

Chapter 5: Monitoring

5.1 Christina Basin Water Quality Monitoring

The Christina Basin TAT stresses the importance of water quality monitoring to assess the water quality pre- and post-BMP implementation. Once the recommendations (or BMPs) in the Christina Basin PCS are implemented, it is important to assess the changes in the water quality to better understand the impact of the practices recommended in this strategy. Delaware is fortunate to have the Surface Water Quality Monitoring Program that addresses pre- and post-TMDL progress monitoring and supports the TMDL Program.

DNREC’s Water Resources Division, Watershed Assessment Section is actively involved in technical monitoring throughout the state. Delaware maintains a General Assessment Monitoring Network (GAMN) of 181 stations throughout the state and has one Special Projects monitoring station in a select watershed. The GAMN stations are long-term monitoring stations and are used to conduct long-term status and trend assessments of water quality conditions. The Special Project monitoring stations are for short-term projects that require data to meet the Department’s needs (Department of Natural Resources and Environmental Control, Division of Water Resources, Watershed Assessment Section, 2007).

Delaware is fortunate to have an aggressive and frequent monitoring program in place. In the past, GAMN stations were sampled 4–6 times per year and are currently being sampled 6–12 times per year. The Christina Basin is a highly monitored watershed in the state. The Watershed Assessment Section has water quality monitoring records dating back 30 years for select monitoring sites in the Christina Basin. According to the *Surface Water Quality Monitoring Program FY07* report, within the basin there are 24 DNREC GAMN stations, and each site will be sampled once a month. Table 5.1 provides a summary of the sampling schedule for the sites in the Christina Basin (Department of Natural Resources and Environmental Control, Division of Water Resources, Watershed Assessment Section, 2007).

Table 5.1 Sampling Schedule for the Christina Basin GAMN Stations

FY 2007 Sampling Schedule	GAMN Stations
July 2006	24
August 2006	24
September 2006	24
October 2006	24
November 2006	24
December 2006	24
January 2007	24
February 2007	24
March 2007	24
April 2007	24
May 2007	24
June 2007	24

The Brandywine Creek watershed contains four GAMN stations, the Christina River watershed contains seven GAMN stations, the Red Clay Creek watershed contains four GAMN stations, and the White Clay Creek watershed contains nine GAMN stations. Table 5.2 provides more

detailed information on these stations in the Christina Basin. Figure 5.1 shows the location of each site in the Christina Basin.

Table 5.2 Stream Monitoring Locations and Information

Station Information	Map Identifier	Storet Number	Station Type	Monitor for Metals Criteria	Other Parameters and Testing
			GAMN	Copper, Lead, Zinc	Datasonde
Brandywine Creek					
Foot Bridge	BW_2	104011	12	12	
Rd. 279 Bridge (USGS gage 01481500)		104021	12	12	
Smith Bridge		104051	12	12	
Brandywine Creek, 0.6 miles upstream of the confluence with Christina River		104081	12		
Christina River					
Rt. 13/Rt. 9 Bridge		106011	12	12	
Route 141, Newport (USGS Tide Gage 01480065)	CR_3	106021	12	12	
Smalley's Dam Spillway	CR_2	106031	12	12	
Old Baltimore Pike, below Newark (USGS Gage 01478000)		106141	12	12	X
Route 273, above Newark	CR_1	106191	12	12	
Little Mill Creek, Atlantic Avenue (USGS Gage 01480095)		106281	12	12	
Conrail Bridge (USGS Tide Gage 01481602)	CR_4	106291	12	12	X
Red Clay Creek					
Stanton, Route 4 (USGS Gage 01480015)		103011	12	12	X
Wooddale, Rt. 8 (USGS gage 01480000)		103031	12	12	
Ashland, Rd. 258a		103041	12	12	
Burrough's Run Confluence		103061	12	12	X
White Clay Creek					
Stanton, Old Route 7 Bridge		105011	12	12	
Chambers Rock Road		105031	12	12	X
Mill Creek Confluence above Rt. 4 at Delaware Park		105071	12	12	
Pike Creek Confluence, Upper Pike Creek Rd.		105101	12	12	X
Middle Run Confluence, Possum Park Rd.		105131	12	12	
DE Park Race Track (USGS gage 01479000)		105151	12	12	X
White Clay Creek, at the end of McKees Lane		105171	12	12	
Pike Creek at Paper Mill Road Bridge		105181	12		
0.8 miles upstream of confluence with Christina River		105161	12		

Eight of the 24 monitoring stations in the Christina Basin are also USGS gage stations where real-time flow monitoring occurs. Real-time data are typically recorded at 15–60 minute intervals, stored onsite, and then transmitted to USGS offices every one to four hours. The USGS and DNREC's Watershed Assessment Section work together to share this data, which results in more detailed data at these eight DNREC monitoring sites. Seven sites in the Christina Basin have datasonde testing. The YSI (or similar) datasondes are continuous water quality monitoring stations that collect data for DO and other parameters several times each day. The continuous monitoring datasonde testing will begin in the Piedmont watersheds, which includes the Christina Basin, and will be rotated in the following years. As of May 2007, the monitoring has not begun due to the need for additional sampling procedure analysis (Department of Natural

Resources and Environmental Control, Division of Water Resources, Watershed Assessment Section, 2007).

According to the *State of Delaware Surface Water Quality Monitoring Program FY 2007* prepared by the Department of Natural Resources, Division of Water Resources, Watershed Assessment Section, the water quality parameters in Table 5.3 are analyzed using the following methods at all stations in the Monitoring Network, FY 2007. Table 5.4 provides information on the metal parameters and the testing method associated with these parameters.

Table 5.3 Water Quality Parameters and Methods

Parameter	Method Reference (EPA)	Reporting Level¹
Water Column Nutrients		
Total Phosphorus	EPA365.1 M	0.005 mg/l P
Soluble Ortho-phosphorus	EPA365.1	0.005 mg/l P
Ammonia Nitrogen	EPA350.1	0.005 mg/l N
Nitrite+Nitrate N	EPA353.2	0.005 mg/l N
Total N	SM 4500 NC	0.08 mg/l N
Carbon and Organics		
Total Organic Carbon	EPA415.1	1 mg/l
Dissolved Organic Carbon	EPA415.1	1 mg/l
Chlorophyll-a (Corr)	EPA 445.0	1 µg/l
Biochemical Oxygen Demand		
BOD ₅ , N-Inhib (CBOD)	SM20 th ed-5210B	2.4 mg/l
BOD ₂₀ , N-Inhib (CBOD)	SM20 th ed-5210B	2.4 mg/l
General		
Dissolved oxygen – Winkler ²	EPA360.2	0.25 mg/l
Dissolved oxygen – Field	EPA360.1	0.1 mg/l
Total Suspended Solids	EPA160.2	2 mg/l
Alkalinity	EPA310.1	1 mg/l
Hardness	EPA130.2	5 mg/l
Field pH	EPA150.1	0.2 pH units
Conductivity – Field	EPA120.1	1 µS/cm
Salinity	SM20 th ed-2520B	1 ppt
Temperature	EPA170.1	°C
Secchi Depth ³	EPA/620/R-01/003	meters
Light Attenuation ⁴	EPA/620/R-01/003	%
Turbidity	EPA180.1	1 NTU
Chloride	EPA325.2	1 mg/l
Bacteria		
Enterococcus cfu/100 ml	SM20 th ed-9230C	1 cfu/100 ml

¹As documented in the ELS Quality Assurance Management Plan, the ELS defines the Limit of Quantitation (LOQ) as the lowest standard in the calibration curve or, in instances where a standard curve is not specified by the procedure, LOQ represents the limitations of the method. For those tests where reference spiking material exists, the ELS measures Method Detection Limit (MDL), as defined in the Federal Register 40 CFR Part 136 Appendix B. MDL values are generated or verified once per year.

Results less than the MDL are considered to be not detected and “< MDL” is reported.

Results greater than the MDL but less than the LOQ are qualified with a J to indicate a result that is extrapolated or estimated. For tests where MDL is not applicable, results less than the LOQ are reported as “< LOQ”. ELS MDLs meet or exceed (i.e., are lower than) the reporting level requirements listed in Table 5.3.

²Secchi Depth to be measured at designated stations.

³Light attenuation to be conducted as practical to obtain correlation with Secchi disk readings.

Table 5.4 Metals Parameters

<i>Metals (dissolved and total)</i>	<i>Method Reference (EPA)</i>	<i>Reporting Level</i>
Copper	EPA 200.7 M	5.0 ug/l
Lead	EPA 200.7 M	3.0 ug/l
Zinc	EPA 200.7 M	10 ug/l
Arsenic (III)	EPA 200.7 M	10 ug/l
Chromium (hex) – Dissolved	SM13 th ed-117A	10 ug/l
Iron	EPA 200.7 M	100 ug/l

DNREC, Water Resources Division, Watershed Assessment Section is committed to providing the resources necessary to ensure that the streams and rivers in the Christina Basin are appropriately monitored. The Watershed Assessment Section is willing to consider supplemental monitoring or relocating monitoring stations where feasible if the current monitoring stations are not deemed adequate (Department of Natural Resources and Environmental Control, Division of Water Resources, Watershed Assessment Section, 2007).

5.2 Citizen Technical Monitoring Program

Several citizen monitoring programs have been established throughout the state to support DNREC’s monitoring efforts. A citizen monitoring program is a volunteer program set up to encourage citizens to monitor specific stream sites for a variety of parameters. The monitoring typically occurs on a monthly basis. Volunteers in the program range from students to professionals. Testing is typically conducted for the following parameters:

- DO
- pH
- Alkalinity
- Nitrates
- Phosphates
- Conductivity
- Salinity in Tidal Reaches
- Temperature
- Flow

The Delaware Nature Society (DNS) has established a citizen technical monitoring program in the Christina Basin. Volunteers in New Castle County collect data on tributaries of the Brandywine, Red Clay, and White Clay Creeks, and the Christina River. According to the Delaware Nature Society, technical monitoring data has been collected at 30 locations within the Delaware portion of the Christina River Basin since 1995. The data is used to augment the DNREC monitoring stations and is published in the Delaware Nature Society’s State of the Christina Basin Watershed reports and every two years as part of DNREC’s Watershed Assessment Report (305(b)) (<<http://www.delawarenaturesociety.org>>).

The Delaware Nature Society’s Citizen Technical Monitoring Program and citizen technical monitoring programs throughout the state are encouraged. The information these groups collect provides DNREC with valuable data and encourages watershed stewardship. Volunteers become the eyes and ears for the streams and provide valuable water quality monitoring data as well as information related to any degradation or unusual circumstances that may become apparent during their monthly monitoring visits.

Figure 5.1 Christina Basin Stream Water Quality Monitoring Stations

