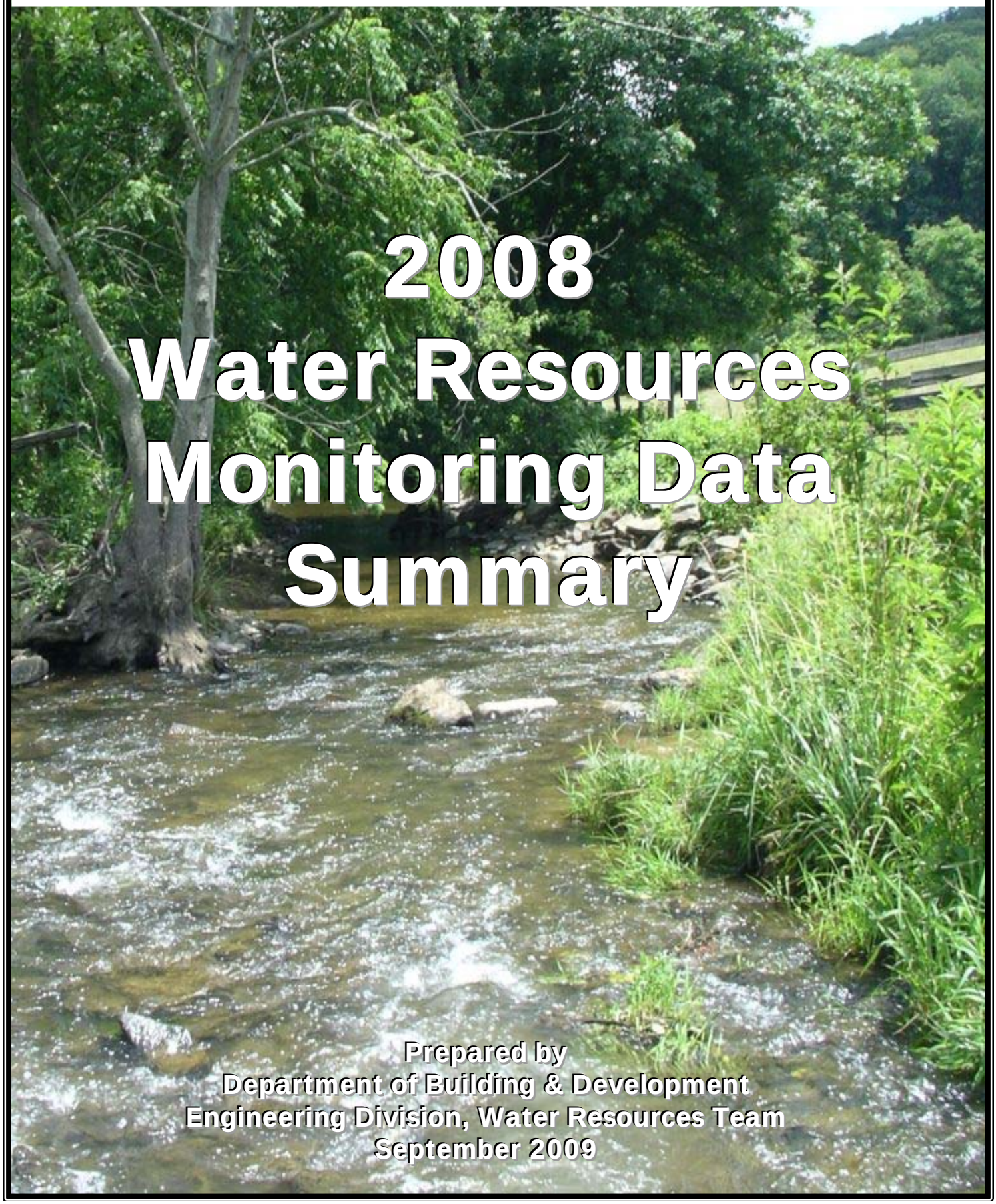
Loudoun County, Virginia



2008 Water Resources Monitoring Data Summary

Prepared by
Department of Building & Development
Engineering Division, Water Resources Team
September 2009

Loudoun County, VA
2008 Water Resources Monitoring Data Summary

ABBREVIATIONS AND ACRONYMS

cfs:	*cubic feet per second*
DEQ:	*Virginia Department of Environmental Quality*
EPA:	*U.S. Environmental Protection Agency*
MCL:	*maximum contaminant level*
mg/L:	*milligrams per Liter*
NWS-COOP:	*National Weather Service Cooperative monitoring station*
OWTS:	*On-site Wastewater Treatment System*
TDS:	*Total Dissolved Solids*
uS/cm:	*microSiemens per centimeter*
USGS:	*U.S. Geological Survey*
WRMP:	*Water Resources Monitoring Program (Loudoun County)*

DATA LIMITATIONS

While efforts have been made to insure the accuracy of the data presented in this report, Loudoun County does not assume any liability arising from the use of these data. Reliance on these data is at the risk of the user. The U.S. Geological Survey (USGS) and the National Climatic Data Center (who distribute National Weather Service data) have data quality assurance procedures in which data are considered "provisional" until they are checked and corrected as needed. Data used in this report that are provisional are:

- USGS rainfall site Limestone/Leesburg from 1/1/2004
- USGS rainfall site Catoctin/Lovettsville from 1/1/2005
- USGS well site Bull Run (USGS-03) from 10/15/2008
- USGS well site Leesburg (USGS-02) from 11/19/2008
- USGS well site Short Hill (USGS-01) from 11/18/2008
- USGS stream gauging station South Fork Catoctin Creek from 10/8/2008
- USGS stream gauging station Catoctin Creek (Taylorstown) from 10/1/2008
- USGS stream gauging station Piney Run from 12/9/2008
- USGS stream gauging station Beaverdam Creek from 10/9/2008
- USGS stream gauging station Goose Creek Middleburg from 10/9/2008
- USGS stream gauging station Goose Creek Leesburg from 10/1/2008
- NWS-COOP precipitation site The Plains 2NNE from 12/1/2008
- NWS-COOP precipitation site Sterling RCS from 12/1/2008
- NWS-COOP precipitation site Mount Weather from 12/1/2008
- NWS-COOP precipitation site Lincoln from 12/1/2008

ACKNOWLEDGMENTS

A grant from the U.S. Environmental Protection Agency supplemented County funds to establish portions of the monitoring sites and infrastructure identified in this report including some of the stream gauges, monitoring wells, and precipitation stations. The grant also reimbursed a portion of the cost associated with time County staff spent developing the Water Resources Monitoring Program including program planning and implementation, data collection, data management, and analyses.

This document was prepared by County staff members Glen Rubis, Scott Sandberg, David Ward, and Dennis Cumbie of the Water Resources Team in the Engineering Division of the Department of Building and Development.

INTRODUCTION AND SETTING

This document presents a summary of the data collected during various water resources monitoring activities in and adjacent to Loudoun County, Virginia, by government and volunteer organizations during calendar year 2008. More specifically, data characterizing precipitation, stream flow, groundwater levels, and surface water and groundwater quality are summarized. Loudoun County Department of Building and Development either collects these data or compiles them from other sources as part of the County's Water Resources Monitoring Program (WRMP). The data are presented and discussed in two sections: water quantity – measurements of precipitation, stream flows, and groundwater levels; and water quality – the chemical and biological characteristics of stream water and groundwater.

The WRMP was initiated in 2001 to help assess the conditions of water resources in Loudoun County which has been one of the fastest growing counties in the nation during the past 10 to 15 years. The current population of Loudoun is approximately 283,000 and is projected to nearly double by 2030.

General Characteristics of Loudoun County

Loudoun County is located in Northern Virginia approximately 30 miles west of Washington, D.C. The county covers an area of 520 square miles and is bordered on the north by the Potomac River and the west by the Blue Ridge Mountains (Figure 1).

Urban and suburban development is concentrated mostly in the eastern part of the county, generally from the Town of Leesburg to Washington Dulles International Airport and the border with Fairfax County. The western portion of the county is more rural, with crop farms, pastures, vineyards, several small towns, and numerous large-lot residential subdivisions.

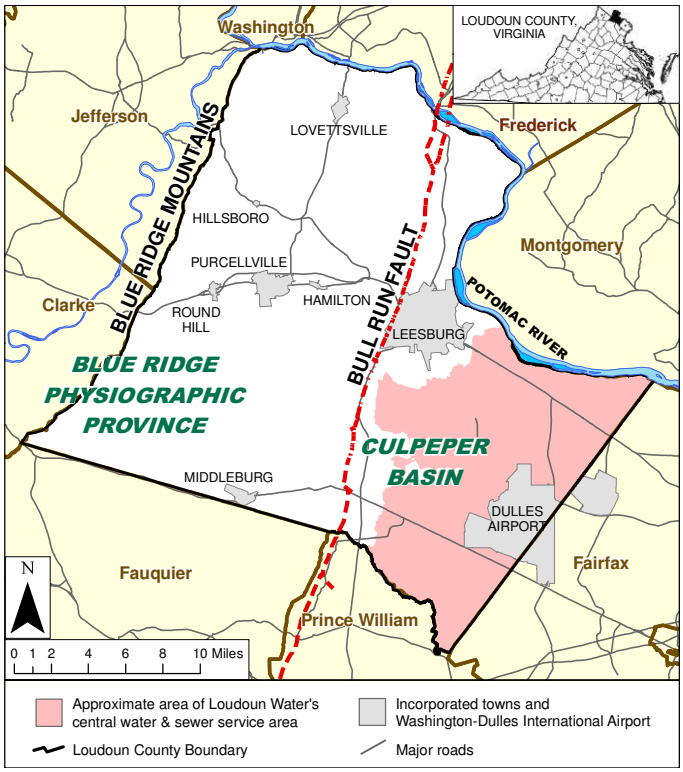


Figure 1. Major features of Loudoun County, VA.

Loudoun Water, an entity created by a resolution of the Loudoun Board of Supervisors in 1959 (see www.loudounwater.org), owns and operates a centralized water and sewer system that serves the developed area of eastern Loudoun as shown in Figure 1. Outside of Loudoun Water's central system area, county residents obtain water for drinking and other uses primarily from wells. In the rural towns and several of the subdivisions, sewage is treated in small wastewater treatment plants while the remaining single family homes and businesses have on-site individual wastewater treatment systems such as a septic tank with drain field.

Physiography and Geology

Loudoun County intersects two physiographic provinces which are separated by the Bull Run Fault (Figure 1). The fault separates the Culpeper Basin (a Triassic-age rift basin) of the Piedmont Province on the east from the Blue Ridge Province on the west. The Culpeper Basin is comprised of sedimentary rocks and sedimentary-derived metamorphic rocks, both which may include intrusions of dense, igneous diabase rock. The north-eastern area of the county, generally from the Town of Leesburg northward, is underlain by limestone conglomerate rock (the Leesburg Member of the Balls Bluff Siltstone) and has surface features and hydrogeology characteristic of karst areas. Western Loudoun is underlain by metamorphic rocks derived from both sedimentary and igneous parent material. Bedrock in the county is covered by regolith (unconsolidated sediments and soils) that is commonly between 20 and 50 feet thick, but ranges from 0 to more than 90 feet thick. Soils are generally less permeable in eastern Loudoun as compared to western Loudoun.

Watersheds

Watersheds are defined by topography and drain all of the surface water in an area to a single location such as a stream or lake. They are often used to delineate areas for monitoring, analyzing, and managing water resources. Watersheds can be defined at many different sizes and one of the watershed scales that is convenient for county-wide investigations in Loudoun is based on the 17 watershed areas shown in Figure 2. The majority of the county is covered by three major drainage areas that empty into the Potomac River by way of the following stream systems: Goose Creek, Catoctin Creek, and Broad Run.

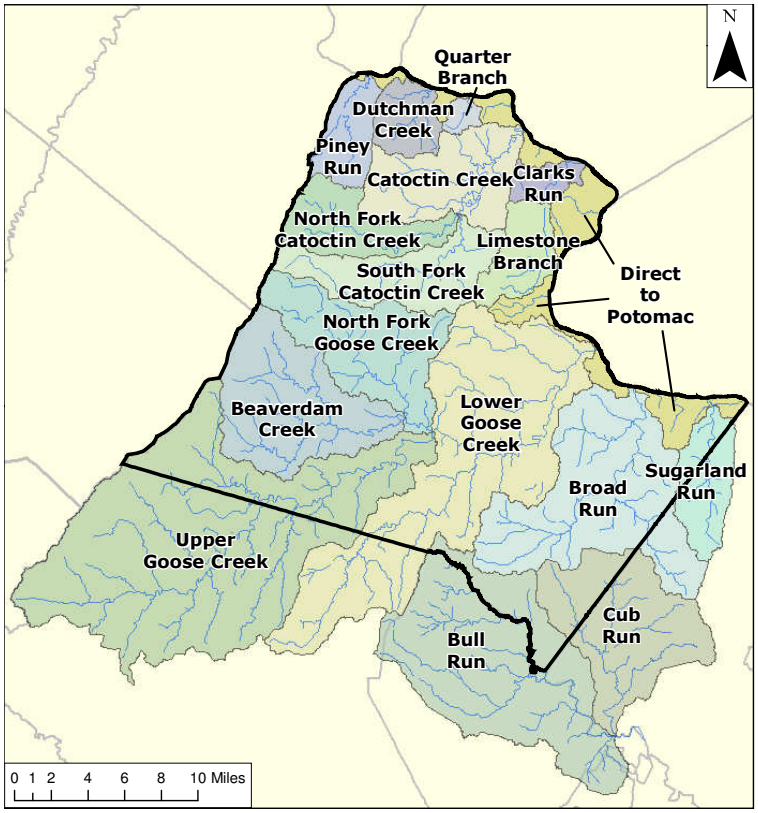


Figure 2. Watersheds and streams in and adjacent to Loudoun County, VA.

The eastern and southern borders of the county share watersheds with the neighboring counties of Fairfax, Prince William and Fauquier. The upper reaches of Broad Run and Sugarland Run watersheds lie to the east in Fairfax County and Goose Creek originates to the southwest in Fauquier County, but all three streams/watersheds drain into Loudoun County and, ultimately, the Potomac River.

The southeastern region of Loudoun includes the headwaters of Bull Run and Cub Run. These streams drain out of Loudoun County to the south and are tributaries to the Occoquan River which empties into the Potomac River.

WATER QUANTITY

This section presents information on the quantity of water resources with data on precipitation, stream flows, and groundwater levels in Loudoun County during calendar year 2008.

Precipitation

Total annual precipitation was above normal during 2008, with approximately 44 inches recorded at Dulles Airport. Precipitation data used in the WRMP are obtained from seven monitoring sites in or adjacent to the county (Figure 3). Five precipitation stations are part of the National Weather Service's cooperative monitoring network and two rain gauges are operated by the U.S. Geologic Survey (USGS). The National Weather Service sites have relatively long periods of record with one having nearly continuous data since 1930 (Table 1). The two USGS rain gauges have mostly continuous data records beginning in 2004.

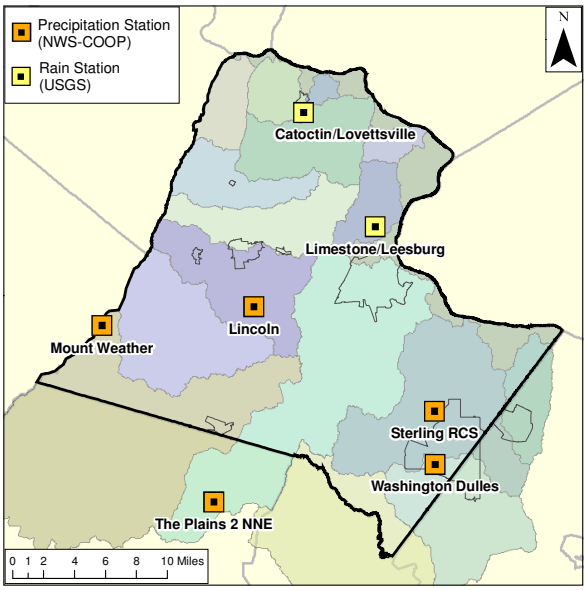


Figure 3. Precipitation monitoring sites.

Data from the long-term records indicate that annual precipitation has ranged from 20.4 inches (at the Lincoln station in 1930) to 67.7 inches (at the Sterling station in 2003). For the 30-year period 1978 through 2007, the normal (median) annual precipitation at the Dulles monitoring station was 40.0 inches. During 2008, precipitation recorded at the two stations with complete daily records was 44.0 and 45.4 inches (Table 1).

Table 1. Precipitation monitoring stations and data.

Precipitation Monitoring Station Name	Start of Record[1]	Station Operated by [2, 3]	Annual Statistics (Inches) for Period of Record[4]			2008 Total (Inches)	2008 Corrected[5] (inches)	Days missing in 2008
			Minimum	Median	Maximum			
Dulles	1964	NWS-COOP	27.0	38.9	65.7	44.0	44.0	0
Limestone Branch	2004	USGS	28.0	39.3	50.4	38.3	43.1	12
Lincoln	1930	NWS-COOP	20.4	41.3	63.5	42.4	48.8	24
Lovettsville	2005	USGS	30.3	40.4	45.4	35.2	36.4	8
Mt. Weather	1949	NWS-COOP	24.8	39.2	64.1	45.2	46.4	31
Sterling RCS	1978	NWS	30.2	40.5	67.7	46.8	46.8	1
The Plains	1955	NWS-COOP	27.7	41.4	63.1	45.4	45.4	0

[1] First full year that generally continuous data collection began.

[2] NWS-COOP = National Weather Service Cooperative weather station. USGS = U.S. Geological Survey.

[3] NWS-COOP stations record liquid and frozen precipitation; USGS stations record liquid precipitation only.

[4] Annual precipitation statistics based on site's period of available record through 2007 (see footnote 1).

[5] Missing daily data filled with the average of that day's data from the remaining active precipitation sites.

Figure 4 presents annual precipitation data from the Dulles station from 1978 through 2008. Figure 5 shows 2008 monthly precipitation at the Dulles station in relation to monthly data for the 30-year period from 1978 through 2007. In general, 2008 started out relatively dry, but a wet April, May, and September resulted in above normal precipitation for the year.

Loudoun County experienced several large precipitation events during 2008. In particular, storms on April 20 and 21, May 8 through 12, and September 5 and 6 produced a total of 16.35 inches of rainfall at the Dulles station with the storm event in May dropping 7.11 inches of rain over the 5-day period. A graph of daily precipitation is shown in Figure 6.

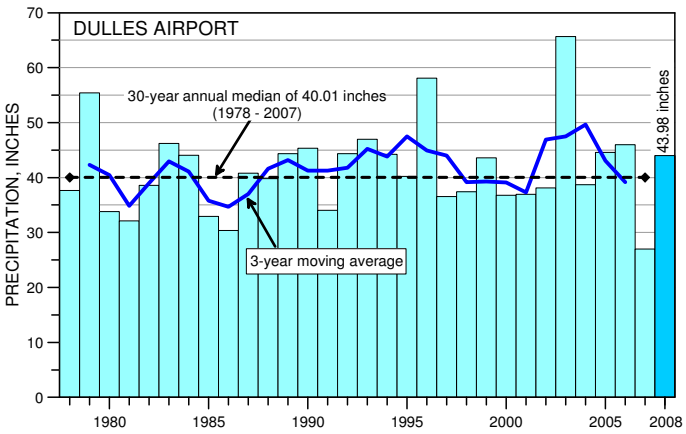


Figure 4. Annual precipitation at Dulles Airport from 1978 through 2008.

The 3-year moving average plot above is useful to smooth out yearly fluctuations and show somewhat longer trends of precipitation deficits and surpluses (compared to the median) which can indicate stresses on water supplies and the environment.

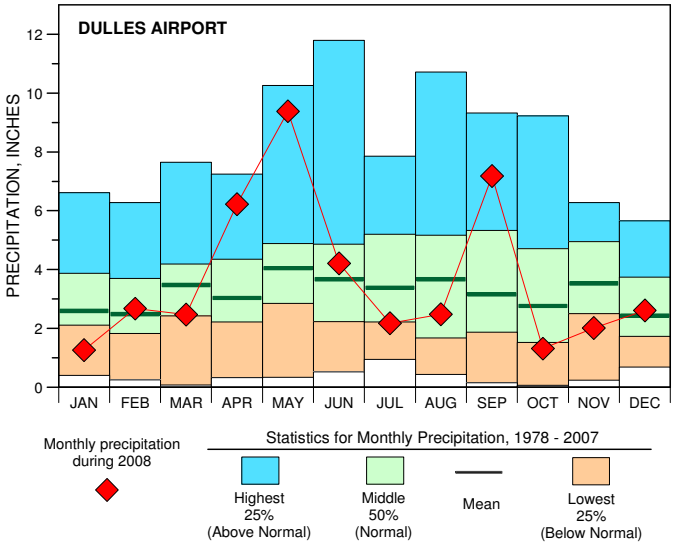


Figure 5. Monthly precipitation at Dulles Airport.

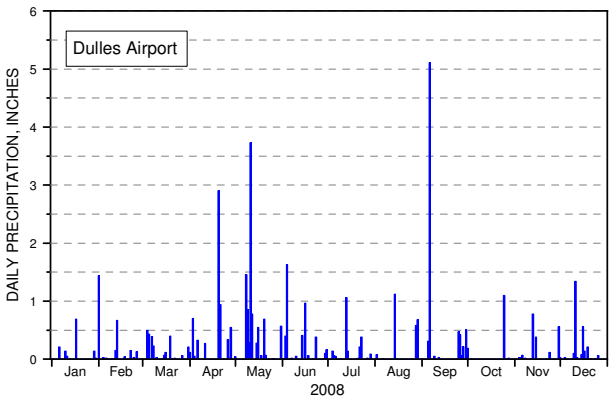


Figure 6. Daily precipitation at Dulles Airport during 2008.

Measurable precipitation was reported on 118 days during 2008 at the Dulles station. For those days with reported precipitation, the average accumulation was 0.37 inches and the median was 0.14 inches.

Streamflow

At the streamflow monitoring sites in Loudoun, average flow rates during 2008 were generally below normal, but minimum flows during 2008 were higher than the minimum flows recorded from 2002 through 2007.

Loudoun County has more than 1,000 miles of perennial stream channels (flow all year long) and an additional 800 miles of intermittent stream channels (flow primarily during wet periods). Knowing how much water flows in the larger perennial streams and how it varies over both short and long time periods is use-

ful in the assessment of flood control, stormwater structures, and environmental conditions. There are ten USGS stream gauges that measure and record water stage (level) in Loudoun County streams (Figure 7).

Measured water levels at each gauging station are reported via telemetry to the USGS, correlated to historical site-specific stream discharges (flows), and the data made available in near real-time with updates every 15 minutes on their web site (http://va.water.usgs.gov/Loudoun/data.htm).

The stream gauge stations are routinely checked and calibrated by the USGS to maintain accuracy but the data are considered provisional until passing the USGS's quality control process.

A review of the 2008 gauging data indicates that, while stream flows were within normal ranges throughout most of the year, flows during portions of the year were also below or above normal. Loudoun County experienced large storm events in April, May, September and December and the resulting stormwater runoff produced pronounced spikes in the flow hydrographs during these times. Figure 8 illustrates the flow of Goose Creek near Route 621 during 2008. Goose Creek, the County's largest stream, flows through the county from its headwaters in Fauquier County to the Potomac River. Hydrographs from Beaverdam Creek and Limestone Branch also showed pronounced low flow periods in January, August, and October. Table 2 lists the ten gauging stations in the county along with selected data statistics. All of the maximum flow rates for 2008 occurred on May 12 and the majority of low flows occurred near the end of August. Frequent very high and extended very low flows can be stressful on stream habitats and riparian communities.

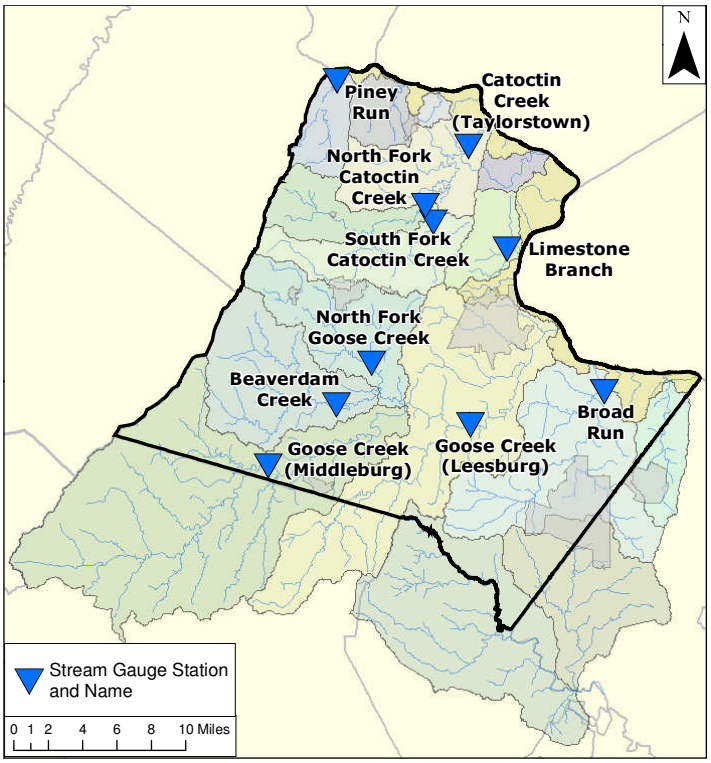


Figure 7. Locations of stream gauging stations.

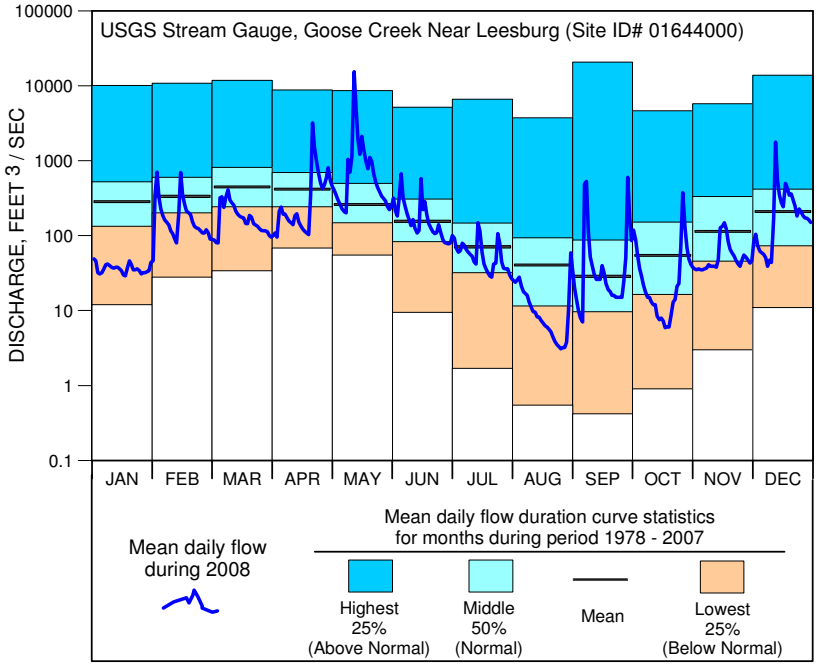


Figure 8. Stream discharge hydrograph for Goose Creek during 2008.

Table 2. Stream gauging stations and basic statistics.

Stream Gauge Site Name	Start of Record	Drainage Area[1] (sq. miles)	2008 Avg[2] (cfs)	'02-'07 Avg[3] (cfs)	2008 Min[4] (cfs)	'02-'07 Min[5] (cfs)	2008 Peak[6] (cfs)	'02-'07 Peak[7] (cfs)	2008 0 Flow[8] (days)	'02-'07 0 Flow[9] (days)
Beaverdam Creek	Jul 2001	47.2	34.7	56.3	0.0	0.0	2640	5000	26	118
Broad Run	Oct 2001	76.1	148.0	123.9	9.2	1.6	10300	5510	0	0
Catoctin Creek - Taylorstown	Oct 1970	89.5	90.8	107.2	2.8	0.1	6770	5400	0	22
Goose Creek - Leesburg	Jul 1909	332.0	237.6	396.6	3.4	1.2	15400	20800	0	0
Goose Creek - Middleburg	Oct 1965	122.0	92.0	143.9	1.0	0.0	4600	14000	0	55
Limestone Branch	Aug 2001	7.9	7.5	9.5	0.7	0.5	449	976	0	0
North Fork Catoctin Creek	Jul 2001	23.1	22.0	25.1	1.2	0.0	1190	1060	0	51
North Fork Goose Creek	Jul 2001	38.1	29.9	58.5	1.3	0.3	2040	3040	0	0
Piney Run	Oct 2001	13.5	12.3	14.9	1.3	0.0	488	436	0	17
South Fork Catoctin Creek	Jul 2001	31.6	31.7	37.5	1.5	0.0	1920	1840	0	33

[1] Drainage area above the stream gauge (square miles)

[2] Average daily flow rate during 2008 (ft^3/sec)

[3] Average daily flow rate for the period of 2002–2007 (ft^3/sec)

[4] The lowest 7-day average flow rate during 2008 (ft^3/sec)

[5] The lowest 7-day average flow rate for the period of 2002–2007 (ft^3/sec)

[6] Peak daily flow rate during 2008 (ft^3/sec)

[7] Peak daily flow rate for the period of 2002–2007 (ft^3/sec)

[8] Number of consecutive days with flow <0.2 cfs during 2008

[9] Number of consecutive days with flow < 0.2 cfs for the period 2002-2007

Groundwater Levels and Wells

Groundwater levels during 2008 were generally within the normal range of long-term recorded levels. There are approximately 14,000 active residential wells throughout Loudoun County and groundwater is the primary source of drinking water for the majority of residents in western Loudoun. In 2008, groundwater levels were recorded throughout the year in 11 dedicated monitoring wells at the sites shown in Figure 9. Eight of these wells were monitored by County staff from the Department of Building and Development and three were monitored by the USGS. Groundwater level data have been collected from the three USGS wells since the late 1960s or early 1970s. Table 3 shows well and groundwater level data from these monitoring wells.

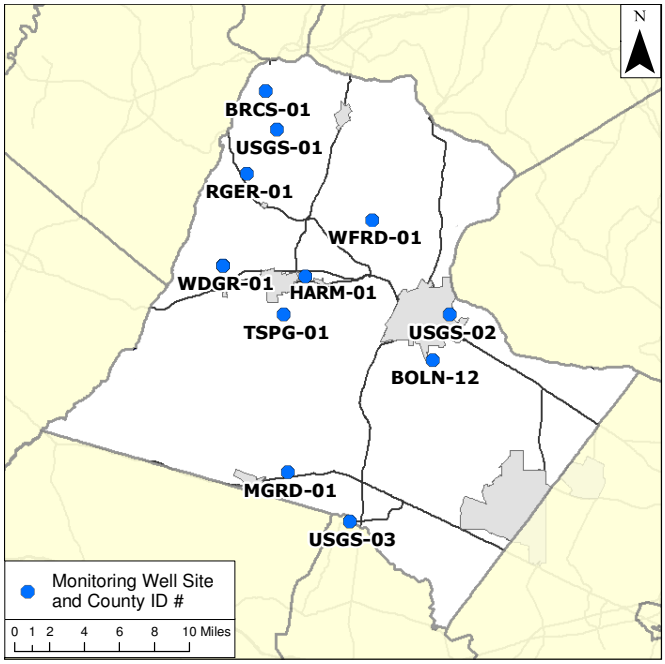


Figure 9. Locations of groundwater monitoring wells.

Figure 10 shows hydrographs for selected monitoring wells that are representative of groundwater levels for the years 2006 through 2008. Groundwater levels began 2008 at levels lower than normal because of low precipitation during the second half of 2007. However, with increased precipitation in April and May of 2008, groundwater levels recovered to more typical ranges.

Table 3. Monitoring well and groundwater level data.

Well Site ID (see map for location)	Monitoring Organization	Well Depth (feet)	Rock Type	Period of Record	Groundwater Level (feet)[1]			
					Historic High	2008 High	Historic Low	2008 Low
USGS-01	USGS	516	Meta-conglomerate/ metasiltstone	8/1969 - Present	51.67	50.34	61.5	61.97
USGS-02	USGS	535	Fluvial, deltaic sandstone	10/1977 - Present	25.93	19.73	41.52	30.56
USGS-03	USGS	165	Siltstone/sandstone	11/1968 - Present	6.73	6.59	13.09	11.54
BOLN-12	Loudoun	515	Fluvial, deltaic sandstone	12/2006 - Present	6.4	7.44	12.8	12.8
BRCS-01	Loudoun	320	Igneous intrusive	12/2007 - Present	21.43	21.43	30.66	30.66
HARM-01	Loudoun	945	Plutonic igneous intrusive	2/2005 - Present	35.14	36.87	54.99	49.67
MGRD-01	Loudoun	400	Plutonic igneous intrusive	12/2007 - Present	-2.67	-2.67	7.11	7.11
RGER-01	Loudoun	700	Igneous intrusive	2/2005 - Present	29.81	30.98	54.45	54.45
TSPG-01	Loudoun	360	Plutonic igneous intrusive	2/2005 - Present	65.93	69.92	82.1	80.98
WDGR-01	Loudoun	940	Mafic igneous intrusive	3/2005 - Present	8.96	9	22.4	21.63
WFRD-01	Loudoun	400	Plutonic igneous intrusive	11/2002 - Present	8.42	11.3	29.68	29.68

[1] Feet below ground surface. Negative number indicates feet above ground surface (flowing artesian condition).

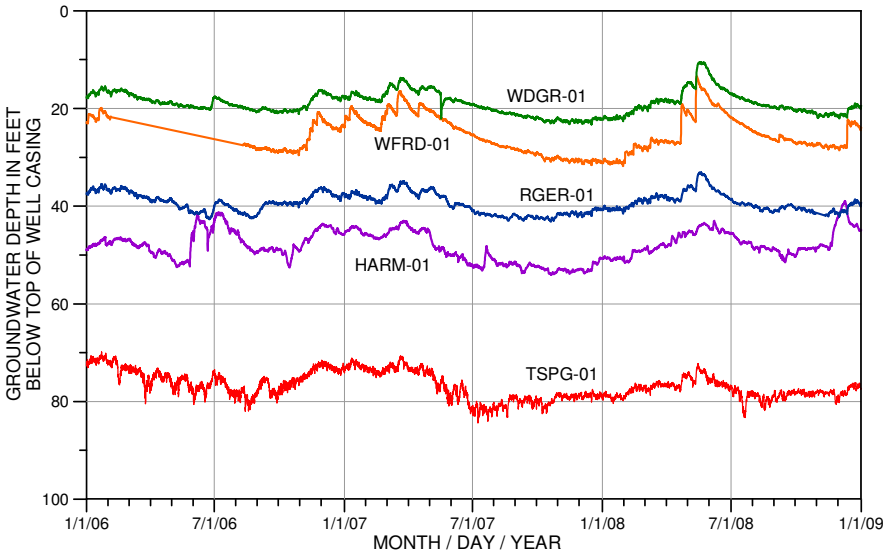


Figure 10. Groundwater levels from County WRMP monitoring wells with at least three years of monitoring data.

The depth from land surface to groundwater varies in different locations of the county primarily due to the local topography and geology. Throughout a normal year, groundwater levels generally rise in the winter and spring and drop in the summer and fall. This occurs because rainfall is distributed fairly evenly throughout the year, but evapotranspiration (evaporation of surface moisture and transpiration of water from plants) is high in the warm months and low during the cool months. With less water lost to evapotranspiration in the fall and winter, the groundwater system receives more recharge water and groundwater levels rise.

Short-term natural increases in groundwater levels occur because of recharge from precipitation. In the absence of additional recharge from precipitation and outside influences such as nearby pumping, groundwater levels typically exhibit a steady, slow decline over time after rain events. Figure 11 is a hydrograph from a monitoring well during 2008 with daily precipitation also plotted to show the effects of precipitation on groundwater levels.

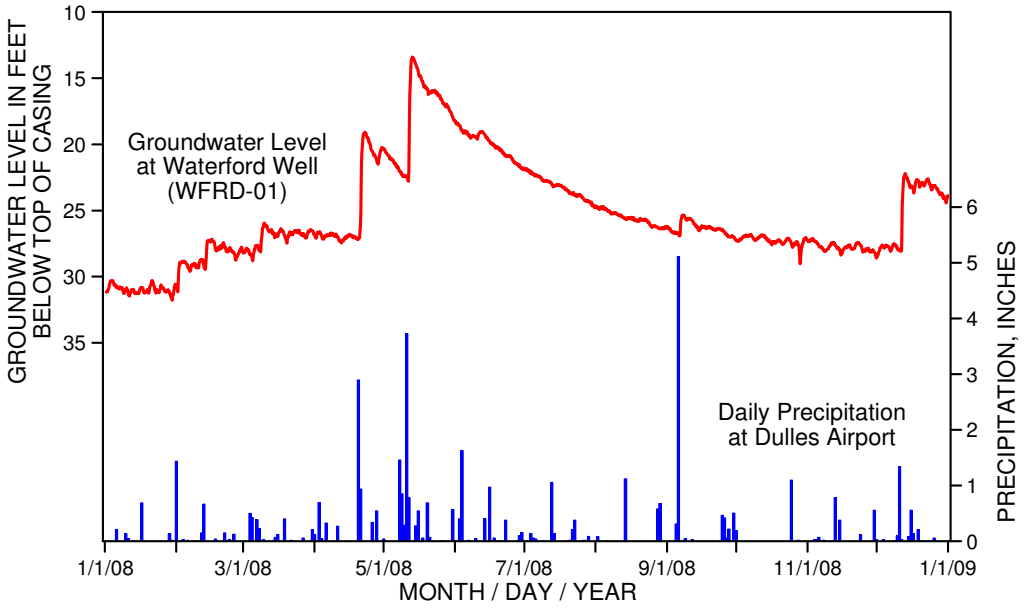


Figure 11. Daily precipitation and groundwater level changes during 2008.

During 2008, 179 new water wells were constructed. Figure 12 presents the number of wells drilled each year since 1978. The installation of new wells is primarily driven by the pace of residential construction and zoning changes affecting residential development potential. The median total depth of wells installed in 2008 was 420 feet and the median estimated yield (based on air-lift pumping) was 13 gallons per minute. The median total depth and median estimated yield of wells installed during the previous 10 years was 400 feet and 10 gallons per minute, respectively. These differences in depths and yields are not considered indicative of changes to groundwater availability.

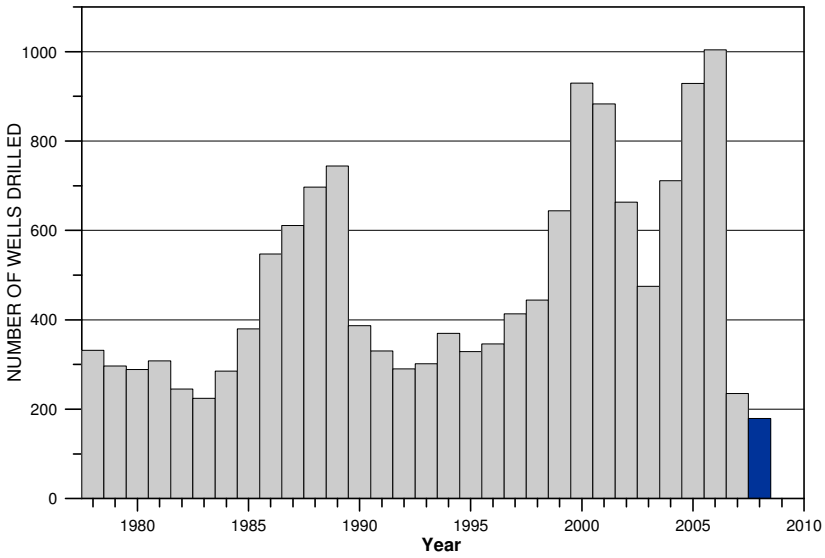


Figure 12. Number of wells constructed in Loudoun County between 1978 and 2008.

WATER QUALITY

The quality of surface water in Loudoun County was quantified in 2008 using several metrics including chemical, microbiological, and benthic macroinvertebrates. Groundwater quality was assessed through chemical and bacteria analyses conducted on well water samples. Monitoring results from each of these data types are discussed below.

Surface Water Chemistry

Chemical sampling and analysis of surface water in 2008 was primarily conducted by the Virginia Department of Environmental Quality (DEQ) as part of their state-wide surface water quality sampling program (see http://www.deq.state.va.us/watermonitoring/). In 2008, DEQ collected samples from approximately 26 sites in Loudoun County and all analytical results were within acceptable ranges.

Nutrients are of particular interest because of their detrimental effect at elevated concentrations on the Chesapeake Bay. Table 4 shows results of sampling by DEQ for nitrogen and phosphorus in surface waters in the county during 2008 and during the period 1999 through 2007.

Table 4. Nitrogen and phosphorus in surface waters.

Basic Statistic	Total Nitrogen		Total Phosphorus	
	1999-2007	2008	1999-2007	2008
# Samples	626	52	1136	46
Minimum	0.10	0.25	0.01	0.01
Maximum	4.09	2.84	3.6	0.15
Mean	1.26	1.20	0.06	0.04
Median	1.20	1.10	0.04	0.03

All concentrations in milligrams per liter

EPA guidance criteria for Virginia Region 9 is 0.69 mg/L for Total Nitrogen and 0.037 mg/L for Total Phosphorus.

Surface Water Microbiology

The primary microbiological area of concern for surface water relates to pathogens that may adversely affect human health. An accepted practice to test for pathogens from human and warm-blooded animal waste is to test water for ***Escherichia coli*** (E. coli) bacteria as an indicator of waste contamination. One of the criteria used by the U. S. Environmental Protection Agency (EPA) for E. coli is if the water is considered safe for humans after casual contact. This criterion is identified by EPA as "recreational use" and includes activities such as fishing and boating.

In 2008, DEQ collected and analyzed approximately 70 samples in Loudoun County and found that approximately 24 percent were above the recreational limit of 235 E. coli colonies per 100 milliliters. These sampling results were similar to those conducted in Loudoun County in previous years. Stream segments that are tested and exceed the recreational use criteria are identified as "impaired" by EPA. Several programs are in place to reduce bacterial contamination in the impaired surface waters of Loudoun County including initiatives to repair or upgrade on-site wastewater treatment systems (e.g., septic systems and drain fields), reduce pet waste, and fence livestock out of streams.

Stream water sampling in the Catoctin watershed by citizen volunteers (Loudoun Watershed Watch) has resulted in almost 1,000 bacteriological samples collected and analyzed over the past 4 years, of which almost 40 percent were above the recreational use limit for E. coli. These data indicate that microbiological contamination is highly variable, but generally increases with stormwater runoff.

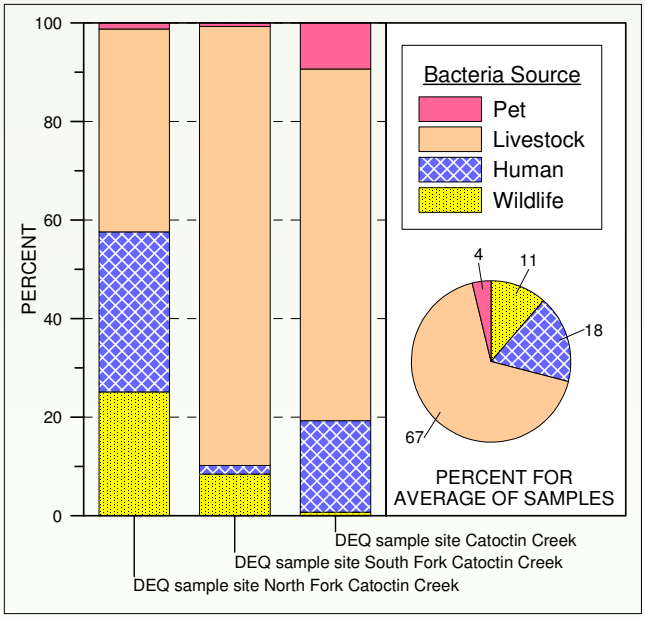


Figure 13. Bacteria sources in stream water samples.

DEQ conducted a year-long study in the Catoctin watershed during 2008 to determine the source of waste responsible for the bacteria contamination. They sampled three stream segments, one each in the North Fork, South Fork, and lower Catoctin creeks. Specialized laboratory analyses were used to determine what kind of warm-blooded animals produced the waste responsible for the E. coli found in the samples. Figure 13 illustrates that waste sources are distributed between pet, livestock, wildlife, and human. Although the proportions are variable, livestock is generally the largest contributor with human sources generally second.

Benthic Macroinvertebrates

Benthic macroinvertebrates are stream bottom-dwelling invertebrate organisms (mostly insect larvae) that can be seen without magnification. Their tolerance of poor water quality varies depending on the species and, as a result, these organisms are used as indicators of water quality.

Sampling a stream for benthic macroinvertebrates usually involves collecting all the organisms within a small area of the stream bottom, identifying the types of organisms collected to the order or family taxa level, and counting the number of each type. These results are then converted to a "macroinvertebrate score" which is used to qualitatively grade the water quality at one of several levels ranging from excellent to poor. In 2008, two techniques were used to evaluate the benthic macroinvertebrate populations: the Virginia Stream Condition Index (VA SCI) used by DEQ and the Virginia Save Our Streams (VA SOS) index used by several citizen volunteer organizations in and adjacent to the county. In 2008, DEQ sampled 11 locations in Loudoun and calculated VA SCI scores which ranged from severely stressed to excellent. Figure 14 illustrates the average stream conditions from 45 samples obtained at 18 locations by DEQ during 2007 and 2008.

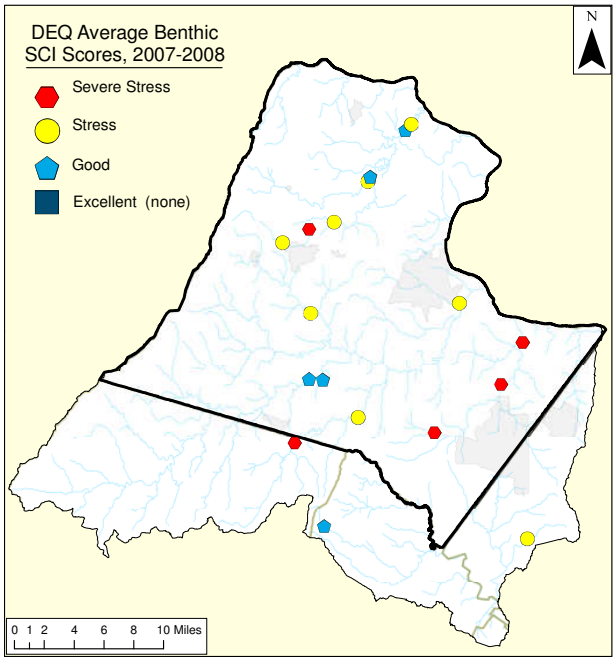


Figure 14. Benthic monitoring results by DEQ in 2007 and 2008

Several volunteer organizations work within the watersheds of the county to collected benthic macroinvertebrate data. In 2008, the volunteer organizations Loudoun Wildlife Conservancy, Goose Creek Association and other groups collected samples from approximately 44 locations using the VA SOS methodology. Results ranged from acceptable to unacceptable. Figure 15 illustrates the average VA SOS scores from 2007 and 2008.

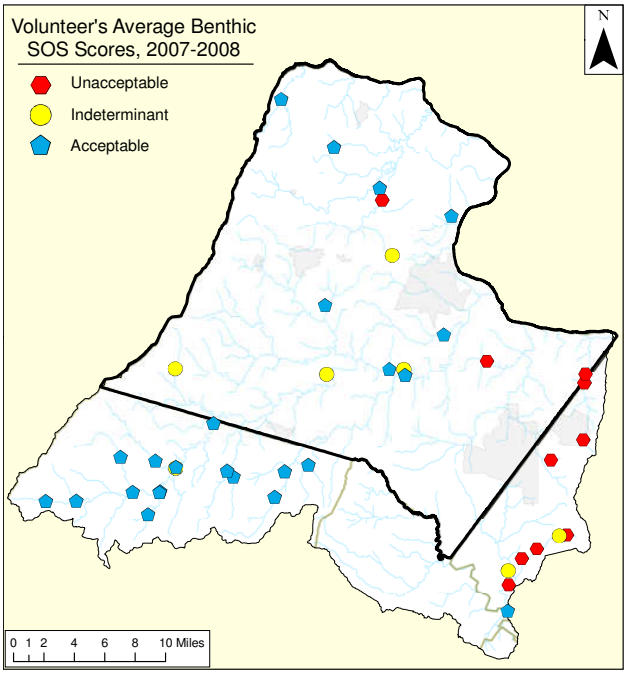


Figure 15. Benthic monitoring results by volunteers in 2007 and 2008

Stream Impairments

Each year, DEQ tests a statistically significant fraction of Virginia's rivers, lakes, and tidal waters as part of their water quality assessment. Over 130 different pollutants are monitored to determine whether the waters can be safely used for swimming, fishing and drinking. Waters that do not meet standards are reported to EPA in the Clean Water Act 303(d) Impaired Waters Report. DEQ has developed lists of impaired waters every even calendar year since 1992. In Loudoun County, DEQ water quality impairments have included:

- recreational/swimming (bacteria)
- aquatic life (benthic macroinvertebrates)
- fishing/consumption (tissue analysis)

In the report released in 2008, there were 13 new impaired stream segments in Loudoun County totaling 43 stream miles. This increased the existing 158 miles of impaired streams by 27 percent. Figure 16 and Figure 17 illustrate the impairments for recreational/swimming and aquatic life uses, respectively. New impairments for aquatic life use slightly exceeded those for recreational/swimming use. Based on past testing results, it is likely that testing in stream segments that were not previously sampled will lead to new impairments listed in 2010.

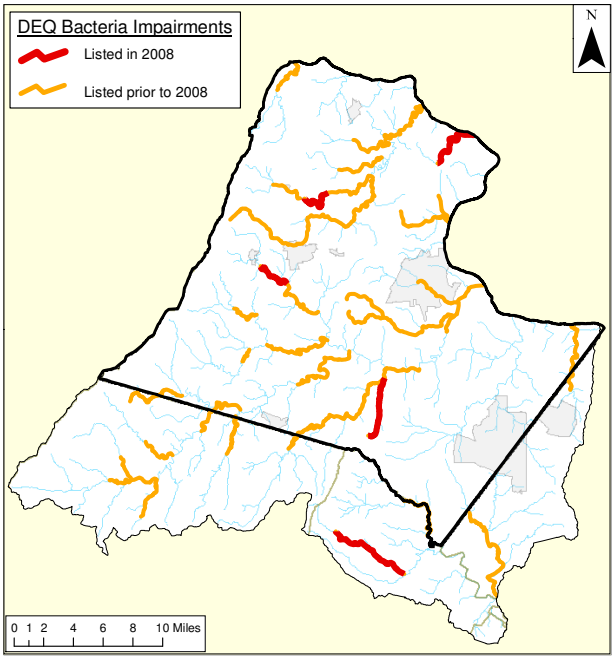


Figure 16. Recreational/swimming use (bacteria) impaired stream segments added in 2008

Groundwater Quality

Groundwater is the source of drinking water for most of Loudoun County outside of Loudoun Water's central service area and the Town of Leesburg. Information on groundwater quality is obtained from several sources. Before new potable water wells can be used, they must be tested and pass drinking water quality standards for a wide range of chemical parameters listed by the County Health Department. In 2008, groundwater samples collected and analyzed from new wells were generally consistent with historical data (Table 5). There are some areas of the county that have elevated levels of iron and manganese which are aesthetic contaminants and do not adversely affect human health at the concentrations found in the county. In general, the county has excellent groundwater quality.

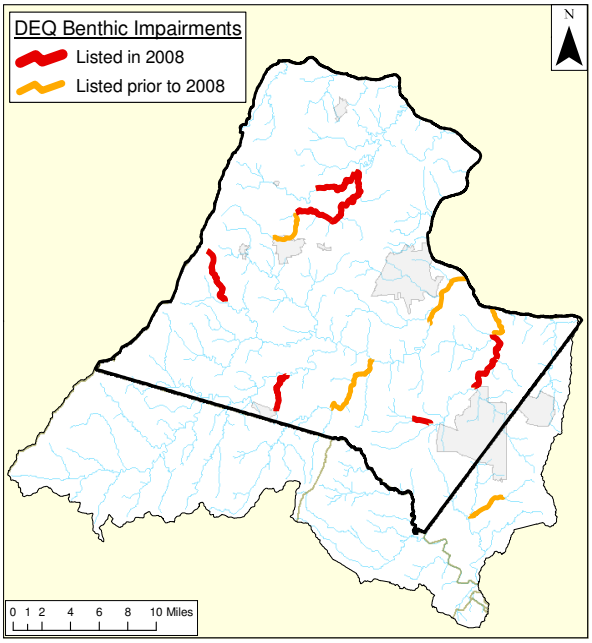


Figure 17. Aquatic life use (benthic macroinvertebrates) impaired stream segments added in 2008.

Table 5. Statistics for selected groundwater chemistry parameters.

Analyte	MCL(mg/L)	Samples		# above MCL	% above MCL
pH	<6.5 or >8.5*	*All*	2690	301	11.2
		2008	69	11	15.9
Nitrate	10	*All*	2765	15	0.5
		2008	145	0	0
Sulfate	250	*All*	2765	7	0.2
		2008	145	0	0
Lead	0.015	*All*	2766	27	0.9
		2008	145	0	0
Fluoride	4	*All*	2765	4	0.1
		2008	148	0	0
Benzene	0.005	*All*	2765	0	0
		2008	146	0	0
Toluene	1	*All*	2766	1	0.03
		2008	146	0	0
Ethylbenzene	0.7	*All*	2765	0	0
		2008	145	0	0
Xylene	10	*All*	2766	0	0
		2008	146	0	0
Arsenic	0.01	*All*	2770	14	0.5
		2008	145	0	0
Manganese	0.05**	*All*	2765	1795	64.8
		2008	145	62	45.7
Iron	0.3**	*All*	2765	1960	70.9
		2008	145	66	45.5
TDS	500**	*All*	2765	12	0.4
		2008	146	2	1.4

* Standard pH units.
** Secondary Maximum Contaminant Level for taste, color, and odor.

As part of the WRMP, nine monitoring wells were sampled for a variety of chemical parameters. A list of the analytes which were detected is shown in Table 6. The results were consistent with historic findings with two samples exceeding the secondary maximum contaminant limit (SMCL) for iron (0.3 mg/L) and six samples exceeding the SMCL for manganese (0.05 mg/L).

There are a few isolated spots in the county where serious groundwater contamination is known to exist, the most notable being Hidden Lane Landfill in northeast Loudoun, which was placed on EPA's National Priorities List (i.e., superfund site) in 2008. (For additional information on the Hidden Lane Landfill, see www.loudoun.gov/tce.) The most prevalent sources of potential groundwater pollution are the on-site wastewater treatment systems (OWTS) serving homes and small businesses in the rural areas of the county. There are approximately 14,500 active OWTSs in the county and during 2008, about 200 new OWTSs were in-

stalled. An OWTS that is properly installed and regularly serviced should not pose a threat to groundwater quality. However, improper OTWS installation or maintenance can cause wastewater to be untreated or undertreated and lead to groundwater or surface water contamination. Because OWTS are typically used in areas with private water wells, it is important to properly maintain the OWTS and regularly have the well water sampled and tested to assure that it is safe to drink.

Table 6. Groundwater sampling data from WRMP monitoring wells.

Well ID	Temperature (ºC)	pH (std units)	Specific Conductance (uS/cm)	Iron (mg/L)	Manganese (mg/L)	Alkalinity (mg/L)	Chloride (mg/L)	Hardness (mg/L)	TDS (mg/L)	Sulfate (mg/L)
RGER-01	14.3	8.15	383	ND	0.095	88	48	140	180	14
WDGR-01	14.6	8.17	233	0.08	0.065	100	7	92	120	10
HARM-01	14.6	7.24	175	0.4	0.078	80	7	64	96	10
TSPG-01	13.9	7.76	260	ND	0.061	98	15	110	140	16
WFRD-01	14.6	7.1	246	0.26	0.089	70	17	91	110	15
BRCS-01	16.1	8.38	194	0.1	0.023	80	ND	55	84	6
MGRD-01	16.9	8.08	300	0.8	0.061	140	ND	140	140	ND

ND = below detection limit uS/cm = microSiemens per centimeter TDS = Total Dissolved Solids

OUTLOOK FOR 2009

In 2009, Loudoun County Department of Building & Development will be completing several major tasks as part of the final year of an EPA grant that has helped establish the WRMP. These tasks include:

County-wide Stream Assessment

An assessment of streams will be conducted at numerous locations across the county based on three fundamental types of stream data:

- benthic macroinvertebrates,
- stream habitat conditions, and
- the boundary between perennial and intermittent streams.

Groundwater Sampling

The county has extensive groundwater chemical data collected as part of the permitting process of new wells, however, there are almost no chemical data collected on wells after they pass the Health Department permit requirements and water quality in older wells is poorly known. In 2009, County staff will start to fill in that gap by requesting permission to sample existing residential wells based on a targeted and probabilistic selection methodology. In addition, sampling will be conducted at several of the county's dedicated groundwater monitoring wells as part of the continuing WRMP work.

Additional Groundwater Monitoring Wells

Continued expansion of the groundwater monitoring well network is planned with additional wells acquired through the well use donation process and by drilling wells at specific locations. Water level data recorders will be placed in the new monitoring wells to record groundwater levels over time.

Additional information on water resources in Loudoun County may be found on the County's web site at: ***www.loudoun.gov/bd***