

State of Delaware Ambient Surface Water Quality Monitoring Program - FY 2015

Department of Natural Resources and Environmental Control Watershed Assessment Branch

Executive Summary

Delaware's Surface Water Quality Monitoring Program for Fiscal Year 2015 is described in this report. Delaware maintains a General Assessment Monitoring Network (GAMN) of 134 stations. GAMN stations are considered long term stations whose data is used to do long term status and trend assessments of water quality conditions of the State's surface waters and support compilation of Watershed Assessment Reports as mandated by the Clean Water Act under section 305(b). This plan implements an updated monitoring strategy that monitors 22 stations monthly, and the remaining stations either 6 or 12 times a year on a rotating basin basis.

Ambient Surface Water Quality Monitoring Program - FY 2015

The purpose of the Ambient Surface Water Quality Monitoring Program is to collect data on the chemical, physical and biological characteristics of Delaware's surface waters. The information that is collected under this Program is used to:

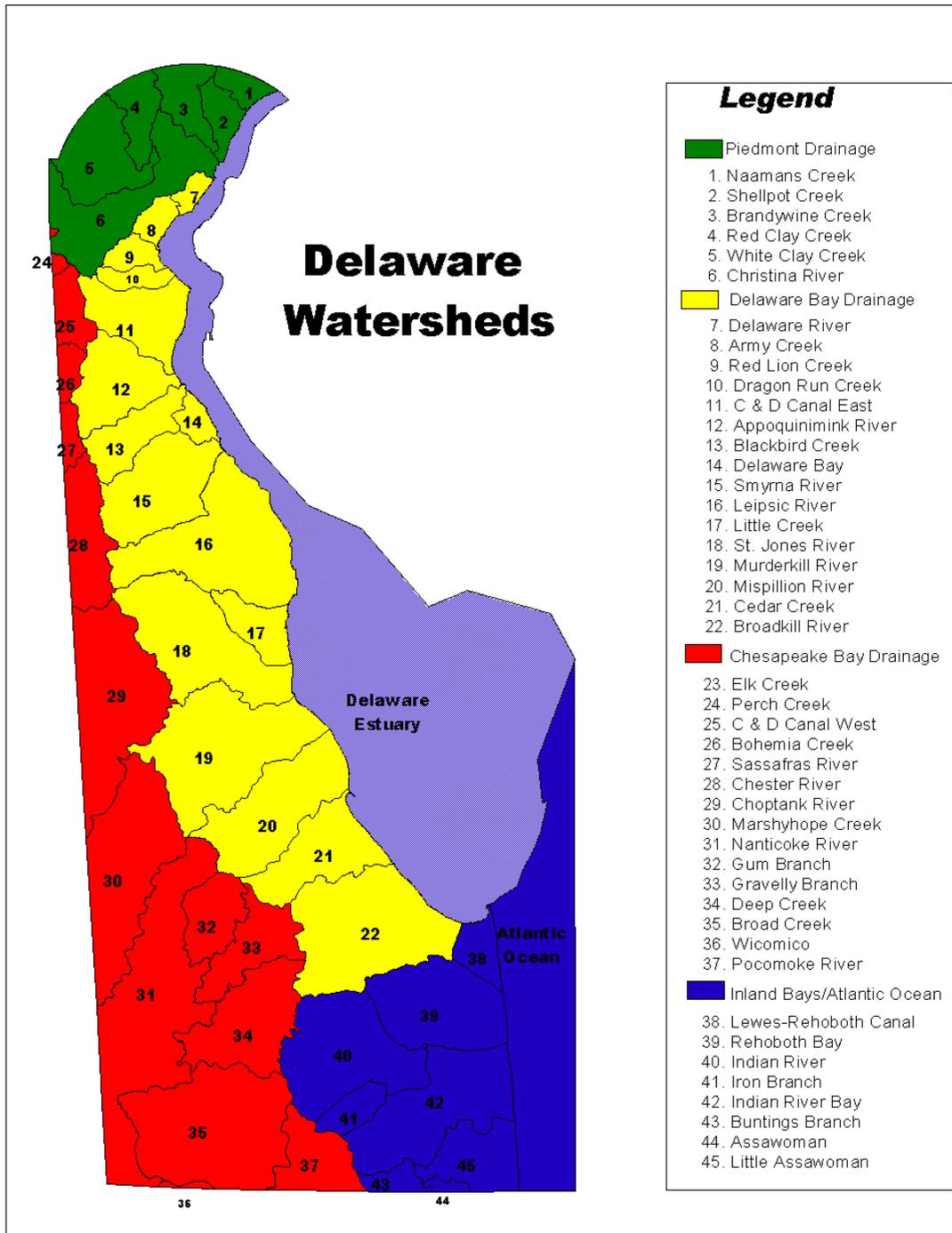
- Describe general surface water quality conditions in the State;
- Identify long term trends in surface water quality;
- Determine the suitability of Delaware surface waters for water supply, recreation, fish and aquatic life, and other uses;
- Monitor achievement of Surface Water Quality Standards;
- Identify and prioritize high quality and degraded surface waters;
- Calculate annual nutrient loads and track progress toward achieving Total Maximum Daily Loads (TMDLs) targets; and
- Evaluate the overall success of Delaware's water quality management efforts.

There are five major components to Delaware's Surface Water Quality Monitoring Program:

- General Assessment Monitoring
- Biological Assessment Monitoring
- Toxics in Biota Monitoring
- Toxics in Sediment Monitoring
- Monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plan.

This report discusses the General Assessment Monitoring network and plan. The current Toxics in Biota Monitoring Plan, Toxics in Sediment Monitoring Plan and the WATAR plan are all available on request.

Figure 1. State of Delaware Basins



Part I The General Assessment Monitoring Network (GAMN)

The General Assessment Monitoring Network (GAMN) provides for routine water quality monitoring of surface waters throughout Delaware. Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, and hardness. Some stations are monitored for dissolved metals. See tables 2 and 3 for parameters and methods. The data from this monitoring is entered into the STORET database, is reviewed and then analyzed in assessing the water quality of each basin for the Watershed Assessment Report (CWA Section 305 (b) Report).

The plan provides for monitoring at stations within each watershed in the state. The network was recently reviewed and updated. The review is discussed in section I.1. See also Table 1: FY 2015 Monitoring Plan and Schedule.

I.1 Changes for Surface Water Quality Monitoring Plan

Over the past several years, a main objective of the Watershed Assessment and Management Section's Ambient Surface Water Quality Monitoring Program was to collect water quality data that could be used for developing and calibrating hydrodynamic and water quality models. These models were used to establish Total Maximum Daily Loads (TMDLs) for nutrients and bacteria in impaired waters of the State.

Now, with the establishment of nutrient and bacteria TMDLs for most impaired waters of the State, a major objective of the Ambient Surface Water Quality Monitoring Program is to collect appropriate data that can be used to track water quality changes and to determine if TMDL requirements are being met.

Considering this (and other emerging) needs, and since the Department's monitoring budget is limited, the surface water quality monitoring plan has been prepared with the following changes: Monitoring stations in earlier monitoring plans were reviewed to determine which stations were critical to meet data needs and which could be dropped. The retained stations fall into 2 categories;

Stations were assigned to one of the following categories:

- a. C1 – Category 1 stations are high priority stations that will be used for calculating annual loads and/or long-term trends. These stations are generally co-located with a USGS stream gaging station, or are located at the mouth of a tidal river. Because of importance of these stations, monitoring at these stations will be conducted monthly, regardless of priority basin schedule (22 stations)
 - b. C2 – The remaining stations are part of Category 2 stations and monitoring frequency at these stations follow Priority Basin schedule.
2. A Rotating Basin Monitoring Plan has been implemented. In this scheme of monitoring, the State is divided into 5 Monitoring Basins. Every year, two of the Basins are considered "Priority Basins" and all stations in a Priority Basin are monitored monthly. Monitoring for stations in other basins will be conducted bimonthly. Priority Basin monthly monitoring will be conducted according to the following schedule:

- a. FY 2014 – Lower Delaware River/Bay, Piedmont
- b. FY 2015 – Piedmont, Chesapeake
- c. FY 2016 – Chesapeake, Inland Bays
- d. FY 2017 – Inland Bays, Upper Delaware River/Bay
- e. FY 2018 – Upper Delaware, Lower Delaware River/Bay

I.2 Objectives

The objective of this monitoring is to collect water quality data for status and trends assessment on all basins within Delaware. The data will also be compared to water quality standards to assess designated use support, as mandated by Section 305(b) of the Clean Water Act. In addition, the data will be used to calculate annual nutrient loads and to track progress toward achieving TMDL targets.

I.3 Scope of Monitoring

Table 1 provides a listing of all stations to be monitored during FY 2015.

Table 2 provides a listing of parameters that will be monitored at all stations in the network. Stations shown for metals testing in Table 1 shall be sampled according to the specifications in Table 3. The Department is in the process of bringing the Environmental Laboratory's recently purchased ICP/MS instrument online and expects to update metals sampling protocols in the near future. The monitoring plan will be adjusted as those details are known.

Part II Special Project Monitoring

Special project monitoring is needed from time to time in specific watersheds to address specific concerns. These projects are generally short term in nature. The Department is not conducting any special projects during the FY 2015 monitoring year.

II.1 Special Surveys

The purpose of special survey monitoring is to collect data that are not obtained using other monitoring activities and are needed for modeling purposes as described above. Special surveys include deployment of continuous monitors (YSI Data Sondes) and sediment sampling. No special survey sediment sampling is called for in this monitoring year.

II.2 Continuous Monitoring

The Department is implementing a network of continuous water quality monitoring stations to collect data for dissolved oxygen and other parameters several times each day using YSI (or similar) datasondes. The Department is cooperating with Delaware Geological Survey (DGS) and the United States Geological Survey (USGS) in operating a number of continuous monitors in the State. The information from these continuous monitoring sites are available on real-time basis via the USGS website and via the Delaware Environmental Observing System (DEOS) website. The Department had also put into place a special highly sophisticated on-site monitoring station/automated lab

device to collect and analyze samples for nutrients and other parameters at the outlet to Millsboro Pond. The data from this station were used to assess nutrient loads leaving the pond and entering the Delaware Inland Bays and thereby monitor TMDL implementation progress.

Part III Field and Laboratory Procedures

Field procedures for sample collection activities are detailed in the Quality Assurance Management Plan, Environmental Laboratory Section. Method references, STORET codes and reporting levels for parameters listed in Table 2 are from an Access database maintained by the Environmental Laboratory Section. Any deviation from standard field, laboratory procedures, or this sampling plan shall be documented with a complete description of the alteration.

Boat run surveys

Boat run surveys should be conducted within one day of tributary sampling in the watershed.

Part IV Quality Assurance, Documentation, Data Usage and Reporting

The quality assurance objectives and quality control procedures for these surveys are documented in the Quality Assurance Management Plan, Environmental Laboratory Section. A duplicate water column sample will be collected and analyzed on 10% of the samples from this project. All analytical results from the duplicate analyses shall be reported with the other data.

All analytical results shall be reported to the Watershed Assessment and Management Section digitally and on paper (using standard Environmental Laboratory Section data report forms).

Table 1 Station Locations, Descriptions Parameters and Sampling Frequency

<i>STATION INFORMATION - FY 2015</i>	<i>STORET #</i>	<i>Type</i>	<i>As</i>	<i>Fe</i>	<i>DIN & DIP</i>	<i>Storm Sampling</i>	<i>No. of Samples for FY 2015</i>	<i>Boat Run Stations</i>
<i>PIEDMONT DRAINAGE</i>								
<i>Brandywine Creek</i>								
Brandywine Creek @ Foot Bridge in Brandywine Park	104011	C2					12	
Brandywine Creek @ New Bridge Rd. (Rd. 279)(USGS gage 01481500)	104021	C1				4 storms	12	
Brandywine Creek @ Smith Bridge Rd. (Rd. 221)	104051	C2					12	
<i>Christina River</i>								
Christina River beneath Rt. 141 in Newport off Water St.	106021	C2					12	
Little Mill Creek @ DuPont Rd.	106281	C2					12	
Christina River @ Conrail Bridge (USGS tide gage 01481602)	106291	C1					12	
Christina River @ Nottingham Rd. (Rt. 273) above Newark	106191	C2					12	
Christina River @ Sunset Lake Rd. (Rt. 72) (USGS 01478000 at Cooches bridge)	106141	C1				4 storms	12	
Smalleys Dam Spillway @ Smalleys Dam Rd.	106031	C2					12	
<i>Red Clay Creek</i>								
Red Clay Creek @ W. Newport Pike (Rt. 4) Stanton (USGS gage 01480015)	103011	C2					12	
Burrough's Run @ Creek Rd. (Rt 82)	103061	C2					12	
Red Clay Creek @ Barley Mill Rd. (Rd. 258A) Ashland	103041	C2					12	
Red Clay Creek @ Lancaster Pike (Rt. 48) Wooddale (USGS gage 01480000)	103031	C1				4 storms	12	
<i>White Clay Creek</i>								
White Clay Creek @ Delaware Park Blvd. (Race Track) (USGS gage 014790000)	105151	C1				4 storms	12	
White Clay Creek @ McKees Lane	105171	C2					12	
White Clay Creek @ Chambers Rock Rd. (Rd. 329)	105031	C2					12	
<i>Naamans Creek</i>								
Naaman Creek @ State Line near Hickman Rd.	101021	C2					12	
S. Branch Naaman Creek @ Darley Rd. (Rd. 207)	101031	C2					12	
Naamans Creek at Rt 3 (Marsh Road)	101061	C2					12	
<i>Shellpot Creek</i>								
Shellpot Creek @ Hay Rd. (Rd. 501)	102041	C2		✓			12	
Rt. 13 Bus (Market Street) Bridge, USGS station is located about 700 ft downstream.	102051	C1				4 storms	12	
Shellpot Crk at Carr Road Bridge	102081	C2					12	

STATION INFORMATION - FY 2015	STORET #	Type	As	Fe	DIN & DIP	Storm Sampling	No. of Samples for FY 2015	Boat Run Stations
CHESAPEAKE BAY DRAINAGE								
Chester River								
Sewell Branch @ Sewell Branch Rd. (Rd. 95)	112021	C2					12	
Choptank River								
Cow Marsh Creek @ Mahan Corner Rd. (Rd. 208)	207021	C2					12	
Tappahanna Ditch @ Sandy Bend Rd. (Rd. 222)	207081	C2					12	
Culbreth Marsh Ditch @ Shady Bridge Rd. (Rd. 210)	207091	C2					12	
White Marsh Branch @ Cedar Grove Church Rd. (Rd. 268)	207111	C2					12	
Marshyhope Creek								
Marshyhope Creek @ Fishers Bridge Rd. (Rd. 308)	302031	C1				8 storms	12	
Nanticoke River								
Nanticoke River @ Sharptown	304011	C2					12	
Nanticoke River @ buoy 66 (confluence with DuPont Gut)	304151	C2					12	✓
Nanticoke River Tributaries								
Raccoon Prong @ Pepperbox Rd. (Rd. 66)	304671	C2					12	
Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	C1				8 storms	12	
Concord Pond @ German Rd. (Rd. 516)	304311	C2					12	
Williams Pond @ East Poplar St. (across from Hospital)	304321	C2					12	
Bucks Branch @ Conrail Rd. (Rd. 546)	304381	C2					12	
Nanticoke River @ Rt. 13	304471	C2					12	
Records Pond @ Willow St.	307011	C2					12	
Horseys Pond @ Sharptown Rd. (Rt. 24)	307171	C2					12	
Gravelly Branch @ Coverdale Rd. (Rd. 525)	316011	C2					12	
Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	307081	C2					12	
Deep Creek above Concord Pond, near Old Furnace at Rd. 46	304591	C2					12	
Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	316031	C2					12	
Broad Creek at Main Street in Bethel (Rd 493)	307031	C2					12	
Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	304681	C2					12	
Clear Brook at Rt 18 (Bowdens Garage Rd)	304491	C2					12	
Pocomoke River								
Pocomoke River @ Bethel Rd. (Rd. 419)	313011	C2					12	
DELAWARE BAY DRAINAGE								

STATION INFORMATION - FY 2015	STORET #	Type	As	Fe	DIN & DIP	Storm Sampling	No. of Samples for FY 2015	Boat Run Stations
Appoquinimink River								
Drawyer Creek off DuPont Parkway. (Rt. 13) at parking area	109071	C2					6	
Shallcross Lake @ Shallcross Lake Rd. (Rd. 428)	109191	C2					6	
Noxontown Pond @ Noxontown Rd. (Rd. 38)	109131	C2					6	
Appoquinimink River @ DuPont Prkwy. (Rt. 13)	109041	C2					6	
Appoquinimink River @ MOT Gut (west bank)	109171	C2					6	
Deep Creek Br of Appoquinimink River at Rt. 71 Bridge (Middletown Natural Area), duplicate with 109081	109251	C1				4 storms	12	
Appoquinimink River @ Silver Run Rd. (Rt. 9) NE side	109121	C2					6	
Appoquinimink River @ confluence with Delaware River	109091	C1					12	✓
Army Creek								
Army Creek @ River Rd. (Rt. 9)	114011	C2					6	
Chesapeake & Delaware Canal								
C & D Canal @ DuPont Pky. (Rt. 13) St. Georges Bridge	108021	C2					6	✓
Lums Pond @ Boat ramp	108111	C2					6	
Dragon Run								
Dragon Creek @ Wrangle Hill Rd. (Rt. 9)	111011	C2					6	
Dragon Creek @ S. DuPont Hgwy. (Rt. 13)	111031	C2					6	
Red Lion Creek								
Red Lion Creek @ Bear Corbitt Rd. (Rt. 7)	107011	C2					6	
Red Lion Creek @ Rt. 9	107031	C2					6	
Blackbird Creek								
Blackbird Creek, Road 463 East of RR Tracks. USGS gage	110011	C1				4 storms	12	
Blackbird Landing Rd 455	110031	C2					6	
Blackbird Creek @ Taylors Bridge Rd. (Rt. 9)	110041	C2					6	
Leipsic River								
Garrisons Lake @ DuPont Highway (Rt. 13)	202021	C2					6	
Leipsic River @ Denny St. (Rt. 9)	202031	C2					6	
Upstream of Masseys Millpond at Rt. 15	202191	C2					6	
Little River								
Little River @ Bayside Dr. (Rt.9)	204031	C2					6	
Little River @ N. Little Creek Rd. (Rt. 8)	204041	C2					6	
Smyrna River								

STATION INFORMATION - FY 2015	STORET #	Type	As	Fe	DIN & DIP	Storm Sampling	No. of Samples for FY 2015	Boat Run Stations
Mill Creek @ Carter Rd. (Rd. 137)	201021	C2					6	
Smyrna River @ Rt. 9 (Flemings Landing)	201041	C2					6	
Duck Creek @ Smyrna Landing Rd. (Rd. 485)	201051	C2					6	
201011 Mill Creek at Rt. 13	201011	C2					6	
Providence Creek @ Duck Creek Rd. (Rt.15)	201161	C2					6	
Broadkill River								
Ingram Branch, Savannah Ditch @ Rd. 246	303011	C2					6	
Ingram Branch @ Rd. 248	303021	C2					6	
Rt. 5 Bridge	303031	C1				4 storms	12	
Rt. 1 Bridge (Mainstem)	303041	C2					6	
Broadkill River 0.10 Miles From Mouth of Broadkill	303061	C1					6	✓
Red Mill Pond at Rt. 1	303051	C2					6	
Beaverdam Creek at Rd. 88	303171	C2					6	
Beaverdam Creek above Rd. 259, Hunters Mill Pond	303181	C2					6	
Round Pole Branch at Rd. 88	303311	C2					6	
Waples Pond at Rt. 1	303331	C2					6	
Pemberton Branch at Rt. 30 above Wagamons Pond	303341	C2					6	
Cedar Creek								
Swiggetts Pond @ Cedar Creek Rd. (Rt. 30)	301021	C2					6	
Cedar Creek @ Coastal Hgwy. (Rt. 1)	301031	C2					6	
Cedar Creek @ Cedar Beach Rd. (Rt. 36)	301091	C2					6	
Mispyllion River								
Mispyllion River @ Rt. 1	208021	C2					6	
Mispyllion River/Cedar Creek confluence @ Lighthouse	208061	C1					6	
Abbotts Pond @ Abbotts Pond Rd. (Rd. 620)	208181	C2					6	
Silver Lake @ Maple Ave.	208211	C2					6	
Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231	C2					6	
Delaware Bay								
Roosevelt Inlet, Mouth	401011	C2					6	✓
Murderkill River								
Murderkill River @ confluence of Black Swamp Creek at Rt. 13	206011	C1				4 storms	12	
Browns Branch @ Milford - Harrington Hwy. (Rt. 14)	206041	C2					6	

STATION INFORMATION - FY 2015	STORET #	Type	As	Fe	DIN & DIP	Storm Sampling	No. of Samples for FY 2015	Boat Run Stations
Murderkill River @ Bay Rd. (Rt. 1/113)	206091	C2					6	✓
Murderkill River @ Bowers Beach Wharf (mouth)	206101	C1					6	✓
Murderkill River near levee @ Milford Neck Wildlife Area (3.25 miles from mouth)	206141	C2					6	✓
Murderkill River @ confluence of Kent County WWTF discharge ditch	206231	C2					6	✓
McColley Pond @ Canterbury Rd. (Rt. 15)	206361	C2					6	
Coursey Pond @ Canterbury Rd. (Rt. 15)	206451	C2					6	
Double Run @ Barretts Chapel Rd. (rd. 371)	206561	C2					6	
St. Jones River								
St. Jones River @ Barkers Landing	205041	C2					6	
St. Jones River @ Rt. 10	205091	C2					6	
Fork Branch @ State College Rd. (Rd. 69)	205151	C2					6	
Moore's Lake @ S. State St.	205181	C2					6	
Silver Lake @ Spillway (Dover City Park)	205191	C1				4 storms	12	
St. Jones at Bowers Beach, mouth to Del.Bay.	205011	C1					6	
Derby Pond @ Rt. 13A	205211	C2					6	
INLAND BAYS DRAINAGE								
Tributary Stations								
Burton Pond @ Rt. 24	308031	C2			✓		6	
Millsboro Pond @ Rt. 24	308071	C1			✓	4 storms	12	
Pepper Creek @ Rt. 26 (Main St.)	308091	C2			✓		6	
Blackwater Creek @ Omar Rd. (Rd. 54)	308361	C2			✓		6	
Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	310031	C2			✓		6	
Bunting Branch								
Buntings Branch @ Rt. 54 (Polly Branch Rd.)	311041	C2			✓		6	
Guinea Creek								
Guinea Creek @ Banks Rd. (Rd. 298)	308051	C2			✓		6	
Iron Branch								
Whartons Branch @ Rt. 20 (Dagsboro Rd.)	309041	C2			✓		6	
Lewes & Rehoboth Canal								
Lewes & Rehoboth Canal @ Rt. 9	305041	C2			✓		6	
Little Assawoman Canal								
Little Assawoman Bay @ Rt. 54 (The Ditch)	310011	C2			✓		6	

STATION INFORMATION - FY 2015	STORET #	Type	As	Fe	DIN & DIP	Storm Sampling	No. of Samples for FY 2015	Boat Run Stations
White Creek @ mouth of Assawoman Canal	312011	C2			✓		6	
Love Creek								
Bundicks Branch @ Rt. 23	308371	C2			✓		6	
Miller Creek								
Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	310121	C1			✓		12	
Stockley Branch/Cow Bridge								
Cow Bridge Branch @ Zoar Rd. (Rd. 48)	308281	C2			✓		6	
Swan Creek								
Swan Creek @ Mount Joy Rd. (Rd. 297)	308341	C2			✓		6	
Vines Creek								
Ocean Boundary Stations								
Lewes & Rehoboth Canal @ Rt. 1	305011	C2			✓		6	
Indian River Inlet @ Coast Guard Station	306321	C1	✓		✓		12	
Boat Run Stations								
Rehoboth Bay @ Buoy 7	306091	C2	✓		✓		6	✓
Masseys Ditch @ Buoy 17	306111	C2	✓		✓		6	✓
Indian River Bay @ Buoy 20	306121	C1	✓		✓		12	✓
Indian River @ Buoy 49 (Swan Creek)	306181	C2	✓		✓		6	✓
Indian River @ Island Creek	306331	C2	✓		✓		6	✓
Island Creek upper third	306341	C2	✓		✓		6	✓
Little Assawoman Bay Mid-bay (Ocean Park Lane)	310071	C2			✓		6	✓

Table 2 Water Quality Parameters to be analyzed at all Stations in the Monitoring Network, FY 2015

<i>Parameter</i>	<i>Method Reference (EPA)</i>	<i>Reporting Level¹</i>
<i>Water Column Nutrients</i>		
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
<i>Carbon and Organics</i>		
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
<i>Biochemical Oxygen Demand</i>		
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
<i>General</i>		
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
<i>Bacteria</i>		
Enterococcus	SM20 th ed-9230C	1 cfu/100 ml

- ¹ As 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 3.
- ² Secchi Depth to be measured at designated stations.
- ³ Light attenuation to be conducted as practical to obtain correlation with Secchi disk readings

Table 3 Metals Parameters

<i>Dissolved 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
Iron	EPA 200.7 M	100 ug/l