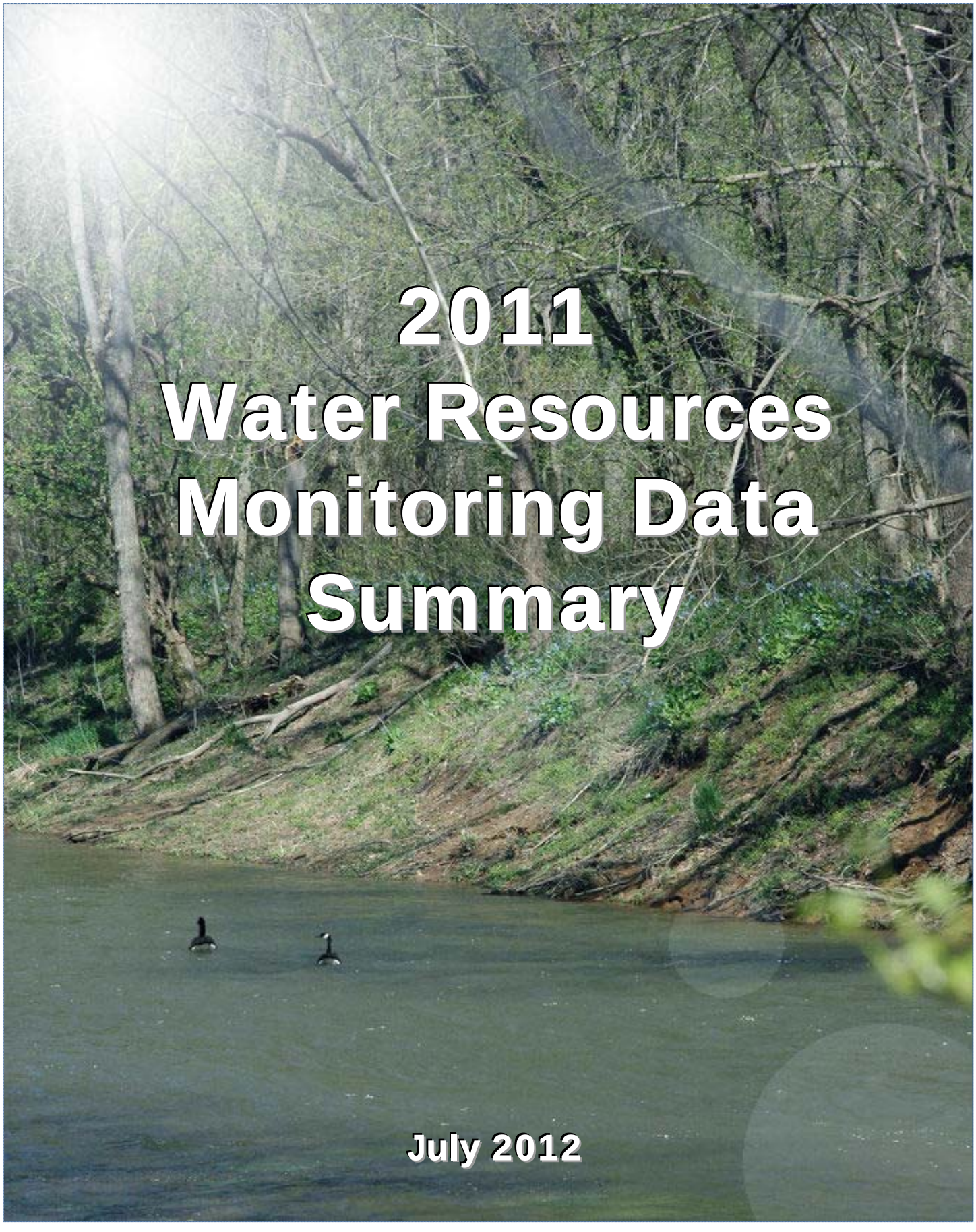
Loudoun County, Virginia



2011 Water Resources Monitoring Data Summary

July 2012

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Water Resources Monitoring Data Summary

Loudoun County, Virginia
Department of Building and Development
Engineering Division
Water Resources Team

July 2012

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)*
NWS:	*National Weather Service (Division of National Oceanographic and Atmospheric Administration)*

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, 1/1/2004 - 12/31/2011
- USGS rainfall site Catoctin/Lovettsville, 1/1/2005 - 12/31/2011
- USGS stream gaging station North Fork Catoctin Creek, 10/4/2010 - 12/31/2011
- USGS stream gaging station Goose Creek (Middleburg), 11/01/2010 - 12/31/2011
- USGS stream gaging station North Fork Goose Creek, 11/01/2010 - 12/31/2011
- USGS stream gaging station Beaverdam Creek, 1/1/2011 - 12/31/2011
- USGS stream gaging station Broad Run, 3/1/2011 - 12/31/2011
- USGS stream gaging station Goose Creek (Leesburg), 10/3/2011 - 12/31/2011
- USGS stream gaging station Catoctin Creek (Taylorstown), 10/4/2011 - 12/31/2011
- USGS stream gaging station Limestone Branch, 10/17/2011 - 12/31/2011

HYPERLINKS

The underlined text in this document indicates hyperlinks to additional data and online resources that may be accessed when this document is opened in a program designed to view portable document format (pdf) files. The report can be found at www.loudoun.gov/watermonitoring and follow the link to Data Analysis & Reporting.

ACKNOWLEDGMENTS

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

Loudoun County, VA
2011 Water Resources Monitoring Data Summary

Table of Contents

INTRODUCTION AND SETTING

This document summarizes data collected during various water resources monitoring activities in and adjacent to Loudoun County, Virginia, by government, private and volunteer organizations during calendar year 2011. Specifically, data characterizing precipitation, stream flow, groundwater levels, and surface water and groundwater quality are presented. 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 decade. The estimated population of Loudoun in 2011 is nearly 320,000 and is forecasted to reach almost 460,000 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 521 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.

Loudoun Water, formerly known as the Loudoun County Sanitation Authority, owns and operates a centralized water and sewer system that serves the developed area of eastern Loudoun as shown in Figure 1. The Town of Leesburg provides treated Potomac River water to residents inside the Town limits, and to several residential areas adjacent to its eastern boundary. Outside of the Leesburg and Loudoun Water central service areas, county residents obtain water primarily from wells. In the rural towns and several of the subdivisions, water may come from small communal water systems and sewage is treated in small waste-water treatment plants. The remaining single-family homes and businesses have on-site individual wastewater treatment systems.

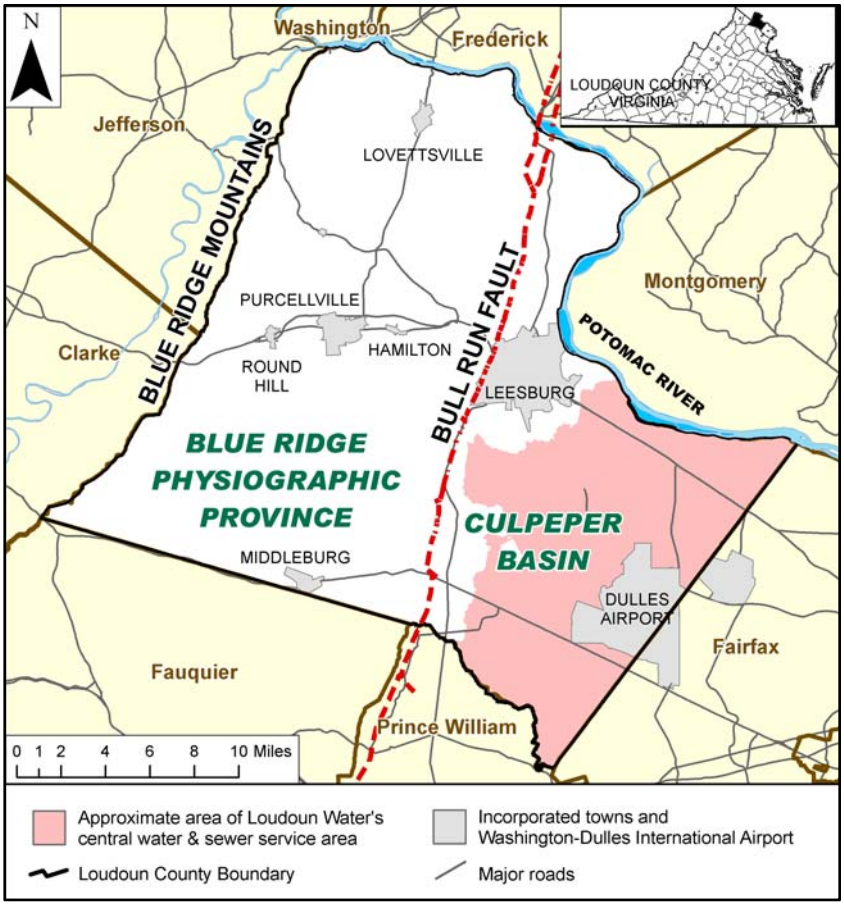

Figure 1. Major features of Loudoun County, VA.

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 the surface features and hydrogeologic characteristics of a karst environment. 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 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 scales but the watershed scale that is most 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.

The eastern and southern borders of the county share watersheds with the neighboring Virginia 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 eventually discharges into the Potomac River.

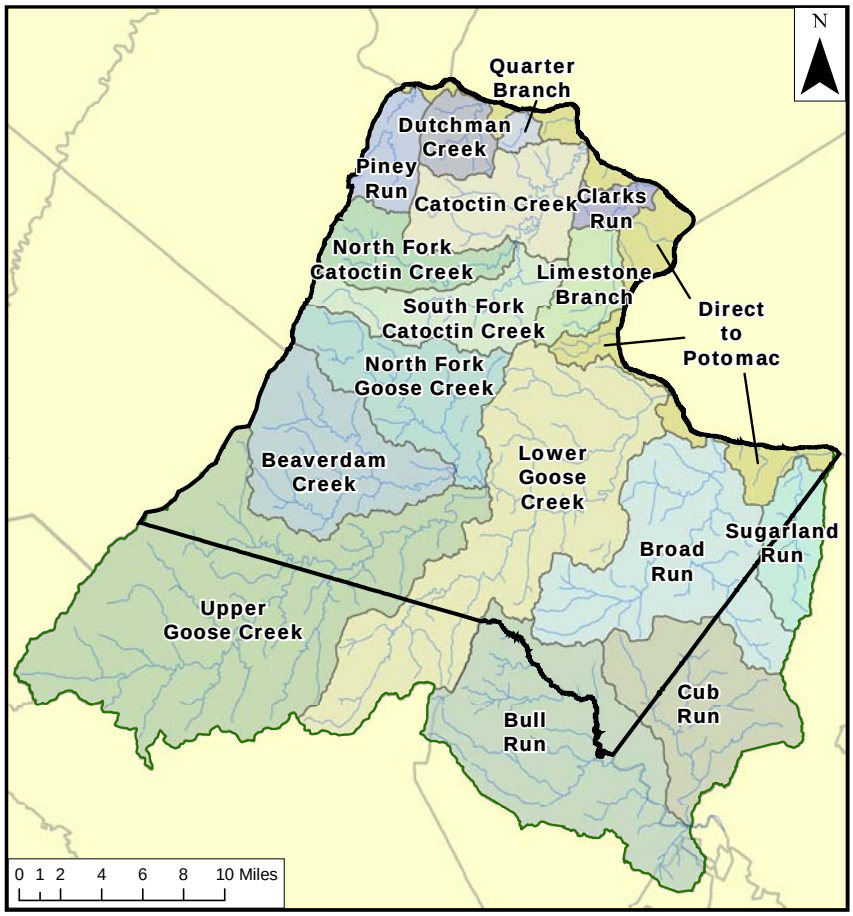

Figure 2. Watersheds and streams in and adjacent to Loudoun County, VA.

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 2011.

Precipitation

Total annual precipitation in 2011, 46.2 inches, was 4.7 inches above the normal (mean) annual precipitation of 41.5 inches for the full period of annual records of 1964 to 2011 at Dulles Airport. Precipitation data used in the WRMP are obtained from seven monitoring sites in or adjacent to the county (Figure 3). Four precipitation stations are part of the National Weather Service's (NWS) cooperative monitoring network and two rain gages are operated by the U.S. Geological Survey (USGS). The NWS sites have relatively long periods of record with one having nearly continuous data since 1930 (Table 1). The two USGS rain gages have mostly continuous data records beginning in 2004 and 2005.

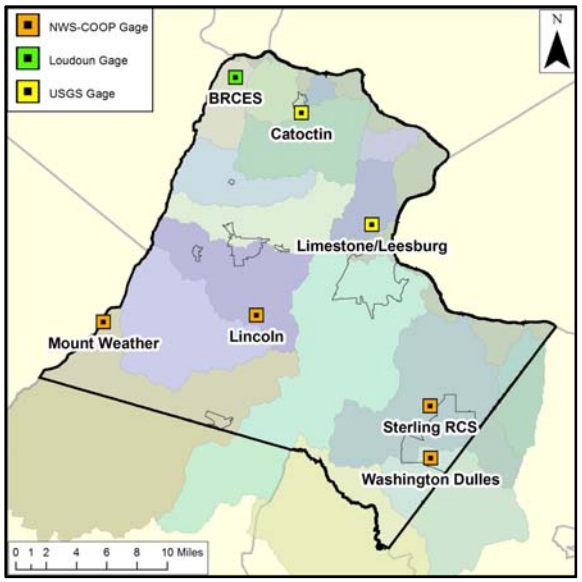

Figure 3. Precipitation monitoring sites.

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 purposes of identifying "normal" (average) conditions and for comparison to current conditions, the standard practice is to group climatic data into periods of 30 consecutive years with the most recent year of the group ending in "0". For the 30-year period of 1981 through 2010, the normal (arithmetic average or mean) annual precipitation at the Dulles monitoring station was 41.5 inches. Of the total precipitation at Dulles during 2011, frozen precipitation totaled 12.6 inches, which was slightly more than half of the normal annual total of 22.6 inches of frozen precipitation and well below the 53.3 inches in calendar year 2010. Note that frozen precipitation contributes to the total (liquid) reported precipitation, however, at a reduced ratio based on the characteristics of the frozen precipitation. For example, heavy snow may be at a 3 to 1 ratio (3 inches of snow equals 1 inch of water) while dry, powdery snow may be 50 to 1 or more.

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]			2011 Total (Inches)[3]	Days missing in 2011
			Minimum	Median	Maximum		
Blue Ridge Center	2009	Loudoun	NA	NA	NA	50.5	0
Dulles	1964	NWS-COOP	27.0	39.1	65.7	46.2	0
Limestone Branch	2004	USGS	28.0	39.0	76.1	48.4	6
Lincoln	1930	NWS-COOP	20.4	41.4	63.5	43.5	*[5]
Lovettsville	2005	USGS	27.6	38.4	61.3	38.4	17
Mt. Weather	1949	NWS-COOP	24.8	40.0	64.1	47.6	1
Sterling RCS	1978	NWS	30.3	42.2	67.7	54.0	1

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

[2] **N**ational **W**eather **S**ervice **Coop**erative weather station; **U.S**. **G**eological **S**urvey; **Loudoun** County Government

[3] NWS-COOP stations record liquid & frozen precipitation; USGS & Loudoun stations record rainfall only.

[4] Annual precipitation statistics based on site's period of available record through 2011 (see footnote 1).

[5] Daily precipitation statistics are not maintained.

Figure 4 presents annual precipitation data from the Dulles Airport station from 1981 through 2011. Figure 5 shows 2011 monthly precipitation at the Dulles Airport station in relation to monthly data for the 30-year period from 1981 through 2010. The data indicate that June was the only month that was substantially below normal during 2011. Conversely, four months – March, April, September, and October – had precipitation well into the "above normal" range for those months. In particular, September and October had more than twice the normal rainfall for those months.

A graph of daily precipitation at Dulles Airport is shown in Figure 6. There were several days with recorded rainfall of approximately 2 inches during 2011. The largest storm event occurred from September 5 through September 9 when a total of 6.7 inches of rainfall was recorded at the Dulles station. This storm caused flooding in numerous areas of Northern Virginia, including Loudoun County, and resulted in two people drowning in Fairfax County. Over the three week period of May 25 through June 15 only 0.15 inches of rain was recorded.

Measurable precipitation was reported on 130 days during 2011 at the Dulles Airport station. For those days with reported precipitation, the average accumulation was 0.36 inches and the median was 0.15 inches.

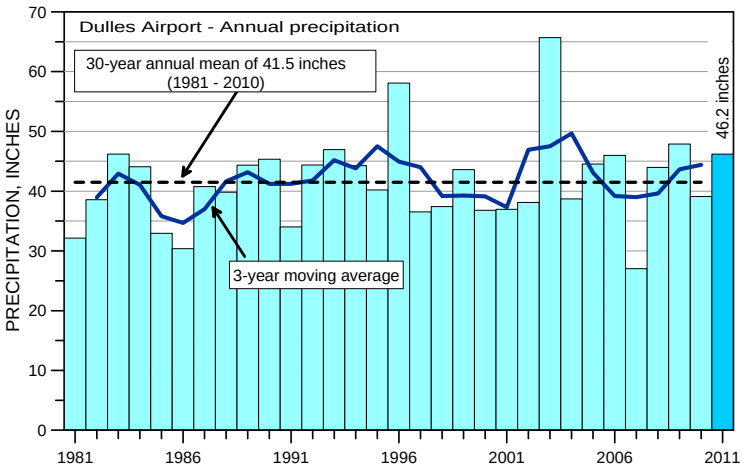

Figure 4. Annual precipitation at Dulles Airport from 1981 through 2011.

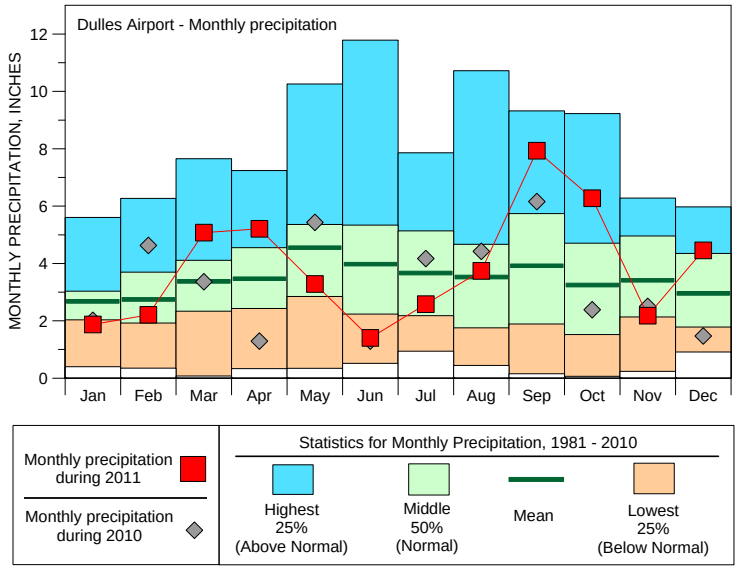

Figure 5. Monthly precipitation at Dulles Airport.

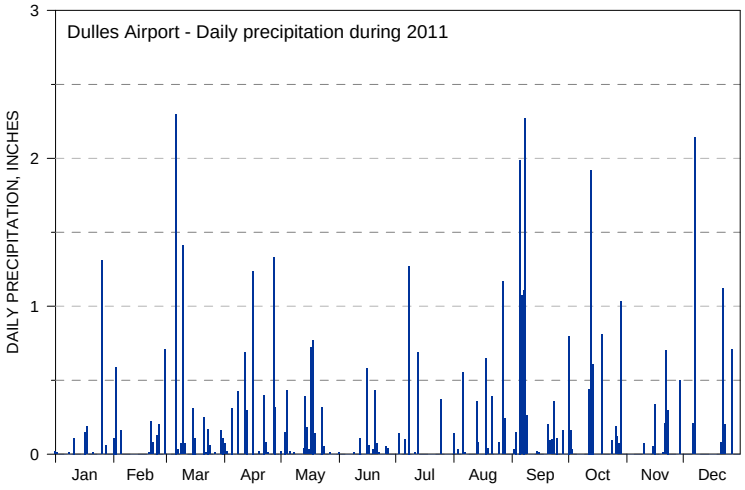

Figure 6. Daily precipitation at Dulles Airport in 2011.

Streamflow

Perennial streams flow all or most of the year. In the past, the USGS has estimated that Loudoun County has approximately 507 miles of perennial streams while more recent investigations using additional data and standardized methodologies have indicated that the county may have over 1,500 miles of perennial streams. Knowing how much water flows in the larger perennial streams and how it varies over both short and long time periods is useful in the assessment of floodplains, flood control, stormwater structures, and environmental conditions. There are 10 stream gages that measure and record water stage (level) in Loudoun County streams (Figure 7). Measured water levels at each gaging station are reported via telemetry to the USGS, correlated to historical site-specific stream discharges (flows), and the data posted in near real-time with updates normally every 15 minutes. The data are available at the USGS web site for Loudoun County. Three additional stream gages are located along the county's perimeter: at Harpers Ferry and Point of Rocks on the Potomac River (both with real-time data on an internet web page) and on Bull Run near Route 705.

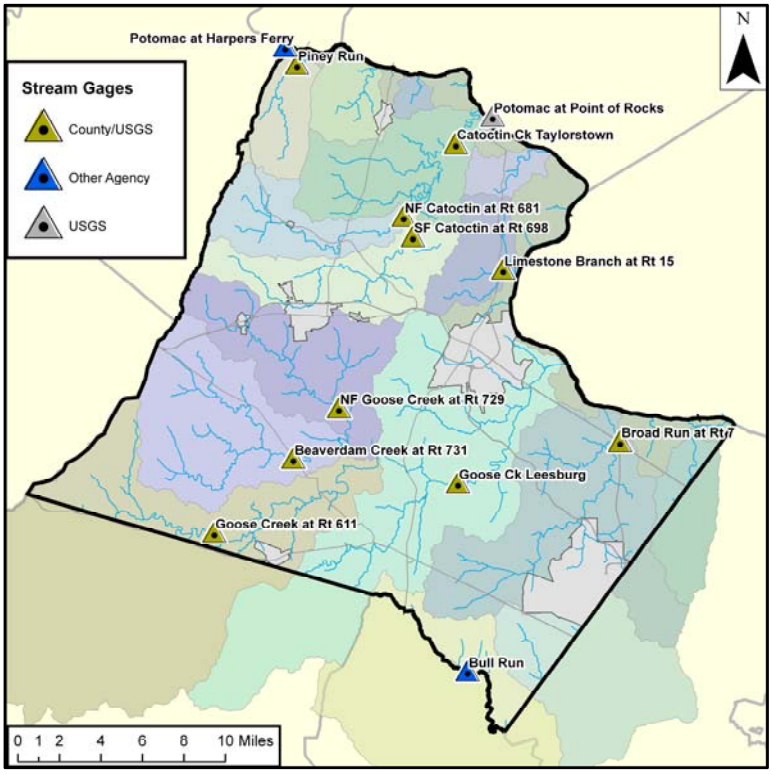

Figure 7. Locations of stream gaging stations.

The USGS regularly inspects the gaging stations to check the monitoring equipment and measure stream channel cross sections, water levels, and stream flow velocities in order to maintain calibration and data accuracy. However, data are considered provisional until passing the USGS's full quality control process.

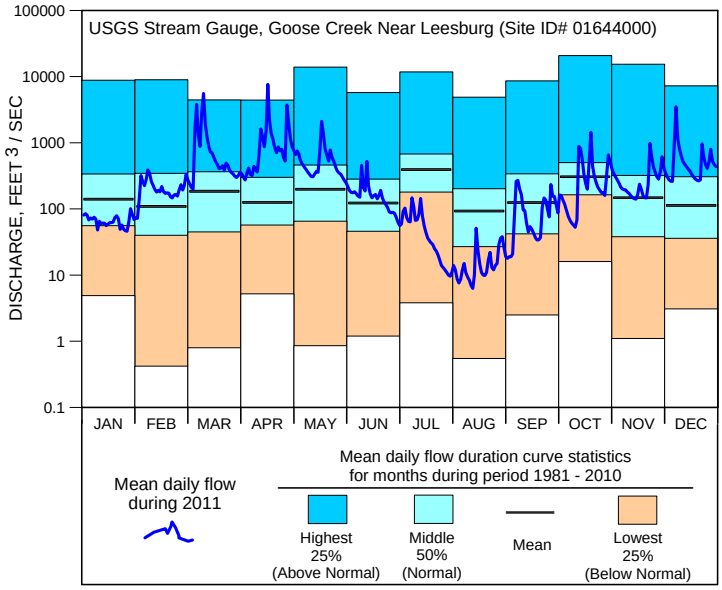

Figure 8. Stream discharge hydrograph for Goose Creek during 2011 compared to data from 1981-2010.

Figure 8 illustrates mean daily flow rates in Goose Creek near Route 621 during 2011 and compares it to monthly flow statistics at the same site for the period 1981 through 2010. These data indicate that streamflows were above normal in March through most of May, in mid-October, and from late November through the end of the year. Flows during July and most of August were below normal. Spikes in streamflow are generally correlated with rainfall at Dulles Airport (Figure 6). Although these two monitoring sites are approximately 5 miles apart, the upper reaches of the watershed drainage area for the streamflow gage are over 30 miles from the Dulles site, which can result in significant variations in accumulated

precipitation and monitoring results during localized storm events. The effect of the large storm that occurred in early September is visible as a spike in the hydrograph that brought flow up from below normal to the normal range for approximately two weeks. During 2011, the peak flow at this station occurred on April 17 with a flow of 7,640 cubic feet per second (cfs) and the minimum flow was 6.3 cfs on August 8. Goose Creek is the County's largest stream and flows through the county from its headwaters in Fauquier County to the Potomac River.

Table 2 lists the 10 gaging stations in the county along with selected data statistics. The peak flow rates for 2011 occurred on April 27 and 28 at all the stream gages except for Goose Creek near Middleburg which peaked on April 16 and Broad Run at Route 7 which peaked on September 9.

Table 2. Stream gaging stations and basic statistics.

Stream Gauge Site Name	Start of Record	Drainage Area[1] (sq. miles)	2011 Avg[2] (cfs)	Previous Historic Avg[3] (cfs)	2011 Min[4] (cfs)	Previous Historic Min[5] (cfs)	2011 Peak[6] (cfs)	Previous Historic Peak[7] (cfs)	2011 Non-flowing[8] (days)	Average Annual Historic Non-flowing[8] (days)
Beaverdam Creek	Jul 2001	47.2	43.7	51.3	0.0	0.0	910	5,000	12	13.1
Broad Run	Oct 2001	76.1	162.8	130.0	12.0	1.3	3,800	10,300	0	0.0
Catoctin Creek - Taylorstown	Oct 1970	89.5	139.9	99.5	3.4	0.1	2,080	6,770	0	2.4
Goose Creek - Leesburg	Jul 1909	332.0	371.5	362.1	6.3	1.1	7,640	20,800	0	0.0
Goose Creek - Middleburg	Oct 1965	122.0	136.3	136.7	2.0	0.0	3,140	14,000	1	6.1
Limestone Branch	Aug 2001	7.9	12.3	8.7	0.9	0.4	510	976	0	0.0
North Fork Catoctin Creek	Jul 2001	23.1	30.7	23.8	0.7	0.0	494	1,190	0	5.7
North Fork Goose Creek	Jul 2001	38.1	48.6	50.4	2.7	0.2	694	3,040	0	0.0
Piney Run	Oct 2001	13.5	16.8	14.0	0.6	0.0	220	488	0	1.9
South Fork Catoctin Creek	Jul 2001	31.6	48.2	35.3	0.7	0.0	953	1,920	0	3.7

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

[2] Average daily flow rate during 2011

[3] Average daily flow rate for the period 2002–2010

[4] Lowest 7-day average flow rate during 2011. Note: Broad Run flow augmented by wastewater discharge up to 11 MGD starting in 2008.

[5] The lowest 7-day average flow rate for the period 2002–2010

[6] Peak daily flow rate during 2011

[7] Peak daily flow rate for the period 2002–2010

[8] Maximum number of consecutive days per year with less than 0.2 cfs flow during the period 2002–2010

[9] Maximum number of consecutive days with very low flow (below 0.2 cfs) during 2011

Groundwater Levels and Wells

There are approximately 14,000 active water supply wells throughout Loudoun County. Groundwater is the primary source of drinking water for the majority of residents in western Loudoun. Groundwater levels during 2011 were recorded at 18 dedicated monitoring wells at the sites shown in Figure 9 and the data were included in the County's Water Resources Monitoring Program. Fifteen 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. Most of the County-monitored wells were established as monitoring sites within the past few years. Table 3 lists the monitoring wells, basic information about each well, and groundwater level data for both 2011 and the well's historic record.

Figure 10 shows hydrographs for selected monitoring wells that are representative of groundwater levels in the county for the years 2010 through 2011. 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 normally exhibit a steady, slow decline over time after rain events. Groundwater levels are typically highest in late spring/early summer and lowest in late fall/early winter. Assuming normal precipitation patterns, this is due to greater recharge to the

groundwater system during cooler winter/spring weather when evapotranspiration is low, thereby allowing more water to infiltrate downward to the water table.

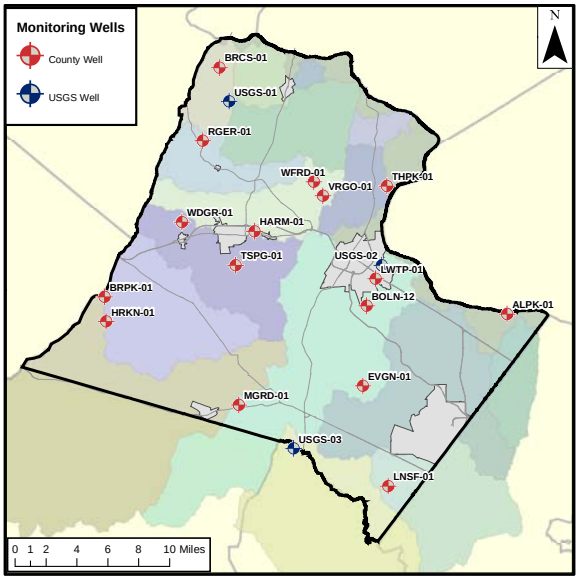

Figure 9. Locations of groundwater monitoring wells.

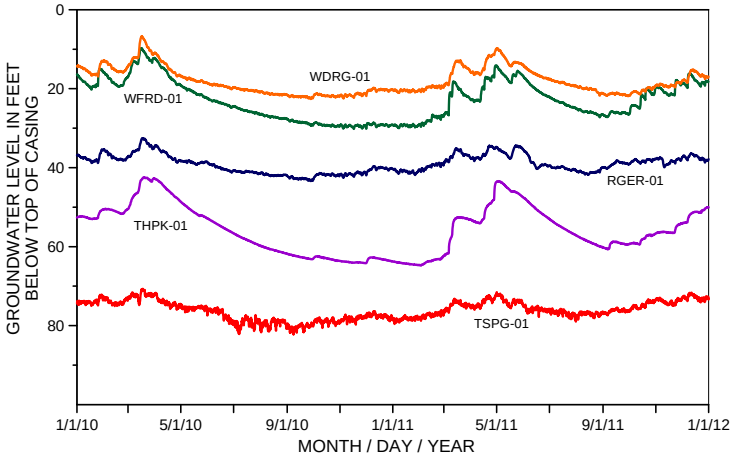

Figure 10. Groundwater levels from selected County WRMP monitoring wells.

Table 3. Monitoring wells and groundwater level data for 2011.

Well Site ID (see map for location)	Monitoring Organization	Well Depth (feet)	Rock Type	Period of Record	Groundwater Level (feet)[1, 2]			
					Historic High	2011 High	Historic Low	2011 Low
USGS-01	USGS	516	Meta-conglomerate/ metasiltstone	8/1969 - Present	1012.5	1013.9	1002.7	1002.2
USGS-02	USGS	535	Fluvial, deltaic sandstone	10/1977 - Present	376.8	383.0	361.2	372.1
USGS-03	USGS	165	Siltstone/sandstone	11/1968 - Present	418.1	418.2	411.7	413.3
BOLN-12	Loudoun	515	Fluvial, deltaic sandstone	12/2006 - Present	346.2	345.8	339.7	341.1
BRCS-01	Loudoun	320	Igneous intrusive	12/2007 - Present	532.8	530.1	521.1	522.1
HARM-01	Loudoun	945	Plutonic igneous intrusive	2/2005 - Present	495.7	498.8	475.8	467.4
MGRD-01	Loudoun	400	Plutonic igneous intrusive	12/2007 - Present	491.7	491.8	477.4	482.8
RGER-01	Loudoun	700	Igneous intrusive	2/2005 - Present	664.9	662.4	653.4	654.9
TSPG-01	Loudoun	360	Plutonic igneous intrusive	2/2005 - Present	435.3	432.0	419.1	423.9
WDGR-01	Loudoun	940	Mafic igneous intrusive	3/2005 - Present	646.8	643.8	629.6	631.6
WFRD-01	Loudoun	400	Plutonic igneous intrusive	11/2002 - Present	421.8	417.4	399.7	401.5
BRPK-01	Loudoun	680	Igneous intrusive	7/2009 - Present	1643.9	1641.6	1632.6	1632.5
THPK-01	Loudoun	360	Limestone conglomerate	7/2009 - Present	195.3	194.4	173.6	173.1
ALPK-01	Loudoun	240	Alluvium/metasiltstone	7/2009 - Present	214.4	210.2	198.7	198.5
HRKN-01	Loudoun	600	Plutonic igneous intrusive	3/2009 - Present	661.7	662.8	673.0	688.8
VRGO-01	Loudoun	300	Igneous intrusive	3/2009 - Present	563.1	562.0	538.4	542.1
EVGN-01	Loudoun	320	Diabase	3/2009 - Present	308.7	306.5	300.2	303.8
LWTP-01	Loudoun	250	Metasiltstone	3/2009 - Present	276.9	311.2	273.4	272.5

[1] Elevation above mean sea level. [2] Historic data highs and lows are during the period of record through 2010.

Figure 11 shows a hydrograph from a monitoring well in Waterford and a plot of daily rainfall at the USGS rainfall gage near Limestone Branch. Both data sets are during 2011 and show the response of groundwater levels to precipitation events.

During 2011, 96 new water supply wells were constructed. Figure 12 presents the number of wells drilled each year since 1980. The installation of new wells is primarily driven by the pace of residential construction and, occasionally, zoning changes affecting residential development potential. As occurred during the previous three to four years, the number of new wells drilled in 2011 remained relatively low. The median total depth of wells installed in 2011 was 410 feet with the depths ranging from 140 to 1,000 feet. The median estimated yield (based on air-lift pumping) was 20 gallons per minute with yields ranging from 1 to 304 gallons per minute.

Virginia uses four indicators for drought: precipitation deficit, daily streamflow statistics, groundwater level statistics, and water supply storage volume statistics.

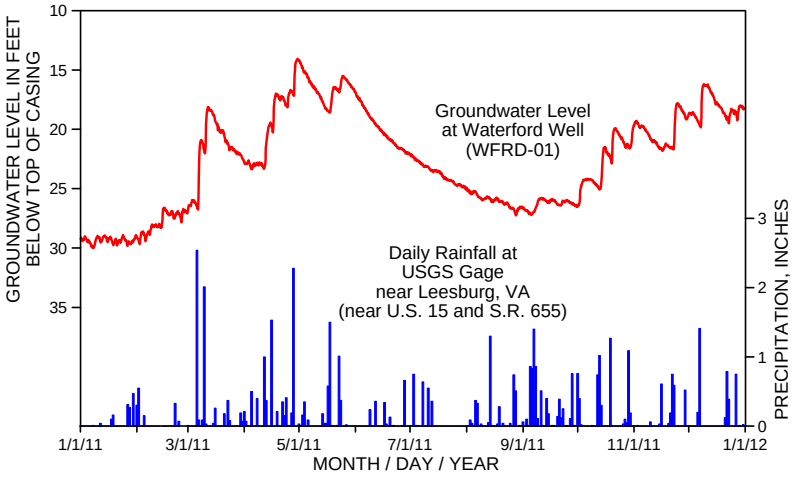

Figure 11. Groundwater hydrograph and daily rainfall in 2011.

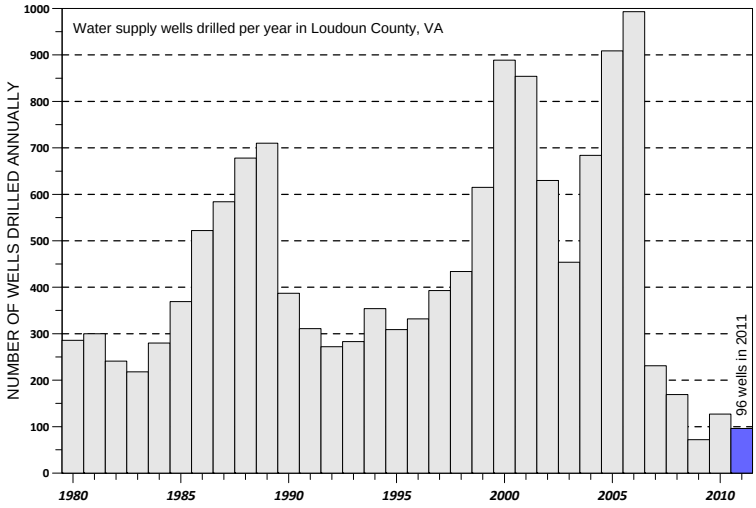

Figure 12. Number of wells constructed in Loudoun County between 1988 and 2011.

WATER QUALITY

The quality of surface water in Loudoun County was quantified in 2011 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 2011 was primarily conducted by the Virginia Department of Environmental Quality (DEQ) as part of their state-wide surface water quality sampling program.

In 2011, DEQ collected 1,769 samples from 34 sites from the watersheds of Loudoun County (some watershed boundaries extend beyond the County's boundaries). Nutrient enrichment has been identified as a major cause of the reported stream impairments nationwide and can lead to low dissolved oxygen, fish kills, shifts in flora and fauna and blooms of nuisance algae. Figure 13 illustrates the results of sampling by

DEQ for nitrogen and phosphorus in the surface waters from the watersheds of Loudoun County during 2011.

In 2000, the U.S. Environmental Protection Agency (EPA) developed ambient water quality criteria recommendations and information for 14 nutrient eco-regions in the continental United States. Individual states could adopt the criteria developed by EPA or elect to develop their own criteria and methodologies. Virginia has been working on a methodology to evaluate nutrient stress in wadeable streams since that time. In 2010, DEQ reported that it hoped to adopt amendments to the water quality standards regulation by 2015. As shown in Figure 13, approximately 59 percent of the samples collected by DEQ in 2011 contained phosphorus concentrations above the 0.037 milligrams per liter (mg/L) EPA guidance criteria and approximately 79 percent contained nitrogen concentrations above the 0.69 mg/L EPA guidance criteria.

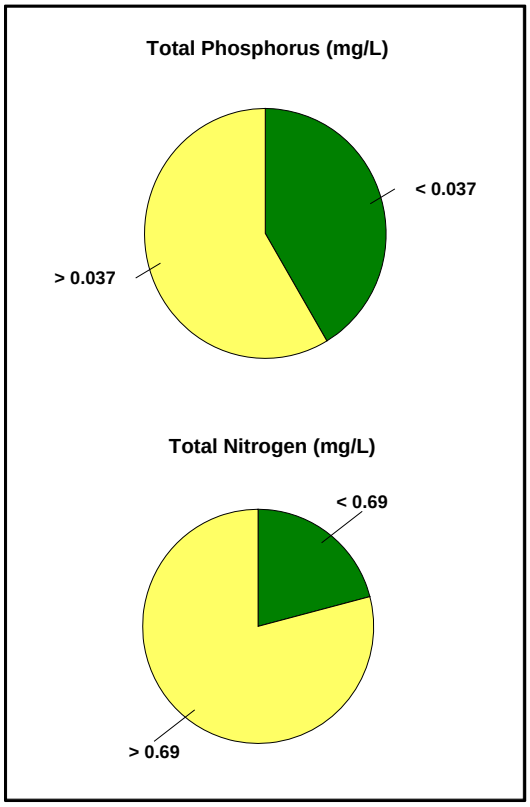

Figure 13. Nutrient concentrations as portions of samples collected from the watersheds of Loudoun County streams by DEQ during 2011.

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. EPA uses *E. coli* concentrations as an indicator of whether the water is considered safe for humans after casual contact. This criterion is identified by EPA as "recreational use" and includes activities such as swimming, fishing and boating.

In 2011, DEQ collected and analyzed approximately 158 samples from the watersheds of Loudoun County and found that approximately 85 percent were above the recreational limit of 235 *E. coli* colonies per 100 milliliters. Stream segments that are tested and exceed the recreational use criteria more than 10 percent of the time may be identified as "impaired" by DEQ. Using a similar approach, Table 4 summarizes the number of sites in which more than 10.5 percent of the samples exceeded the recreational limit over the last 5 years. 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.

Table 4. Summary of surface water microbiological testing by DEQ.

Year	Number of Samples	Number of Monitoring Sites	Number of Sites Exceeding[1]	Percent Sites Exceeding[1]
2007	152	30	16	53%
2008	152	27	18	67%
2009	180	29	24	83%
2010	159	28	23	82%
2011	158	33	28	85%

[1] Exceeds recreational use criteria for *Escherichia coli* .

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 macro-invertebrates usually involves collecting all the organisms within a small area of the stream bottom, identifying the types of organisms collected to the order, family or genus 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. In 2011, two techniques were used to evaluate the benthic macro-invertebrate populations: the Virginia Stream Condition Index (VA SCI) at both the family and genus level used by DEQ and the Virginia Save Our Streams (VA SOS) index used by several citizen volunteer organizations in and adjacent to the county. During the period 2006 through 2011, DEQ sampled a total of 134 times at 38 locations in Loudoun and calculated VA SCI scores which ranged from severe stress to excellent. Figure 14 illustrates the average stream conditions from benthic samples collected by DEQ between 2006 and 2011.

Several volunteer organizations work to collect benthic macroinvertebrate data. From 2006 through 2011, Loudoun Wildlife Conservancy, Goose Creek Association, and other volunteer groups collected 438 samples from approximately 55 locations using the VA SOS methodology. Results ranged from acceptable to unacceptable as shown in Figure 15.

Benthic macroinvertebrate species vary in their tolerance of poor water quality. Monitoring benthic populations is an efficient way for professionals and volunteers to assess one aspect of stream water quality.

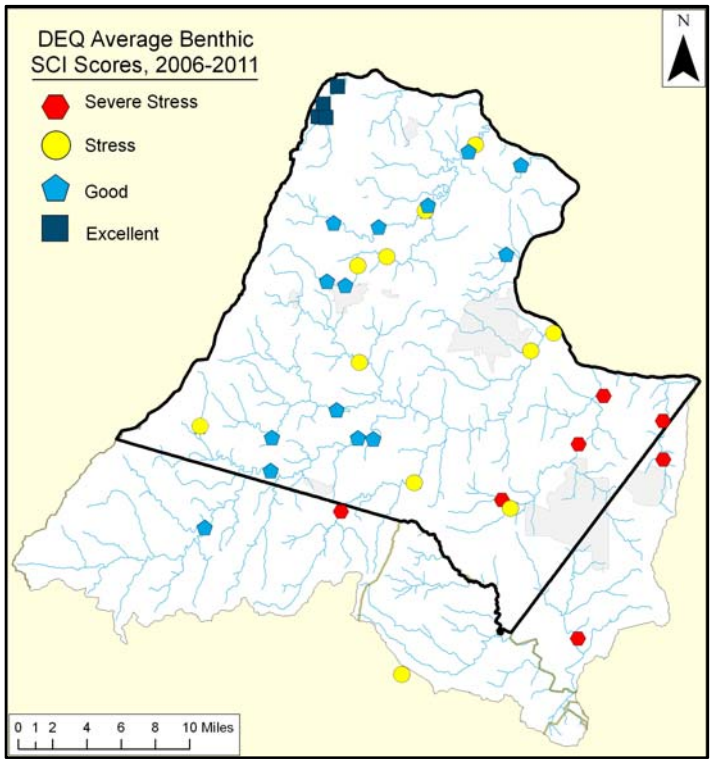

Figure 14. Summary of DEQ benthic monitoring results.

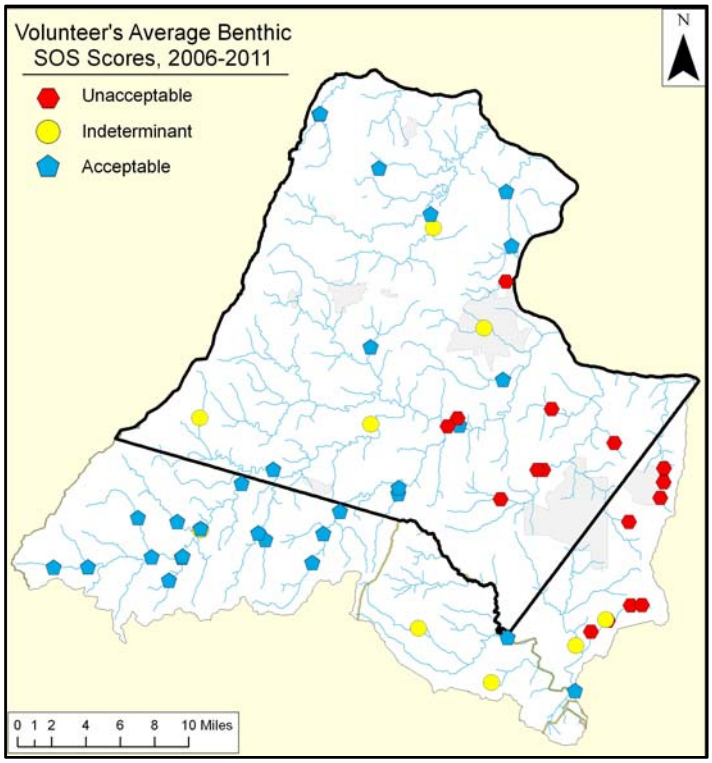

Figure 15. Summary of volunteer benthic monitoring results.

Stream Assessments

In 2009, Loudoun County conducted a comprehensive study of stream health. In the study, the stream benthic macroinvertebrate population was evaluated at 200 locations and the stream habitat was evaluated at 500 locations. This was the first comprehensive evaluation of Loudoun County's steam health. The study resulted in a large amount of data and photos so a "stream conditions" mapping web site was developed to communicate the information to the public. The interactive map (Figure 16) includes data from the Loudoun County 2009 stream assessment project as well as 2010 VA DEQ stream impairments, stream gages, scenic river information and other data. The public can easily access the site from www.loudoun.gov/streamassessment and enter their home address to identify nearby field studies of stream segments.

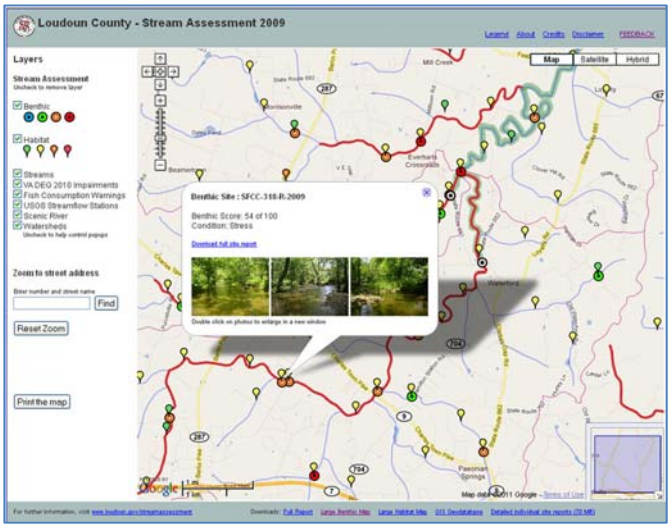

Figure 16. Online interactive stream conditions map.

Stream Impairments

Each year, DEQ tests a statistically significant fraction of Virginia's streams, rivers, lakes, and tidal waters as part of their water quality assessment program. 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 adopted 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:

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

In the last report released in 2010, there were a total of 124 stream miles in Loudoun County identified as impaired for one or more criteria. Listing a stream as "impaired" begins a multi-year process of identifying pollution sources, determining appropriate pollution loadings, and designing and implementing corrective measures. Figure 17 through Figure 20 illustrate the impairments for aquatic life use, recreational/ swimming use, fish consumption and public water supply, respectively.

Surface water quality impairments are reported to the Environmental Protection Agency every two years by the Virginia Department of Environmental Quality (DEQ). The Final 2010 305(b)/303(d) Water Quality Assessment Integrated Report *(Integrated Report) was released on Feb. 9, 2011. The 2010 Integrated Report summarizes the water quality conditions from Jan. 1, 2003, to Dec. 31, 2008.*

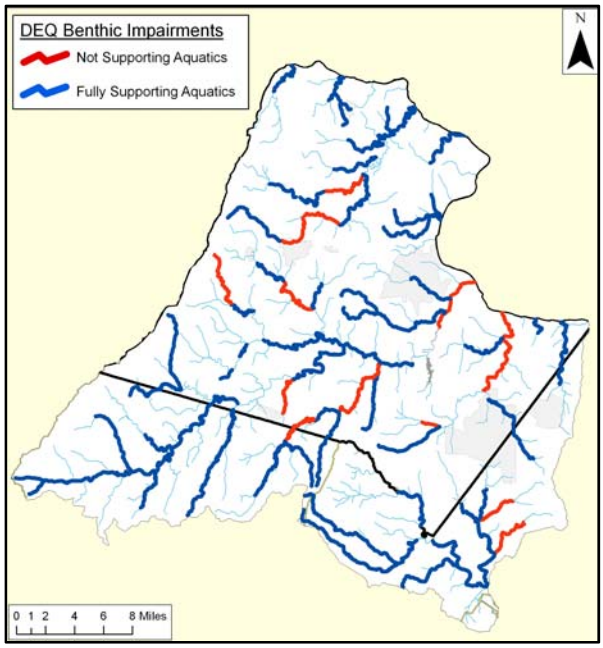

Figure 17. Aquatic life use (benthic macroinvertebrates) impaired stream segments.

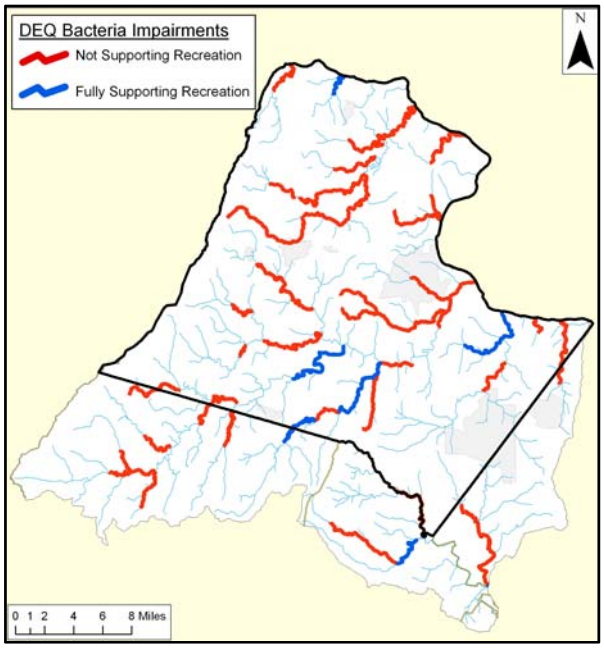

Figure 18. Recreational/swimming use (bacteria) impaired stream segments.

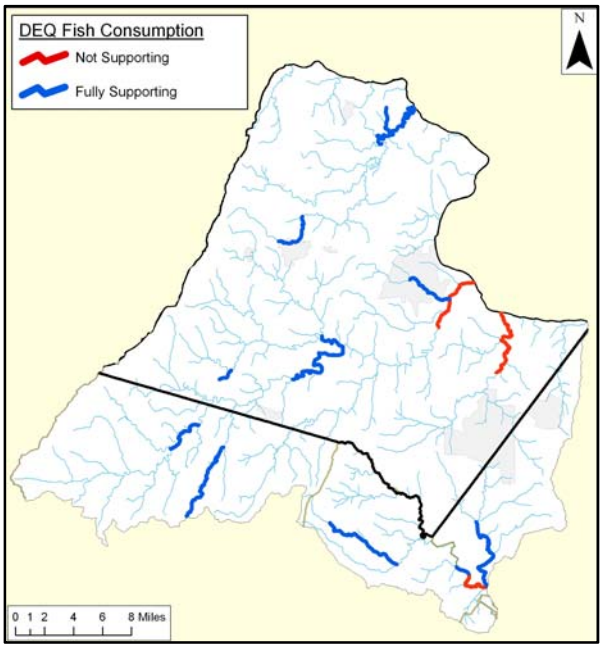

Figure 19. Fish consumption use (PCB and mercury in fish tissue) impaired stream segments.

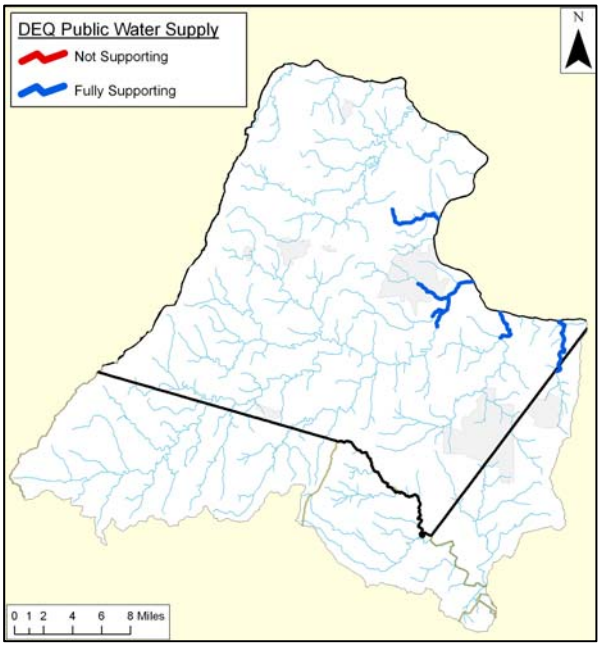

Figure 20. Public water supply use (chemicals) impaired stream segments.

Groundwater Quality

Groundwater is the source of drinking water for most of Loudoun County outside of Loudoun Water's central service area (see Figure 1) 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 2011, 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, groundwater quality in the county is good.

Table 5. Statistics for selected groundwater chemistry parameters.

Analyte	MCL(mg/L)	Samples		# above MCL	% above MCL
Nitrate	10	*All*	3263	15	0.5
		2011	94	0	0.0
Sulfate	250	*All*	3263	13	0.4
		2011	94	0	0.0
Lead	0.015	*All*	3266	32	1.0
		2011	94	2	2.1
Fluoride	4	*All*	3263	7	0.2
		2011	94	2	2.1
Arsenic	0.01	*All*	3270	15	0.5
		2011	94	0	0.0
Manganese	0.05*	*All*	3270	2092	64.0
		2011	94	63	67.0
Iron	0.3*	*All*	3288	2208	67.2
		2011	94	56	59.6
TDS	500*	*All*	3266	21	0.6
		2011	93	0	0.0

* Secondary MCL for taste, color, and odor.

There are a few isolated locations in the County where significant groundwater contamination is known to exist. The most notable location is the Hidden Lane Landfill in northeast Loudoun, which was placed on the EPA's National Priorities List (Superfund). The EPA has developed a fact sheet to update citizens on clean-up and investigation activities at the site. The Hidden Lane fact sheet and more information can be found by visiting the EPA web site.

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 15,000 active OWTSs in the county and during 2011, 132 new OWTSs were installed. An OWTS that is properly installed and serviced should not pose a threat to groundwater quality. However, improper OWTS installation or maintenance can cause wastewater to be untreated or undertreated and lead to groundwater or surface water contamination. Because OWTSs 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. The Loudoun County Department of Environmental Health can provide information on maintenance and testing of private water wells and OWTSs at (703-777-0234 and www.loudoun.gov/onsite).

Groundwater in the county is generally of good quality. Some wells have elevated levels of iron and manganese which diminish the aesthetics of the water, but do not adversely affect human health. Owners of private wells used to supply drinking water should have their well water tested regularly to assure that the water is safe to consume.

FUTURE WATER RESOURCES OUTLOOK

The EPA grant that supported the WRMP ended in 2009; however, continuation of most monitoring activities is positioned to continue with limited local funding. Although no major new monitoring projects are planned, the monitoring objectives for 2012 and beyond will include:

- **Precipitation/rainfall – continue to monitor and/or obtain data from the stations operated by NWS, USGS, or Loudoun County.**
- **Stream flow – continue the cooperative funding agreement with the USGS to monitor stream stage and discharge (flow) within 10 of the county's major watersheds.**
- **Groundwater levels – maintain continuous groundwater level recording instrumentation in the 19 dedicated monitoring wells operated by Loudoun County or the USGS. Additional wells may be brought into the monitoring network through the County's monitor well donation program in which either wells with easements are given to the County or the County is provided long-term monitoring use of an inactive well by the owner.**
- **Water quality sampling – groundwater and/or surface water quality sampling may be conducted depending on available funding.**

The Department of Building & Development has proposed to continue watershed management planning activities through initiation of a pilot project in the Broad Run watershed. The Upper Broad Run Watershed Management Plan Pilot Project would be the first detailed watershed management plan by Loudoun County Government and could be completed in 2014. Water resources monitoring data will be used to help develop the plan and, if the plan is implemented, track progress in the efficacy of watershed improvement projects.

On December 30, 2010, the U. S. Environmental Protection Agency issued a Total Maximum Daily Load (TMDL) for the 64,000 square-mile Chesapeake Bay watershed, which includes all of Loudoun County. The Bay TMDL is focused on reducing the amounts of phosphorus, nitrogen, and sediment entering the Chesapeake Bay from the contributing watershed. The target amounts that will meet the Bay TMDL goal are sometimes called the "pollution diet". Virginia submitted the state Phase II Watershed Implementation Plan (WIP) to the EPA in March of 2012. The Phase II WIP is designed to show how the Commonwealth and local Bay jurisdictions, including Loudoun, will meet Virginia's portion of the pollution diet. The deadline to put in place all of the measures designed to accomplish the pollution diet is 2025. Data from the WRMP will be available to help support goals of the Phase II WIP for Loudoun County.

County staff will continue to explore grant opportunities to supplement Loudoun County funding for monitoring and watershed management programs.

More information about Loudoun County's water resources monitoring program can be obtained at:

www.loudoun.gov/watermonitoring

2011 – Moment to Remember

Sugarland Run topped the bridge at Route 7 in Sterling

On September 8, 2011 Sterling Fire and Rescue performed swift river rescue. (www.flickr.com/photos/sterlingfire/with/6128447281/)

While there is no precipitation gage near Sugarland Run, it is estimated that the localized (and unofficial) storm approached and possibly exceeded the “100-year rainfall” (1 percent chance of occurring in a given year) depth of 7.70 inches (Table II, Chapter 5, Loudoun Facility Standards Manual). Data obtained from independent personal weather stations recorded 13.6 inches of rain during the preceding week and 7.4 inches on Sept 8th.

Remember: “Turn Around ... Don't Drown”