



## Water Monitoring

## Resource Brief

### Importance

The National Capital Region Network Inventory & Monitoring (NCRN I&M) program tracks the condition of freshwater streams in the region's National Parks. We look at levels of the nutrients nitrate and phosphorus; chemical parameters such as pH, specific conductance, dissolved oxygen, and temperature; and flow, discharge, and depth measurements. All of these measures are important to keeping a habitat healthy for aquatic organisms, wildlife,

and humans. Stream water also reflects the condition of the surrounding land (the watershed) and affects nutrient cycles and the productivity of ecosystems.

National Capital Region (NCR) parks are part of the 64,000 square mile watershed of the Chesapeake Bay, the largest estuary in the United States. All NCR park streams eventually flow into the Bay, most through the Potomac River, its second-largest tributary.

### Monitoring

NCRN monitors water in 37 wadeable (1st to 4th order), non-tidal streams for the following parameters:

- specific conductance\*
- dissolved oxygen
- air & water temperature
- nitrate
- phosphorus
- acid neutralizing capacity (ANC)
- pH
- salinity
- discharge
- flow
- water depth
- wetted width



Photo: NPS

\*temperature corrected version of conductivity

We gathered samples every month from June 2005 to October 2013. Through this intensive effort, we documented monthly and seasonal patterns in water quality and quantity. As of October 2013, NCRN now monitors the same sites and parameters on a seasonal basis—every three months. Also, starting in October 2012, extremely detailed monitoring began at 7 sites using continuous logging devices that take measurements every 15 minutes. This continuous monitoring is best for capturing data that fluctuates on a daily basis or with storm events. We use it to measure:

- conductivity
- dissolved oxygen
- air & water temperature
- water level & air pressure

### Results

The following results come from monthly monitoring (6/2005 - 10/2013) in 37 streams (Table 1).

Below, sections for key chemical and nutrient parameters have a header showing the percentage of all measurements that met standards for acceptable water quality. For each parameter, the observed range includes 95% of all measurements so as to show a typical value range for NCR streams.

#### Acid Neutralizing Capacity (ANC): 93.7% Acceptable

The ANC of a waterbody is a measure of its ability to buffer acidic inputs and is based on the water's chemical composition. ANC levels are higher in areas of karst geology. In the NCR, 33 streams are in non-karst terrain and 4 are in karst terrain.

**Observed Range:** 232-2,383  $\mu\text{eq/L}$  in non-karst streams  
973-5,689  $\mu\text{eq/L}$  in karst streams

**Threshold:** >200  $\mu\text{eq/L}$  in non-karst streams is acceptable  
>600  $\mu\text{eq/L}$  in karst streams is acceptable

**Standouts/Trends:** While all PRWI (see Table 1 for park abbreviations) streams show an increasing trend in ANC, Carters Run, Boneyard Run, and Mawavi Run typically have failing ANC levels.

#### Dissolved Oxygen (DO): 95% Acceptable (warm water); 94% Acceptable (cold water)

DO is necessary for the survival and growth of many aquatic organisms. Levels of DO depend on water temperature and



air pressure. High pressures and cool temperatures allow more oxygen to be dissolved in the water. Due to changes in temperature, DO has a strong daily and seasonal variability. State regulations identify 34 of NCRN-monitored streams as warm water and 3 as cold water.

**Observed Range:** 4.1-14.4 mg/L in warm water streams  
5.2-14.1 mg/L in cold water streams

**Threshold:** >5.0 mg/L for warm water streams is acceptable  
>6.0 mg/L for cold water streams is acceptable

**Standouts/Trends:** The cold water streams in CATO sometimes fail during July and August as do the warm water streams Youngs Branch (in MANA) and Normanstone Creek and Pinehurst Branch (in ROCR). Overall, streams of ANTI, CATO, GWMP, and HAFE have a trend of increasing DO levels.

## pH: 99.2% Acceptable

pH measures how acidic or basic water is. It has a profound impact on the toxicity and solubility of many chemicals.

**Observed Range:** 6.8-8.6

**Threshold:** 6.0-9.0 is acceptable

**Standouts/Trends:** Oxon Run in NACE frequently has above threshold basic readings. At PRWI, while pH shows an increasing trend in all streams, Mawavi Run, Carters Run, and Boneyard Run still frequently have below threshold acidic readings.

## Specific Conductance: 26% Acceptable

Specific conductance is a temperature corrected measure of the ability of water to conduct an electrical current. It is related to the amount of ions dissolved in water. An increase in specific conductance can indicate the presence of pollution that could be toxic to aquatic life.

**Observed Range:** 53-1089  $\mu\text{S}/\text{cm}$

**Threshold:** < 171  $\mu\text{S}/\text{cm}$  is acceptable for the health of both fish and macroinvertebrates (Morgan et al. 2007).

**Standouts/Trends:** Most streams in the region fail.

## Total Nitrate: 56% Acceptable (Ecoregion IX); 0.6% Acceptable (Ecoregion XI)

Nitrate ( $\text{NO}_3$ ) is the form of nitrogen most available for use by plants and animals. It is an ingredient in the over-enrichment of water bodies that can cause algal blooms and depletion of oxygen. According to the Environmental Protection Agency (EPA), 32 NCRN-monitored streams are in Ecoregion IX and 5 are in Ecoregion XI.

**Observed Range:** 0.4 -5.4 mg/L  $\text{NO}_3$  in Ecoregion IX  
0.5-8.0 mg/L  $\text{NO}_3$  in Ecoregion XI

**Threshold:** <2.0 mg/L  $\text{NO}_3$  in Ecoregion IX is acceptable  
<0.31 mg/L  $\text{NO}_3$  in Ecoregion XI is acceptable

**Standouts/Trends:** In Ecoregion IX, only streams in PRWI have regularly acceptable measurements. Almost every measurement within Ecoregion XI failed.

## Total Phosphorus: 0% Acceptable

Phosphorus (measured as  $\text{PO}_4$ ) is frequently a limiting nutrient in aquatic systems. A minor increase in phosphorous concentration can change the population and community dynamics of algae and diatoms leading to algal blooms and depletion of oxygen. According to the EPA, most NCRN-monitored streams (32) are in Ecoregion IX and 5 are in Ecoregion XI.

**Observed Range:** 0.11-0.98 mg/L  $\text{PO}_4$  in Ecoregion IX  
0.11-0.81 mg/L  $\text{PO}_4$  in Ecoregion XI

**Threshold:** <0.1 mg/L  $\text{PO}_4$  in Ecoregion IX is acceptable  
<0.03 mg/L  $\text{PO}_4$  in Ecoregion XI is acceptable

**Standouts/Trends:** While all NCR streams fail to meet the acceptable threshold for total phosphorus, improving trends exist at ANTI, GWMP, most of PRWI, and WOTR.

## Water Temperature: 99.9% Acceptable (warm water); 95% Acceptable (cold water)

Water temperature fluctuates both seasonally and on a daily basis and causes changes in both dissolved oxygen levels and specific conductance. High temperatures can also stress aquatic life adapted to cooler habitats such as trout. Of NCRN monitored streams, state regulations identify 34 as warm water and 3 as cold water.

**Observed Range:** 2.4 -24.7 C in warm water streams  
1.5-20.5 C in cold water streams

**Threshold:** <32 C for warm water streams is acceptable



<20 C for cold water streams is acceptable

**Standouts/Trends:** Cold water streams at CATO sometimes exceed temperature thresholds during July and August.

## Online Water Quality

NCRN water monitoring data can be viewed through an interactive online tool. This “visualizer” lets users see all of the data, thresholds, and trends for a particular stream and allows users to download the information as raw data or as a graph. To view the NCRN water quality visualizer, go to: [http://science.nature.nps.gov/im/units/ncrn/monitor/water\\_quality/visualizer.cfm](http://science.nature.nps.gov/im/units/ncrn/monitor/water_quality/visualizer.cfm).

**Table 1:** Streams Monitored in NCR

## Streams Monitored in NCR

As of September 2013, the following streams were part of monthly monitoring by NCRN I&M. Except where noted they are all warm water, non-karst streams, in Ecoregion IX. Those with continuous monitoring devices are noted by an asterisk (\*).

### ANTI\_\_Antietam National Battlefield:

Sharpsburg Creek (karst, Ecoregion XI)

### CATO\_\_Catoctin Mountain Park:

\*Big Hunting Creek (cold water, Ecoregion XI)

Blue Blazes Creek (cold water, Ecoregion XI)

\*Owens Creek (cold water, Ecoregion XI)

### GWMP\_\_George Washington Memorial Parkway:

Mine Run

Minnehaha Creek

Pimmit Run

Turkey Run

### HAFE\_\_Harpers Ferry National Historical Park:

Flowing Springs Run (karst, Ecoregion XI)

### MANA\_\_Manassas National Battlefield Park:

\*Youngs Branch

### MONO\_\_Monocacy National Battlefield:

Bush Creek (karst)

Gambrill Creek (karst)

### NACE\_\_National Capital Parks - East:

Henson Creek

Oxon Run

Still Creek

### PRWI\_\_Prince William Forest Park:

Boneyard Run

Carter's Run

Mary Bird Branch

Mawavi Run

Orenda Run

\*Quantico Creek

\*South Fork Quantico Creek

Sow Run

Taylor Run

### ROCR\_\_Rock Creek Park:

Broad Branch

Dumbarton Oaks

Fenwick Branch

Hazen Creek

Klinge Valley Stream

Luzon Branch

Normanstone Creek

Palisades Creek

Pinehurst Branch

Piney Branch

\*Rock Creek below Dumbarton Oaks

### WOTR\_\_Wolf Trap National Park for the Performing

Arts:

Courthouse Creek

\*Wolf Trap Creek

## References

Morgan, R. P., K. M. Kline, and S. F. Cushman. 2007. Relationships among nutrients, chloride and biological indices in urban Maryland streams. *Urban Ecosystems* 10:153-166.

NCRN I&M Water Monitoring webpage: [http://science.nature.nps.gov/im/units/ncrn/monitor/water\\_quality/index.cfm](http://science.nature.nps.gov/im/units/ncrn/monitor/water_quality/index.cfm)