	1
Mill Creek	7/17/03	17.5	8.74	7.13	59.8	7.88	N	0.17	16	
Mill Creek	10/8/03	11.9	10.46	7.5	54	1.89	L	0.01	6	1, 3, 48
Mill Creek	10/8/03	11.9	10.46	7.5	54	1.89	L	0.01	0	2, 3, 48

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Laurel Creek at Quinnimont	1/23/01	0.7	14.29	7.6	41.7	3.17	69.66	0.00	15	1, 18
Laurel Creek at Quinnimont	4/16/01	9.2	11.25	7.5	61.3	4.51	55.53	0.02	52	19
Laurel Creek at Quinnimont	5/29/01	13.1	9.74	7.3	72.4	5.14	N	0.56	75	20, 49
Laurel Creek at Quinnimont	10/25/01	11.7	10.52	8.14	181.6	0.25	1.57	0.38	3	1
Laurel Creek at Quinnimont	2/12/02	1.4	15.69	7.61	47.2	3.4	43.8	0.01	18	1, 18
Laurel Creek at Quinnimont	5/21/02	9	11.22	7.62	58.2	2.32	78.6	0.00	23	18, 22
Laurel Creek at Quinnimont	7/31/02	20.7	9.45	7.95	101.6	2.8	21.3	0.54	23	1
Laurel Creek at Quinnimont	4/2/03	9	11.46	7.39	49.4	5.82	148	0.04	40	1
Laurel Creek at Quinnimont	5/29/03	13	10.04	7.62	78.2	4.01	54.1	0.39	63	
Laurel Creek at Quinnimont	7/17/03	19.2	8.64	7.91	97.3	2.29	31.6	0.17	11	1
Laurel Creek at Quinnimont	10/8/03	12.1	10.62	7.83	88.1	0.44	9.82	0.01	1	2, 3
Laurel Creek at Quinnimont	10/8/03	12.1	10.62	7.83	88.1	0.44	9.82	0.01	3	1, 3
Piney Creek at McCreery	1/23/01	0.2	14.45	7.6	153.9	5.85	192.9	0.00	730	1, 18
Piney Creek at McCreery	4/16/01	11.2	10.86	7.5	216.1	2.33	115.72	0.02	104	19, 50
Piney Creek at McCreery	5/29/01	14.1	9.85	7.5	178.3	6.27	220.13	0.56	1200	20
Piney Creek at McCreery	10/25/01	13	9.84	8	373.8	0.65	14.8	0.38	48	
Piney Creek at McCreery	2/12/02	1.8	15.63	7.8	263.2	3.5	100	0.01	40	18, 51, 52
Piney Creek at McCreery	5/21/02	9.6	10.99	7.38	142.1	6.3	262	0.00	440	18, 22
Piney Creek at McCreery	7/31/02	21.8	8.99	7.54	243.2	16.8	97.7	0.54	240	
Piney Creek at McCreery	4/2/03	8.4	12.42	8.11	335	4.44	302	0.04	192	
Piney Creek at McCreery	5/29/03	14.1	9.51	7.6	209.4	7.43	234	0.39	185	
Piney Creek at McCreery	7/17/03	20.3	8.08	7.85	305.1	4.5	97.7	0.17	122	
Piney Creek at McCreery	10/8/03	12.6	10.16	7.98	294	1.47	60.1	0.01	21	3
Piney Creek at McCreery	10/8/03	12.6	10.16	7.98	294	1.47	60.1	0.01	1	2, 3
Dowdy at McKendree Road	4/16/01	9.1	11.07	6.7	20.5	0.67	N	0.02	0	19, 53
Dowdy at McKendree Road	4/23/01	12.1	10.35	6.1	22.2	0.73	N	0.09	0	1, 20, 54
Dowdy at McKendree Road	6/5/01	13.8	9.85	6.3	24.7	8.35	N	0.15	11	1, 18
Dowdy at McKendree Road	2/25/02	3	13.53	6.05	17.7	0.41	L	0.00	0	19
Dowdy at McKendree Road	6/12/02	15.9	8.48	6.06	24.2	0.68	L	0.00	1	1
Dowdy at McKendree Road	11/20/02	7.5	11.43	5.64	19.2	1.19	H	0.12	1	1
Slater at McKendree Road	4/16/01	9.1	11.14	7.2	42.1	5.9	N	0.02	11	1, 19, 55
Slater at McKendree Road	4/23/01	12.4	10.4	7	48.5	5.37	N	0.09	3	1, 20
Slater at McKendree Road	6/5/01	14.4	9.55	7.1	52	5.64	N	0.15	5	1, 18
Slater at McKendree Road	11/13/01	6.7	11.87	7.8	181.7	21.4	L	0.00	121	56, 57, 58, 59
Slater at McKendree Road	2/25/02	2.8	13.74	7.1	37.2	2.44	L	0.00	0	26
Slater at McKendree Road	6/12/02	16.9	8.82	7.38	64.6	5	L	0.00	9	1
Slater at McKendree Road	11/20/02	6.8	11.64	7.04	28.3	2.69	N	0.12	4	1
Slater at McKendree Road	4/10/03	8	11.1	7.04	33.7	12.7	H	0.65	3	1
Slater at McKendree Road	6/5/03	13.3	9.95	7.41	41.2	6.18	N	0.38	4	1
Slater at McKendree Road	6/12/03	15.9	9.26	7.13	45.4	5.62	N	0.30	4	1
Slater at McKendree Road	7/24/03	17.6	8.32	7.43	52.3	4.68	N	0.70	7	1
Slater at McKendree Road	8/28/03	19.3	8.64	7.33	51.9	4.07	L	0.00	18	2
Slater at McKendree Road	10/2/03	10.5	10.39	7.45	43.1	2.3	N	0.24	8	1
Slater Creek at mouth	11/20/02	7.4	11.86	7.19	38.3	4.61	N	0.12	10	1

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Slater Creek at mouth	4/10/03	8.3	11.08	7.07	37.2	20.8	H	0.65	16	61
Slater Creek at mouth	6/5/03	14	9.77	7.24	46.4	6.31	N	0.38	6	1
Slater Creek at mouth	6/12/03	16.6	9.32	7.27	40.8	6.49	N	0.30	13	
Slater Creek at mouth	7/24/03	18.8	8.34	7.4	57.1	3.43	N	0.70	7	1
Slater Creek at mouth	8/28/03	20.9	6	7.07	65.7	2.96	L	0.00	54	2
Slater Creek at mouth	10/2/03	11.7	9.9	7.3	45.2	2.32	L	0.24	6	1
Buffalo Creek at McKendree Road	4/16/01	9.2	11.32	7.3	54.8	4.39	N	0.02	11	1, 19
Buffalo Creek at McKendree Road	4/23/01	12.7	10.33	7.5	68.1	5.13	N	0.09	10	1, 20
Buffalo Creek at McKendree Road	6/5/01	14.1	9.6	7.4	96.6	7.63	N	0.15	11	1, 18
Buffalo Creek at McKendree Road	11/13/01	9.6	8.05	7.6	135.4	0.57	L	0.00	0	26
Buffalo Creek at McKendree Road	2/25/02	3.8	13.14	7.8	67.5	1.1	L	0.00	0	53
Buffalo Creek at McKendree Road	6/12/02	17.4	8.48	7.71	147.7	2.26	L	0.00	55	
Buffalo Creek at McKendree Road	11/20/02	7.5	11.82	7.37	44.2	3.71	H	0.12	5	1
Buffalo Creek at McKendree Road	4/10/03	8.2	11.2	7.13	37.2	9.33	H	0.65	3	1
Buffalo Creek at McKendree Road	6/5/03	13.5	9.77	7.52	56.7	6.02	N	0.38	10	1
Buffalo Creek at McKendree Road	6/12/03	15.4	9.69	7.53	68.1	5.75	N	0.30	5	1
Buffalo Creek at McKendree Road	7/24/03	17.5	8.46	7.69	110.5	3.88	N	0.70	9	1
Buffalo Creek at McKendree Road	8/28/03	19.5	7.73	7.71	113.5	3.04	L	0.00	17	2, 36
Buffalo Creek at McKendree Road	10/2/03	10.5	10.55	7.71	63.8	1.57	N	0.24	3	1
Dunloup Creek	1/23/01	0.5	14.58	7.3	169.6	4.62	48.8	0.00	190	18
Dunloup Creek	4/23/01	13.4	9.97	8.2	349.3	3.87	47.98	0.09	125	20
Dunloup Creek	6/5/01	15.2	9.69	7.8	377.2	7.22	55.78	0.15	690	1, 18
Dunloup Creek	11/13/01	4	13.35	8.6	397.2	0.47	11.3	0.00	5	1, 63
Dunloup Creek	1/10/02	1.6	14.54	8.4	334.5	0.67	11.3	0.00	1	1, 63
Dunloup Creek	1/29/02	7	12.6	8.2	231	2.35	43.5	0.01	25	1, 3, 63
Dunloup Creek	4/9/02	12.4	10.66	8.14	310.4	3.7	104	0.01	50	18, 64
Dunloup Creek	4/9/02	12.5	10.54	8.21	308.8	3.16	107	0.01	78	18, 64
Dunloup Creek	4/9/02	12.5	10.55	8.23	308.9	3.07	109	0.01	63	18, 64
Dunloup Creek	4/9/02	12.6	10.52	8.26	310.9	2.87	112	0.01	47	18, 64
Dunloup Creek	4/9/02	12.6	10.49	8.26	308.7	2.41	112	0.01	61	18, 64
Dunloup Creek	4/9/02	12.7	10.48	8.27	309.3	2.96	112	0.01	47	18, 64
Dunloup Creek	4/9/02	12.8	10.44	8.28	310	2.39	112	0.01	35	18, 64
Dunloup Creek	4/16/02	13.9	9.45	8.24	308.2	2.54	87.2	0.00		18, 65, 67
Dunloup Creek	6/12/02	17.8	8.62	8.21	526	4.98	42.6	0.00	63	
Dunloup Creek	7/10/02	20.4	8.59	8.17	554	3.28	15.1	0.01	83	
Dunloup Creek	7/10/02	20.3	8.33	8.19	556	3.87	19.6	0.01	88	
Dunloup Creek	7/10/02	20.4	8.4	8.28	547	2.52	18.3	0.01	58	
Dunloup Creek	7/10/02	20.4	8.28	8.25	548	2.84	18.3	0.01	45	
Dunloup Creek	7/10/02	20.4	8.34	8.28	548	2.61	18.3	0.01	28	1
Dunloup Creek	11/20/02	7.5	11.74	7.7	184.2	3.28	89.4	0.12	964	1
Dunloup Creek	4/10/03	9.4	11.11	7.55	163.1	14.2	249	0.65	183	1, 68
Dunloup Creek	6/5/03	13.6	9.8	7.97	252.5	11.7	128	0.38	385	
Dunloup Creek	6/12/03	15.8	9.82	7.94	310.7	9.11	99.4	0.30	1730	1
Dunloup Creek	7/24/03	17.1	8.89	8.3	446.5	5.95	43.3	0.70	175	
Dunloup Creek	8/28/03	19.1	8.48	8.17	400.7	4.43	40.1	0.00	396	2
Dunloup Creek	10/2/03	9.9	10.55	8.28	337.2	2.18	50.7	0.24	278	1

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Arbuckle Creek	1/23/01	1.5	14.09	7.9	188.3	5.47	10.88	0.00	255	18
Arbuckle Creek	4/23/01	13.2	10.78	8.4	283.4	3.15	10.44	0.09	50	1, 20
Arbuckle Creek	6/5/01	15.1	9.41	8	314	6.33	9.2	0.15	690	1, 18
Arbuckle Creek	11/13/01	5.4	12.24	8.3	325.8	0.41	L	0.00	20	1
Arbuckle Creek	1/10/02	0.5	14.47	8.1	299.7	0.72	L	0.00	5	1
Arbuckle Creek	1/29/02	6.5	11.54	8	216.5	2.21	N	0.01	20	1, 3
Arbuckle Creek	6/12/02	18.1	7.9	7.91	422.2	1.29	L	0.00	17	1
Arbuckle Creek	11/20/02	8.5	11.22	7.84	176.1	2.62	11.9	0.12	500	1
Arbuckle Creek	4/10/03	9.5	10.73	7.8	177.8	4.78	19.4	0.65	2500	1
Arbuckle Creek	6/5/03	14	9.82	7.93	197.5	7.92	23.5	0.38	4080	1, 70, 71
Arbuckle Creek	6/12/03	15.6	9.64	7.94	257.2	7.32	11.9	0.30	620	70, 72
Arbuckle Creek	7/24/03	17.4	8.56	8.07	323.9	4.51	2	0.70	110	1, 73
Arbuckle Creek	8/28/03	19.9	8.42	7.87	344	3.41	3.08	0.00	270	2
Arbuckle Creek	10/2/03	11	10.17	8.08	273	1.72	2.25	0.24	175	74
Coal Run	1/16/01	2.5	13.85	8	204.8	1.92	N	0.00	17	1
Coal Run	2/20/01	8	11.57	8	195.4	6.44	N	0.00	180	27
Coal Run	5/2/01	13.8	8.35	8.1	308.1	7.02	L	0.08	324	1
Coal Run	6/11/01	15.1	9.47	7.66	272	7.1	N	0.00	287	
Coal Run	11/7/01	5.8	11.63	8.2	285.8	0.35	L	0.00	0	75
Coal Run	1/17/02	2.1	13.6	8.1	218	0.52	L	0.00	1	1
Coal Run	1/29/02	6.5	12.2	7.9	209	0.83	N	0.01	10	1, 3
Coal Run	6/13/02	18.2	8.74	7.81	330.8	2.41	L	0.01	10	1
Coal Run	11/13/02	9.5	10.83	7.81	154.8	3.29	N	0.17	120	18
Coal Run	4/9/03	9.7	10.84	7.82	170.3	9.72	N	0.67	283	1
Coal Run	6/4/03	14	9.94	7.84	190	13.2	N	0.52	1225	32
Coal Run	6/11/03	15.8	9.12	7.97	257	4.21	N	0.00	65	
Coal Run	7/23/03	17.9	8.66	8.02	303.1	4.22	L	0.75	18	1
Coal Run	8/27/03	20.1	7.78	7.92	349.3	4.01	L	0.00	36	2
Coal Run	10/1/03	12	9.92	8.03	276.5	1.5	N	0.24	18	
Keeney Creek above Winona	6/4/03	12.6	9.81	7.18	69.4	20.8	H	0.52	233	1
Keeney Creek above Winona	6/11/03	14	8.79	7.21	103.2	2.83	N	0.00	63	1
Keeney Creek above Winona	7/23/03	16.5	7.84	7.48	107.2	2.35	L	0.75	4670	1
Keeney Creek above Winona	8/27/03	15.7	7.92	7.22	184.6	1.65	L	0.00	72	2
Keeney Creek above Winona	10/1/03	12.1	8.86	7.3	172.4	0.93	N	0.24	75	1
Keeney Creek at Winona	1/16/01	3.5	12.88	7.9	123.9	1.3	L	0.00	1567	
Keeney Creek at Winona	2/20/01	5.4	11.92	7.1	77.2	2.99	N	0.00	1400	27
Keeney Creek at Winona	5/2/01	11.8	10.16	7	120.2	1.48	L	0.08	367	
Keeney Creek at Winona	6/11/01	13.7	9.61	6.9	100.3	2.69	N	0.00	4350	1
Keeney Creek at Winona	11/7/01	4.7	10.42	7.6	142.6	0.19	L	0.00	625	
Keeney Creek at Winona	1/17/02	4.1	12.6	7.8	123	0.48	L	0.00	675	
Keeney Creek at Winona	6/13/02	17.2	8.41	7.13	135.9	2.32	L	0.01	1425	
Keeney Creek at Winona	11/13/02	9.9	10.48	7.36	73.2	6.05	H	0.17	350	18
Keeney Creek at Winona	4/9/03	8.2	10.85	7.28	81.5	4.17	H	0.67	1550	
Keeney Creek at Winona	6/4/03	12.6	9.9	7.07	72.2	21.4	H	0.52	10000	1
Keeney Creek at Winona	6/11/03	13.5	9.58	7.06	88.7	4.61	N	0.00	500	
Keeney Creek at Winona	7/23/03	16.2	8.79	7.15	121.8	2.82	L	0.75	1180	1
Keeney Creek at Winona	8/27/03	17.8	8.33	7.22	96	2.29	L	0.00	4000	2
Keeney Creek at Winona	10/1/03	11.3	9.91	7.3	109.3	2.1	N	0.24	1260	1

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Keeney Creek below Winona	4/9/03	8.1	11.02	7.14	71.4	5.39	H	0.67	1500	
Keeney Creek below Winona	6/4/03	12.8	10.02	7.24	66.2	19.3	H	0.52	333	1
Keeney Creek below Winona	6/11/03	13.9	9.65	7.22	89	4.99	N	0.00	300	1
Keeney Creek below Winona	7/23/03	16.8	8.84	7.54	125.9	2.88	L	0.75	235	
Keeney Creek below Winona	8/27/03	18.3	8.32	7.25	135.8	2.47	L	0.00	400	2
Keeney Creek below Winona	10/1/03	11	10.34	7.53	107.7	1.54	N	0.24	190	1
Wolf Creek	1/16/01	5.9	12.52	8.7	270.2	1.43	7.38	0.00	23	
Wolf Creek	2/20/01	4.8	12.59	7.8	93.6	4.45	39.4	0.00	87	27
Wolf Creek	5/2/01	13.3	10.13	8.5	241.4	1.53	9.2	0.08	5	1
Wolf Creek	6/11/01	15.9	9.68	8.2	196.8	7.36	15.3	0.00	86	
Wolf Creek	11/7/01	8.4	10.64	8.7	477	0.42	17.2	0.00	0	75
Wolf Creek	1/17/02	6.1	11.7	8.7	375.1	0.83	1.4	0.00	8	1, 76
Wolf Creek	1/29/02	7.4	12.48	7.9	175	2.9	N	0.01	38	1, 3
Wolf Creek	6/13/02	17.7	8.82	8.22	405.3	6.47	6.14	0.01	17	1
Wolf Creek	11/13/02	10.1	10.99	7.75	107.8	8.56	77.61	0.17	248	18
Wolf Creek	4/9/03	9.7	10.68	7.56	114.8	11.4	72.7	0.67	213	
Wolf Creek	6/4/03	15	9.43	7.53	130.5	51.1	H	0.52	2250	77
Wolf Creek	6/11/03	16.3	8.98	7.93	176.4	6.05	24.4	0.00	18	1
Wolf Creek	7/23/03	17.5	8.8	8.41	480	4.66	4	0.75	8	1
Wolf Creek	8/27/03	18.6	8.12	8.3	501	3.04	3.23	0.00	18	2
Wolf Creek	10/1/03	12.6	9.53	8.39	339.9	2.45	6.89	0.24	7	1
Marr Branch	1/16/01	3.7	12.97	7.5	128.5	2.49	4.3	0.00	65	
Marr Branch	2/20/01	5.4	12.57	7.5	87.7	3.43	3.7	0.00	63	1, 27, 82, 83
Marr Branch	5/2/01	15	9.35	7.9	262.2	2.25	0.99	0.08	68	
Marr Branch	6/11/01	16.4	8.98	7.21	156.4	5.43	2.39	0.00	98	
Marr Branch	11/7/01	6.1	9.48	8.4	513	0.62	1.7	0.00	48	
Marr Branch	1/17/02	5.2	12.1	8.4	312.3	1.86	1.6	0.00	68	
Marr Branch	6/13/02	19.4	7.32	7.34	335.9	3	1.08	0.01	520	
Marr Branch	11/13/02	10.5	9.87	7.44	93.8	5.47	8.28	0.17	1380	1, 18
Marr Branch	4/9/03	9.6	10.43	7.42	112.2	11.5	13.8	0.67	433	
Marr Branch	6/4/03	13.6	9.37	6.99	87	33.5	34	0.52	4600	
Marr Branch	6/11/03	15.6	8.91	7.32	129.5	6.47	5	0.00	233	
Marr Branch	7/23/03	18.9	7.48	7.61	222.9	5.23	0.77	0.75	293	
Marr Branch	8/27/03	20.5	8.01	7.6	259.6	2.69	0.94	0.00	108	2, 84
Marr Branch	10/1/03	12.5	9.38	7.68	174.5	4.6	2.5	0.24	785	1
Claremont Mine Spring	4/16/01					2.88		0.02	0	19, 53
Claremont Mine Spring	4/23/01					2.39		0.09	0	20, 53
Claremont Mine Spring	6/5/01					1.65		0.15	2	1, 18
Claremont Mine Spring	11/13/01					0.5		0.00	0	53
Claremont Mine Spring	2/25/02					0.87		0.00	0	53
Claremont Mine Spring	6/12/02					1.1		0.00	0.7	1
Claremont Mine Spring	11/20/02	14.1		6.22		2.94		0.12	1	1
Claremont Mine Spring	4/10/03	9.4		6.52		4.09		0.65	0	53
Claremont Mine Spring	6/5/03	13.2		6.4		2.94		0.38	0.4	1
Claremont Mine Spring	7/24/03	15		6.3		1.71		0.70	0	53, 62
Claremont Mine Spring	10/2/03	12.9		6.46		1.65		0.24	0	53

Appendix 2. New River Gorge National River

Site Name	Date	Water Temp. (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precip. (inches)	Fecal Coliforms per 100 ml	Comments
Ajax Mine Spring	1/16/01					0.28		0.00	0	53, 78
Ajax Mine Spring	1/16/01					0.39		0.00	0	53, 79
Ajax Mine Spring	2/20/01					0.17		0.00	0	27, 53, 78
Ajax Mine Spring	5/2/01					0.07		0.08	0	53
Ajax Mine Spring	6/11/01					0.75		0.00	0	53, 73
Ajax Mine Spring	11/7/01					0.27		0.00	0	53
Ajax Mine Spring	1/17/02					0.62		0.00	0	53
Ajax Mine Spring	6/13/02					0.2		0.01	0	53
Ajax Mine Spring	11/13/02					0.31		0.17	1	1, 18
Ajax Mine Spring	4/9/03					0.22		0.67	0	53
Ajax Mine Spring	6/4/03			6.13		0.29		0.52	0.5	1, 80
Ajax Mine Spring	7/23/03	14.5		6.22		0.22		0.75	0	53, 78
Ajax Mine Spring	10/1/03	12.6		6.26		0.1		0.24	0	53, 81

Key to Comments

1: FC/100 ml is an estimate
2: Analyzed at AnaLabs
3: Actual 48hr precip is a trace
4: Used 50 ml count
8: Lots of yellow/brown colonies on both filters
9: DO meter low battery and lost calibration
10: 200 ml dilution had confluent colonies due to debris
11: Lots of brown algae and goose droppings
12: Lots of algae
13: 2 mold colonies in each dilution
15: Geese above falls
17: half of 30ml filter pink with 2 pink colonies
18: 48hr precip actually 24hr
19: 48hr precip actually 72hr
20: 48hr precip actually 96hr
21: 8 regular size and numerous small colonies on 75ml filter
22: 96hr precip was 0.80
23: 10 large colonies and numerous small colonies in 200 ml dilution
26: Actual FC reading was <0.5 FC/100 ml
27: 48hr precip from the IFLOWS gage for Fayette County
28: Discharge is USGS daily mean value
29: Bank side sample
30: Murkiness due to human activity upstream
31: Water inside 8ml dish smeared bacteria
32: Incubated grid side up
34: Ice in the river
35: Used 100 ml count
36: Actual Analabs FC is <18 FC/100 ml
37: Iced over
40: Gage covered with ice
41: Low water gage missing
42: Actual FC reading was <4 FC/100 ml
43: 2 mold colonies on 50 ml filter
44: Used 40 ml count
45: Collected sample on stream right
46: Colony growth along filter grid for 300 ml dilution
47: 330ml count not discernable, colonies grew along filter grids
48: Analabs FC is < 1FC/100 ml
49: Gage broken
50: Dark brown algae on stream bed
51: Discharge from rating curve 3
52: Numerous small colonies on 50 ml filter, 11 regular size
53: Actual FC was <.4 FC/100 ml
54: 4 pink colonies per dilution
55: Black plastic pipe in creek
56: Actual FC was >120 FC/100 ml
57: Very low flow
58: Just hydro seeded area around creek
59: Sedimentation on filters caused colonies to grow together
61: Actual FC was < 17FC/100 ml
62: Water temp taken from pH meter
63: Discharge from rating table 8
64: 96hr precip was .03
65: 96hr precip was .31
67: 100 ml filter confluent growth with purple colonies
68: Lots of anglers
70: Discharge from low water gage
71: High water gage reading 2.5 ft (28.5 cfs)
72: High water gage reading 2.27 ft
73: High water gage reading 1.95 ft
74: High water gage reading 2.03 ft
75: Actual FC was < 1 FC/100 ml
76: Discharge from rating table 1
77: Discharge above rating curve
78: Big hose sample
79: Spigot composite
80: Used 200 ml count
81: Sample taken from small hose on left
82: Visual clarity was clear side of milky
83: Water had milky haze, but could see bottom
84: Smells like urine

Appendix 3. Gauley River National Recreation Area

Site	Date	Water Temperature (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precipitation (inches)	Fecal Coliform / 100 ml	Comments
Gauley River below Summersville Dam	2/13/01	3.1	13.7	7	43.6	3.76	1960	0.06	15	
Gauley River below Summersville Dam	5/9/01	6.2	12.26	6.9	43.3	1.95	347	0.02	0	53
Gauley River below Summersville Dam	6/19/01	14.7	9.68	7.1	52.5	3.3	400	0.00	4	1
Gauley River below Summersville Dam	10/18/01	18	8.95	7.5	103.9	4.33	563	0.27	0	1
Gauley River below Summersville Dam	12/6/01	11	10.31	7.4	108.8	5.88	120	0.00	2	1, 85
Gauley River below Summersville Dam	6/18/02	13.2	9.87	7.62	52.2	1.67	473	0.68	2	1, 86
Gauley River below Summersville Dam	9/9/02	20.1	6.26	6.48	77	2.23	2580	0.00	19	2, 87, 88
Gauley River below Summersville Dam	9/13/02	20.5	5.8	6.55	75.4	2.76	2420	0.00	321	2
Gauley River below Summersville Dam	9/20/02	21.2	5.47	6.31	77.9	2.9	2460	0.00	179	2
Gauley River below Summersville Dam	4/8/03	7.9	11.6	7.27	41.4	4.06	192	0.85	1	1
Gauley River below Summersville Dam	6/2/03	13.6	8.91	7.04	46	4.54	4200	0.92	22	
Gauley River below Summersville Dam	7/21/03	15.8	9.28	6.64	51.4	1.82	786	0.00	17	2, 6, 36
Gauley River below Summersville Dam	7/21/03	15.8	9.28	6.64	51.4	1.82	786	0.00	2	6, 36
Gauley River below Summersville Dam	9/12/03	19.2	8.96	6.81	54.4	5.8	2870	0.00	30	89
Gauley River below Summersville Dam	9/12/03	19.2	8.96	6.81	54.4	5.8	2870	0.00	54	2, 89
Gauley River below Summersville Dam	9/15/03	19.6	8.36	6.7	57.5	4.57	2890	0.03	17	36
Gauley River below Summersville Dam	9/15/03	19.6	8.36	6.7	57.5	4.57	2890	0.03	17	2, 36
Gauley River below Summersville Dam	9/29/03	18.4	8.66	6.88	60.4	4.29	2890	0.10	12	5, 6, 90
Gauley River below Summersville Dam	9/29/03	18.4	8.66	6.88	60.4	4.29	2890	0.10	12	6, 90
Gauley River above Mason Branch	2/13/01	3.4	13.39	7.3	46.9	3.27	1864	0.06	9	1, 28
Gauley River above Mason Branch	5/9/01	10.2	10.68	6.9	60.1	1.79	482	0.02	4	1
Gauley River above Mason Branch	6/19/01	17	9.26	7.2	66.8	3.47	545	0.00	3	1
Gauley River above Mason Branch	10/18/01	15.9	8.43	7.7	108.3	2.43	632	0.27	6	1
Gauley River above Mason Branch	12/6/01	8.8	11.12	7.9	112.3	1.31	153	0.00	1	1
Gauley River above Mason Branch	6/18/02	16	9.27	7.68	71.4	1.45	548	0.68	2	1
Gauley River above Mason Branch	9/9/02	20.3	9.32	7.48	75.2	2.87	2592	0.00	125	2
Gauley River above Mason Branch	9/13/02	20.5	8.63	7.59	75.2	4.52	2428	0.00	440	2
Gauley River above Mason Branch	9/20/02	21.7	8.24	7.55	77.1	5.61	2479	0.00	580	2, 91
Gauley River above Mason Branch	4/8/03	8.6	11.66	7.24	46.7	40.6	2732	0.85	1113	
Gauley River above Mason Branch	6/2/03	13.5	10.81	7.12	46	6.34	6000	0.92	98	
Gauley River above Mason Branch	7/21/03	18	9.22	7.32	61.3	14.2	1325	0.00	63	6
Gauley River above Mason Branch	7/21/03	18	9.22	7.32	61.3	14.2	1325	0.00	108	2, 6
Gauley River above Mason Branch	9/12/03	19	9.04	7.31	56.3	6.27	3083	0.00	30	6
Gauley River above Mason Branch	9/12/03	19	9.04	7.31	56.3	6.27	3083	0.00	72	2, 6
Gauley River above Mason Branch	9/15/03	19.8	8.84	7.28	59.8	4.83	3038	0.03	36	2
Gauley River above Mason Branch	9/15/03	19.8	8.84	7.28	59.8	4.83	3038	0.03	26	
Gauley River above Mason Branch	9/29/03	17.9	8.91	7.35	62.3	4.47	3305	0.10	21	5
Gauley River above Mason Branch	9/29/03	17.9	8.91	7.35	62.3	4.47	3305	0.10	44	
Gauley River above Swiss	2/13/01	3.8	13.17	7.2	48.4	3.77	2110	0.06	6	1, 28
Gauley River above Swiss	5/9/01	13.8	9.94	7.1	70.5	1.89	619	0.02	6	1, 28
Gauley River above Swiss	6/19/01	20.8	8.75	7.14	81.5	2	767	0.00	7	1, 28
Gauley River above Swiss	10/18/01	15.5	8.41	7.8	114.1	1.62	709	0.27	3	1, 28, 92
Gauley River above Swiss	12/6/01	8.6	11.18	8	123.2	0.62	153	0.00	3	1, 28
Gauley River above Swiss	6/18/02	19.2	7.97	7.5	98.7	3.66	544	0.68	19	1, 93
Gauley River above Swiss	9/9/02	22.5	8.04	7.63	82.1	1.67	1320	0.00	54	2, 88, 94, 95
Gauley River above Swiss	9/13/02	20.7	8.65	7.8	76.2	2.7	1780	0.00	1100	2, 94
Gauley River above Swiss	9/20/02	24.1	7.44	7.68	83.6	1.62	747	0.00	125	2, 96

Appendix 3. Gauley River National Recreation Area

Site	Date	Water Temperature (C)	Dissolved Oxygen (mg/l)	pH	Field Conductivity (umhos/cm)	Turbidity (NTU)	Discharge (cfs) Stage (visual)	48 Hour Precipitation (inches)	Fecal Coliform / 100 ml	Comments
Gauley River above Swiss	4/8/03	10	10.83	7.48	60.5	17.6	3290	0.85	113	
Gauley River above Swiss	6/2/03	14.1	9.81	7.37	48.3	6.97	8120	0.92	63	1
Gauley River above Swiss	7/21/03	20.4	8.86	7.47	70.5	8.8	1640	0.00	18	2
Gauley River above Swiss	7/21/03	20.4	8.86	7.47	70.5	8.8	1640	0.00	72	
Gauley River above Swiss	9/12/03	19.9	8.24	7.45	63.4	5.47	2020	0.00	21	
Gauley River above Swiss	9/12/03	19.9	8.24	7.45	63.4	5.47	2020	0.00	36	2
Gauley River above Swiss	9/15/03	20.3	8.32	7.46	67.4	4.28	2780	0.03	54	2, 97
Gauley River above Swiss	9/15/03	20.3	8.32	7.46	67.4	4.28	2780	0.03	14	97
Gauley River above Swiss	9/29/03	17.9	8.78	7.42	62.3	4.45	3630	0.10	15	2
Gauley River above Swiss	9/29/03	17.9	8.78	7.42	62.3	4.45	3630	0.10	19	5
Meadow River	2/13/01	2.8	12.45	6.7	61.3	2.31	334	0.06	13	1, 28
Meadow River	5/9/01	15.3	8.47	7.1	105.7	1.6	135	0.02	15	
Meadow River	6/19/01	21.8	7.22	6.8	129	2.07	145	0.00	30	
Meadow River	10/18/01	9	9.79	7.9	176.7	1.1	69	0.27	55	
Meadow River	12/6/01	7.2	9.5	7.8	145.5	0.6	33	0.00	3	1
Meadow River	6/18/02	19	7.44	7.98	107.9	1.4	75	0.68	20	1
Meadow River	9/9/02	22.8	6.85	7.83	214.7	0.92	12	0.00	71	2
Meadow River	9/13/02	20.3	7.13	7.83	214	0.83	7.7	0.00	2890	2
Meadow River	9/20/02	22.9	3.31	7.21	228.5	0.93	19	0.00	125	2
Meadow River	4/8/03	7.6	11.68	7.52	45.4	41.8	2540	0.85	1188	
Meadow River	6/2/03	11.6	9.95	7.24	50.1	12.4	1800	0.92	827	1
Meadow River	7/21/03	19.6	8.11	7.25	85.3	25.1	539	0.00	234	2, 6, 98
Meadow River	7/21/03	19.6	8.11	7.25	85.3	25.1	539	0.00	150	6, 98
Meadow River	9/12/03	17.8	7.87	7.51	95.7	4.51	216	0.00	21	6
Meadow River	9/12/03	17.8	7.87	7.51	95.7	4.51	216	0.00	54	2, 6
Meadow River	9/15/03	20.4	7.89	7.57	113.8	2.76	158	0.03	67	
Meadow River	9/15/03	20.4	7.89	7.57	113.8	2.76	158	0.03	144	2
Meadow River	9/29/03	14	9.19	7.44	82	6.16	415	0.10	105	99
Meadow River	9/29/03	14	9.19	7.44	82	6.16	415	0.10	52	5, 99
Peters Creek at Ford	2/13/01	5	12.35	7.9	180.4	1.98	N	0.06	54	
Peters Creek at Ford	5/9/01	16	9.04	7.9	227.7	1.48	N	0.02	152	
Peters Creek at Ford	6/19/01	19.6	8.72	7.9	346.4	2.3	N	0.00	102	
Peters Creek at Ford	10/18/01	8.1	10.34	8	331.5	0.64	L	0.27	162	1
Peters Creek at Ford	12/6/01	6.6	12.18	8.2	304.4	1.24	L	0.00	18	1
Peters Creek at Ford	6/18/02	18	8.2	8.01	412.9	2.23	L	0.68	132	
Peters Creek at Ford	9/9/02	22.4	8.17	7.99	535	2.22	L	0.00	143	2
Peters Creek at Ford	9/13/02	18.6	8.88	8.11	505	1.96	L	0.00	8200	2
Peters Creek at Ford	9/20/02	22.3	8.02	8.02	491	1.78	L	0.00	440	2
Peters Creek at Ford	4/8/03	9.7	11.06	7.48	121.2	12	H	0.85	280	
Peters Creek at Ford	6/2/03	12.3	10.79	7.43	143.5	8.35	H	0.92	240	
Peters Creek at Ford	7/21/03	20.4	8.51	7.91	283.9	4.27	N	0.00	342	2
Peters Creek at Ford	7/21/03	20.4	8.51	7.91	283.9	4.27	N	0.00	110	
Peters Creek at Ford	9/12/03	16.9	9.24	7.83	335.6	1.91	L	0.00	840	2
Peters Creek at Ford	9/12/03	16.9	9.24	7.83	335.6	1.91	L	0.00	173	
Peters Creek at Ford	9/15/03	19.5	8.3	7.84	332.1	10.8	L	0.03	640	6
Peters Creek at Ford	9/15/03	19.5	8.3	7.84	332.1	10.8	L	0.03	920	2, 6
Peters Creek at Ford	9/29/03	13.9	9.74	7.87	272.4	1.44	L	0.10	63	5
Peters Creek at Ford	9/29/03	13.9	9.74	7.87	272.4	1.44	L	0.10	118	

Appendix 3. Gauley River National Recreation Area

Key to Comments-GARI	
1=FC/100 ml count is an estimate	89=White suds in side creek
2=Analyzed at AnaLabs	90=Light haze to water
5=Analyzed at REIC	91=Lots of kayakers playing in hydraulic
6=NERI FC is an estimate	92=Laurel Creek is dry
28=Discharge is USGS daily mean value	93=Discharge is USGS daily mean value for Belva gage
36=Actual Analabs FC is <18 FC/100 ml	94=Used 16:00 Belva gage reading
53=Actual FC was <.4 FC/100 ml	95=River level came up considerably before sampling
85=Summersville Lake 55ft below normal pool	96=Discharge 16:30 Belva gage reading
86=Releasing water	97=Discharge 15:30 Belva gage reading
87=Actual FC was < 20 FC/100 ml	98=Used 2 ml count
88=Actual Ecoli was < 2/100 ml	99=Conductivity recorded as 8.2 on field sheet

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As the nation’s principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.