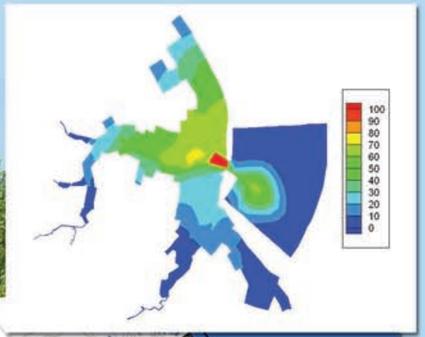
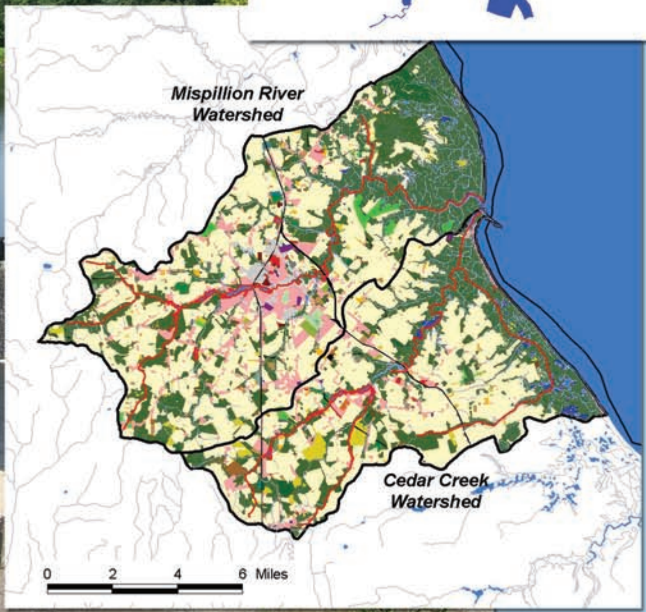
Bacteria, Nutrient, and Dissolved Oxygen TMDL Development for Mispillion River and Cedar Creek, Delaware

August 2006





Prepared for:
Delaware Department of Natural Resources and Environmental Control

Prepared by:
Water Resources and TMDL Center
Tetra Tech, Inc.

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PREFACE

Draft Proposed TMDLs for the Mispillion River and Cedar Creek watersheds were reviewed during a public workshop held on May 18, 2006. All comments received at the workshop and during the May 1 through 31 comment period were considered by DNREC. This report has been updated to address comments by Mid-Atlantic Environmental Law Center. The updates can be found in Sections 1, 2, and 5.

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are violating water quality standards. TMDLs represent the total pollutant loading that a waterbody can receive without violating water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions. By following the TMDL process, states can establish water quality based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of their water resources (USEPA 1991).

Due to their high nutrient concentrations, low dissolved oxygen levels, and high bacteria levels the Delaware Department of Natural Resources and Environmental Control (DNREC) identified and included in the state's 1996, 1998, 2002, 2004, and Draft 2006 Section 303(d) lists of impaired waters several waterbodies in the Mispillion River and Cedar Creek watersheds. The nine listings in the Mispillion River watershed and three listings in the Cedar Creek watershed include tidal and non-tidal rivers and streams as well as several ponds and lakes. As such, the state is required to develop TMDLs for applicable water quality parameters. The first steps in the TMDL development process have already been conducted and included compilation of available data; evaluation of monitoring data to identify the extent, location, and timing of water quality impairments; development of a technical approach to analyze the relationship between source pollutant loading contributions and in-stream response; model configuration; model testing (calibration and corroboration); and scenario analysis. These steps were detailed in "Data Review and Modeling Approach – Mispillion River and Cedar Creek TMDL Development," dated March 31, 2005 and "Model Configuration and Calibration Results – Mispillion River and Cedar Creek Models for TMDL Development," dated November 1, 2005. This document presents the results of the modeling studies and provides the technical basis for the calculation of the TMDLs.

1.1 Background Information

The Mispillion River and Cedar Creek watersheds lie adjacent to each other, in the southern portion of the coastal plain of southern Delaware (Figure 1-1). The Mispillion River forms the dividing line between Kent and Sussex Counties. Cedar Creek lies just to the south of Mispillion River, in northeastern Sussex County. Both watersheds are contained within one U.S.

Geological Survey (USGS) 8-digit hydrologic cataloging unit – 02040207. Typical of the coastal plain, the topography is generally characterized by flat to gently sloping land.

The Mispillion River is approximately 20 miles long and contains nearly 70 miles of waterways, plus several lakes and ponds. The watershed itself encompasses an area of approximately 76 square miles. The headwaters of the Mispillion River originate several miles inland and the river flows to the east where it drains into Delaware Bay. The river flows through one major urban area upon passing through the City of Milford, DE. Downstream portions of the watershed primarily consist of wetlands. The topography is generally characterized by flat to gently sloping land, which is typical of the coastal plain.

Cedar Creek is a smaller stream, approximately 15 river miles. The watershed encompasses an area of approximately 52 square miles. The Cedar Creek drainage originates just west of Route 113 and flows east through a series of ponds until it becomes an estuary east of Route 1. The stream discharges to Delaware Bay at Mispillion River Inlet (Blosser et al., 1983). The watershed is sparsely populated and is comprised of wetlands, forests, and agricultural areas.

The Mispillion River and Cedar Creek flow into Delaware Bay; hence, downstream portions of both waterbodies are considered estuaries. The upstream boundary of an estuary is the limit of tidal influence. Depending on streamflow and tide variability, the tidal influence varies. In both watersheds, cropland is the dominant land use/land cover, followed by wetlands. Other land cover types include various types of forest and developed areas. These land use categories are discussed further in Section 4.1.1.2.

There is one currently permitted facility and one formerly permitted facility located in the Mispillion River watershed and none in the Cedar Creek watershed. The currently permitted facility is DE0051047 (Baltimore Aircoil Milford Plant) and the formerly permitted facility is DE0051098 (Sea Watch International). DE0051047 has a permit for cooling water and stormwater and DE0051098 had a stormwater permit, however it was voided on 2/23/03. At that time, a General Industrial Storm Water Permit was issued, which does not include limits for stormwater discharge, but does require monitoring of various constituents.

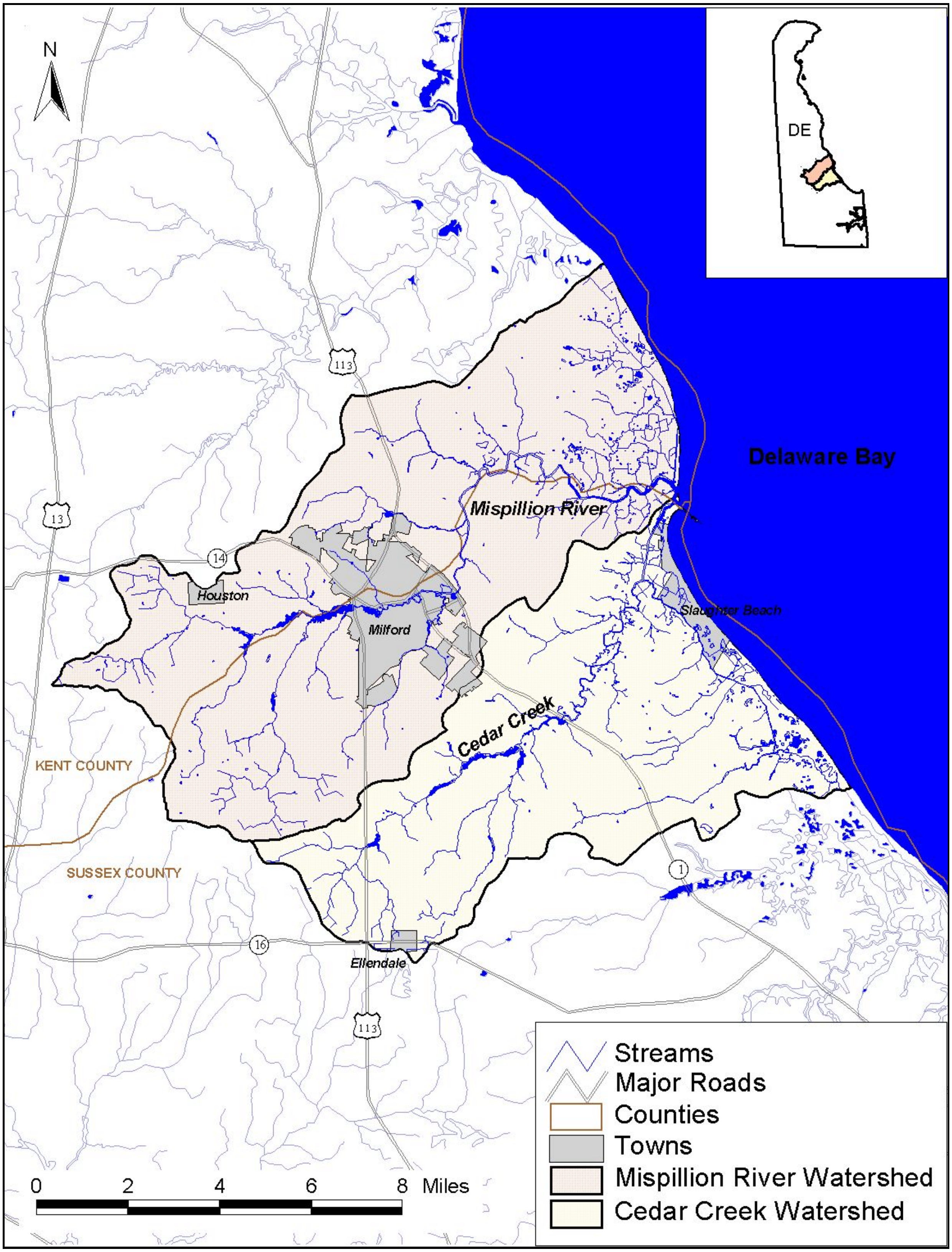

Figure 1-1. Location of the Mispillion River and Cedar Creek watersheds.

1.2 Impairment Listing

The Delaware 303(d) List reported that designated uses in the Mispillion River and Cedar Creek watersheds were impaired for a variety of reasons (Table 1-1). Table 1-1 shows impairments listed in the 1996, 1998, 2002, 2004, and Draft 2006 List. Figure 1-2 shows the location of the Mispillion River watershed, major streams, and the impaired segments. Figure 1-3 shows the Cedar Creek watershed, major streams, and the impaired segments. Note that Church Branch, Cedar Mill Pond, Cubbage Pond, Clendaniel Pond, and Hudson Pond are included under the impairment listings for Upper Cedar Creek.

Table 1-1. Delaware 303(d) List of DO, bacteria, and nutrients impairments in the Mispillion River and Cedar Creek watersheds.

Segment	ID	Description	Size	Pollutant	Year Listed
		Mispillion River Watershed			
Lower Mispillion	DE210-001	From dam at Silver Lake to mouth at Delaware Bay	13.2 mi	Nutrients DO Bacteria	1996 1996 1996
Upper Mispillion	DE210-002	From the headwaters to Silver Lake in Milford, excluding Silver, Haven, and Griffith Lakes; Blairs, Abbotts and Tub Mill Ponds	11.2 mi	Nutrients DO Bacteria	1996 1996 1996
Johnson Branch	DE210-003	Johnson Branch, including its tributaries, from the confluence of the headwaters to the confluence with Haven Lake	4.02 mi	Nutrients* Bacteria*	2006 2006
Lednum Branch from the headwaters to Silver Lake	DE210-004	Lednum Branch -- eastern tributary of the headwaters to its confluence	4.02 mi	Nutrients* Bacteria*	2006 2006
Mispillion tributaries from the dam at Silver Lake to the Mouth	DE210-005	King's Causeway Branch	2.45 mi	DO Bacteria* Nutrients*	2004 2006 2006
Tub Mill Pond	DE210-L01	Pond north of Milford	4.8 acres	Nutrients DO*	1996 2006
Silver Lake	DE210-L02	Silver Lake at Milford	28.5 acres	Nutrients Bacteria	1996 1996
Haven Lake	DE210-L03	Lake west of Milford; upstream of Silver Lake	82.5 acres	Nutrients DO	1996 1996
Griffith Lake	DE210-L04	Lake west of Milford; upstream of Haven Lake	32.2 acres	Nutrients	1996
Blairs Pond	DE210-L05	Pond southwest of Milford	28.5 acres	Nutrients Bacteria	1996 1996
Abbotts Mill Pond	DE210-L06	Pond southwest of Milford	25.6 acres	Nutrients Bacteria DO	1998 1998 2002
		Cedar Creek Watershed			
Lower Cedar Creek	DE080-001	Tidal segment from Cedar Creek Mill Pond to mouth at Delaware Bay	8.8 mi	Nutrients DO Bacteria	1996 1996 1996

Segment	ID	Description	Size	Pollutant	Year Listed
Upper Cedar Creek	DE080-002	From the headwaters to Cedar Creek Mill Pond, including Church Branch and Cedar Mill Pond, Cubbage Pond, Clendaniel Pond and Hudson Pond	13.0 mi	Nutrients	1996
				DO	2004
				Bacteria	1996
Slaughter Creek	DE080-003	From the headwaters to the confluence with Cedar Creek	7.91 mi	DO	2004
				Nutrients*	2006
				Bacteria*	2006

* These segments are listed in the draft 2006 303(d) List. Although TMDL development was not originally designed to address these newly listed segments, they were included in the modeling inherently. As a result, these reaches are included in the TMDLs and conditions meet water quality criteria based on the loads developed.

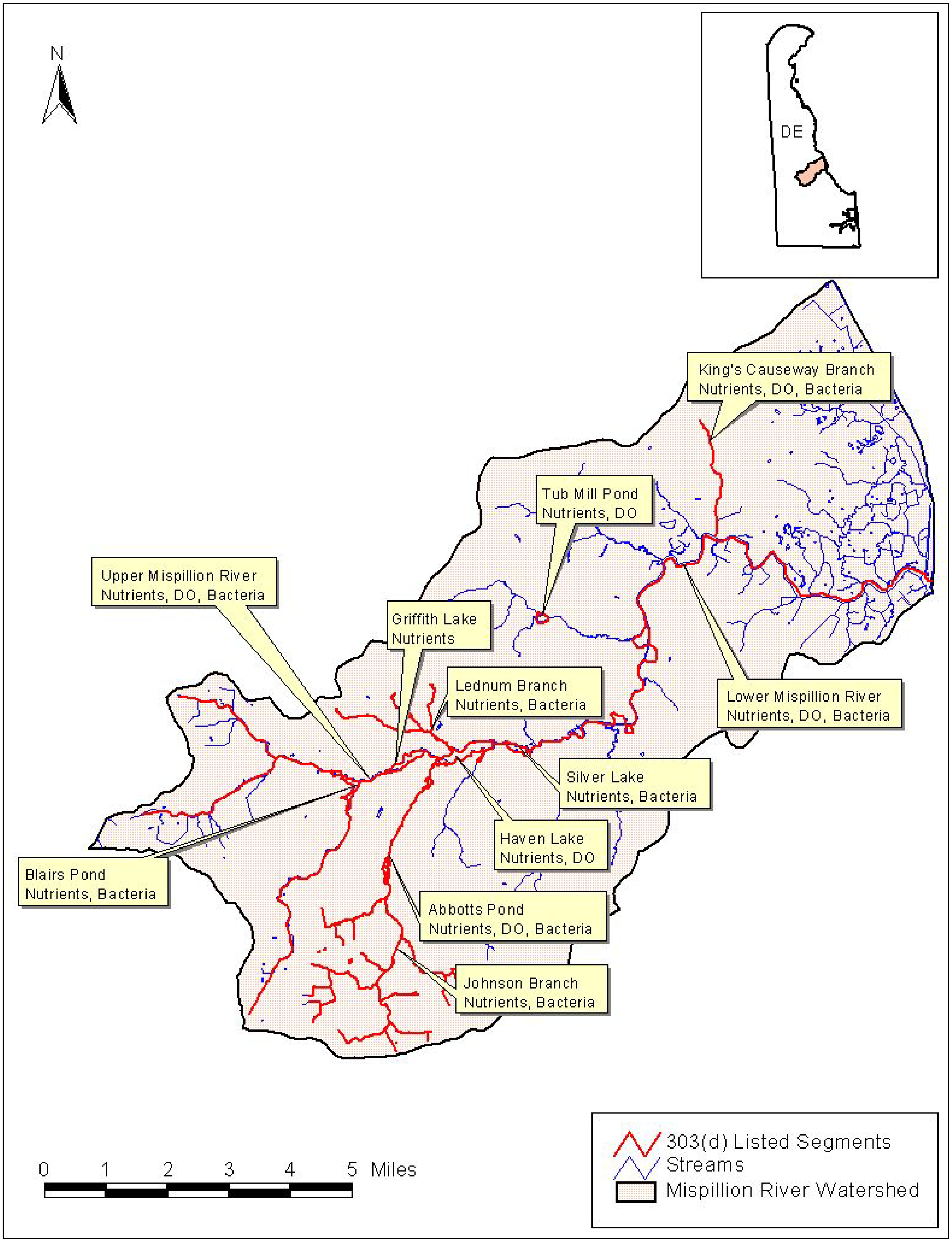

Figure 1-2. Location of the impaired segments in the Mispillion River watershed.

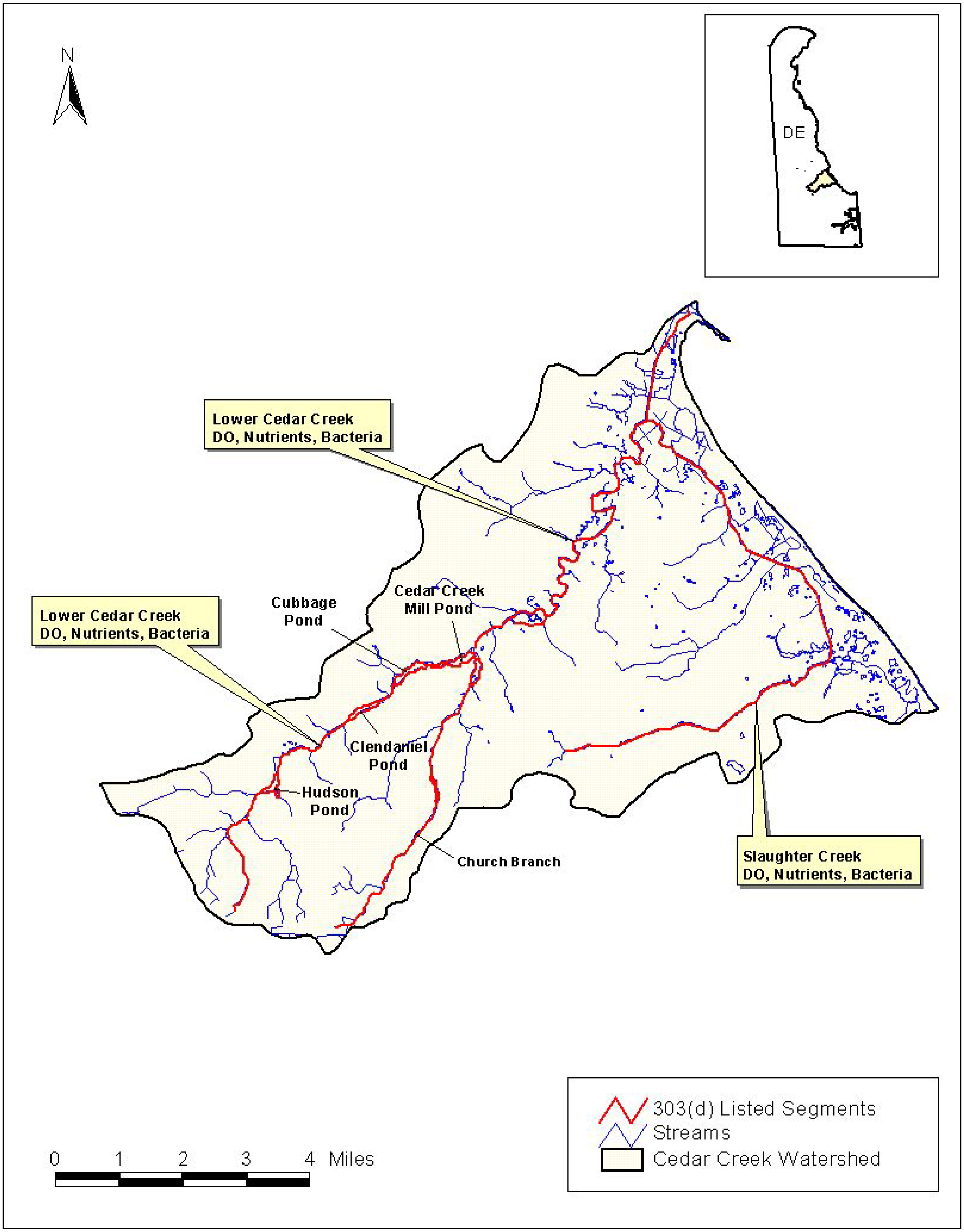

Figure 1-3. Location of the impaired segments in the Cedar Creek watershed.

1.3 Applicable Water Quality Standards

The Mispillion River and Cedar Creek watersheds are regulated by the applicable water quality standards of the State of Delaware. This section presents the current applicable water quality standards relevant to TMDL development for nutrients, DO, and bacteria. The information presented was obtained from the State of Delaware Surface Water Quality Standards, As Amended July 11, 2004 (DNREC, 2004). Table 1-2 provides the beneficial use designations for the waterbodies in the Mispillion River and Cedar Creek watersheds.

Table 1-2. Beneficial uses designated for the Mispillion River and Cedar Creek watersheds.

Designated Beneficial Uses	Mispillion River Basin (20)	Cedar Creek Basin (21)
Public Water Supply Source	-	-
Industrial Water Supply Source	X	X
Primary Contact Recreation	X	X
Secondary Contact Recreation	X	X
Fish, Aquatic Life & Wildlife**	X	X
Cold Water Fish (Put-and-Take)		-
Agricultural Water Supply	(a)	(a)
ERES Waters*		(b)
Harvestable Shellfish Waters		-

(a) Designated use for freshwater segments only.
(b) Designated use for marine water segments only.
X this designated water use to be protected throughout entire stream basin
- water uses not designated in the stream basin
* waters of exceptional recreational or ecological significance
** includes shellfish propagation

Fresh waters are defined as waters of the State which contain natural levels of salinity of 5 parts per thousand or less, whereas marine waters are defined as waters of the State which contain natural levels of salinity in excess of 5 parts per thousand. Certain waters, such as downstream portions of the Mispillion River and Cedar Creek, are subject to natural variations in salinity such that those waters meet the definition of fresh at some times and marine at other times. Note that the DO criteria are more stringent for fresh water, while numeric bacteria standards are more stringent for marine waters. Nutrient targets remain the same for both fresh and marine waters. Standards for both fresh and marine waters are discussed below.

As noted in Table 1-2, the marine portion of Cedar Creek is designated as waters of exceptional recreational or ecological significance (ERES). Section 5.6 of the State of Delaware Surface Water Quality Standards, as amended, July 11, 2004, requires that: "Designated ERES waters shall be accorded a level of protection and monitoring in excess of that provided most other waters of the State. These waters are recognized as special natural assets of the State, and must be protected and enhanced for the benefit of present and future generations of Delawareans." These waters are to be restored to their natural condition, to the maximum extent practicable, and discharges shall be avoided. Pollution control strategies shall be developed for ERES waters and BMPs are to be adopted (DNREC, 2004).

1.3.1 Dissolved Oxygen

The dissolved oxygen standard is excerpted below, in part, from Section 4.5.2 of the State of Delaware Surface Water Quality Standards.

For fresh waters:
- the daily average dissolved oxygen shall not be less than 5.5 mg/L, and
- the instantaneous minimum shall not be less than 4.0 mg/L.

For marine waters:
- the daily average dissolved oxygen shall not be less than 5.0 mg/L, and
- the instantaneous minimum shall not be less than 4.0 mg/L.

For all waters, in cases where natural conditions prevent attainment of these criteria, allowable reduction in dissolved oxygen levels as a result of human activities shall be determined through application of the requirements of Sections 5 and 9 of the Standards. DNREC may mandate additional limitations on a site-specific or seasonal basis in order to provide incremental protection for early life stages of fish.

1.3.2 Nutrients

According to Delaware's Nutrient Management Law, nutrients are defined as "nitrogen, nitrate, phosphorus, organic matter and any other elements necessary for or helpful to plant growth". Nutrient over-enrichment is recognized as a significant problem in some of Delaware's waters, including those in the Mispillion River and Cedar Creek watersheds. Excess nutrients in a waterbody can lead to nuisance algal blooms and low DO concentrations, which in turn impacts fish and macroinvertebrate populations. In the State of Delaware Surface Water Quality Standards, the narrative nutrients criteria are stated as follows:

- It shall be the policy of this Department to minimize nutrient input to surface waters from point and human induced nonpoint sources.
- The types of, and need for, nutrient controls shall be established on a site-specific basis. Nutrient controls may include, but shall not be limited to, discharge limitations or institution of best management practices.
- For lakes and ponds, controls shall be designed to eliminate over-enrichment.
- The specific measures to be employed by existing NPDES facilities to meet the aforementioned criteria are specified in a separate section of the standards.

Furthermore, DNREC developed numeric target values for total nitrogen and total phosphorus in order to implement the above criteria. For the purpose of TMDL development, nutrient target levels to be met are 3.0 mg/L for Total Nitrogen and 0.2 mg/L for Total Phosphorus.

1.3.3 Bacteria

The bacteria standard is excerpted below, in part, from Section 4 of the State of Delaware Surface Water Quality Standards. The following criteria apply to waters designated for primary and secondary contact recreation use, which includes the Mispillion River and Cedar Creek.

Table 1-3. Bacterial water quality criteria.

Waterbody Type	Geometric Mean (Enterococcus, #/100mL)	Single-Sample Value (Enterococcus, #/100mL)
Primary Contact Recreation Fresh Waters	100	185
Primary Contact Recreation Marine Waters	35	104
Secondary Contact Recreation Fresh Waters	500	925
Secondary Contact Recreation Marine Waters	175	520

2.0 DATA REVIEW AND SOURCE ASSESSMENT

Analyses were performed on historical water quality and streamflow data to determine critical flow conditions and relative loads to assess the impact of point and nonpoint sources on instream water quality. These analyses helped to assess pollutant sources in the Mispillion River and Cedar Creek watersheds.

2.1 Data Sources

A wide range of information was reviewed for the impaired watersheds. The categories of data examined include physiographic data describing physical conditions of the watershed, environmental monitoring data identifying potential pollutant sources and contributions to the impaired waters and their tributaries, hydrologic flow data, and water quality monitoring data. Table 2-1 summarizes the various data types and data sources reviewed and collected.

Table 2-1. Sources of data for the Mispillion River and Cedar Creek watersheds.

Data Category	Description	Data Source(s)
Watershed Physiographic Data	Land use (National Land Cover Data)	DNREC
	Stream reach coverage	DNREC
	Digital elevation model (30 meter resolution)	USGS - National Elevation Dataset (NED)
	Soils	NRCS/USGS STASGO
	Weather information	DNERR
Hydrologic data	Streamflow data	USGS
	Tide data	NOAA
Water Quality	Instream concentrations of nutrient, oxygen, and bacteria, as well as other parameters	DNREC, EPA STORET, USGS
Bacteria Source Information	Animal counts, septic systems information, agricultural practices, etc.	DNREC

USGS - United States Geological Survey; STASGO - State Soil and Geographic Database; DNERR - Delaware National Estuarine Research Reserve; DNREC - Delaware Department of Natural Resources and Environmental Control; NOAA - National Oceanic and Atmospheric Administration; US EPA - United States Environmental Protection Agency; EPA STORET - STOrage and RETrieval System

Additionally, a number of technical reports describing past modeling efforts and studies in the State of Delaware were reviewed. These are described in more detail in the data review and modeling reports. The reader is referred to these reports for more detailed data summaries and analysis.

2.2 Data Review

The 303(d) Lists from 1996, 1998, 2002, 2004, and Draft 2006 reported that the Mispillion River, Cedar Creek, and various tributaries are impaired because of low dissolved oxygen, nutrients, and bacteria. The impaired uses include fish and aquatic life use, wildlife use and habitat, and primary and secondary contact recreation uses. Summaries and discussions of relevant water quality data follow. Figures 2-1 and 2-2 show all surface water quality monitoring stations in the Mispillion River and Cedar Creek watersheds, respectively.

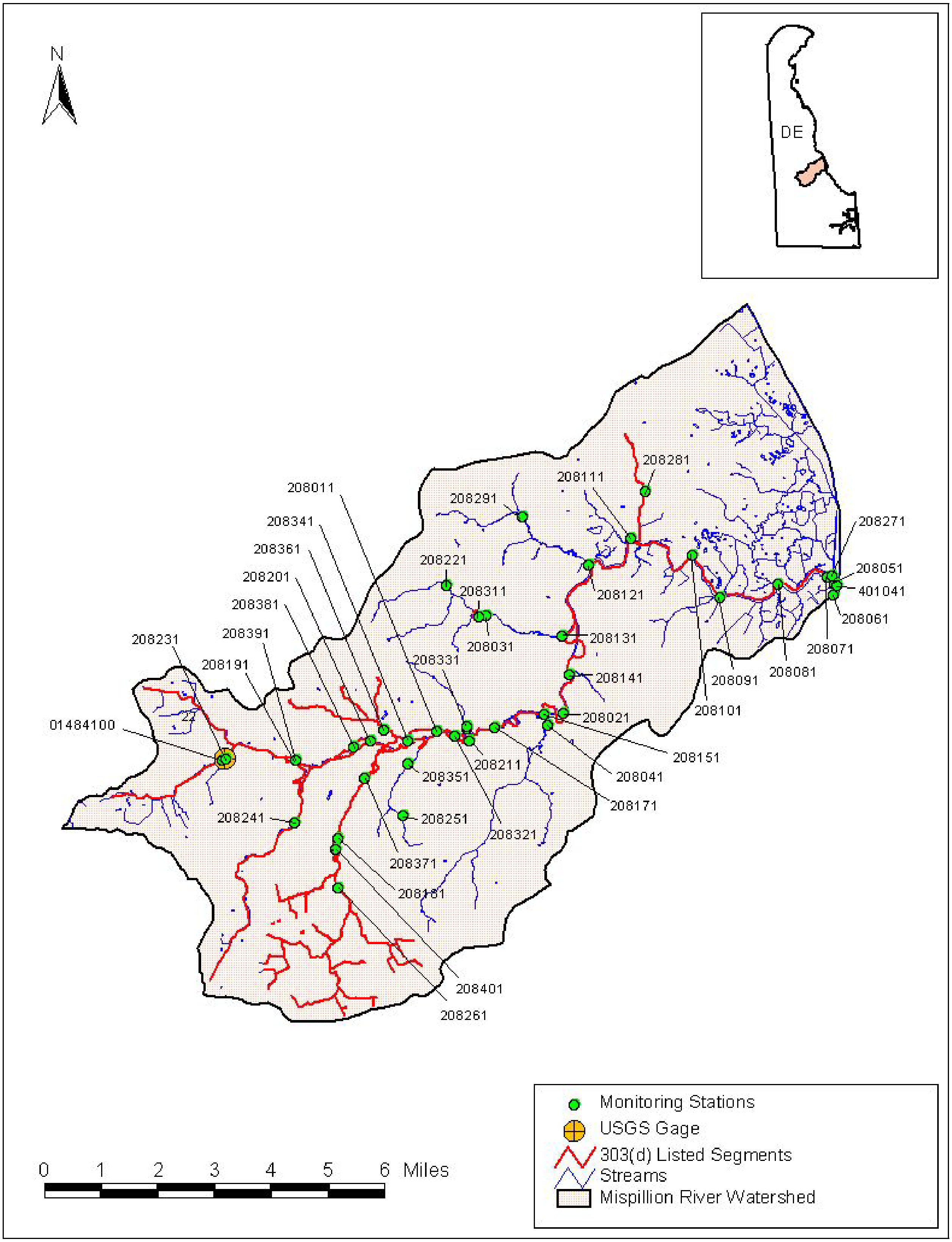

Figure 2-1. Sampling sites in the Mispillion River watershed.

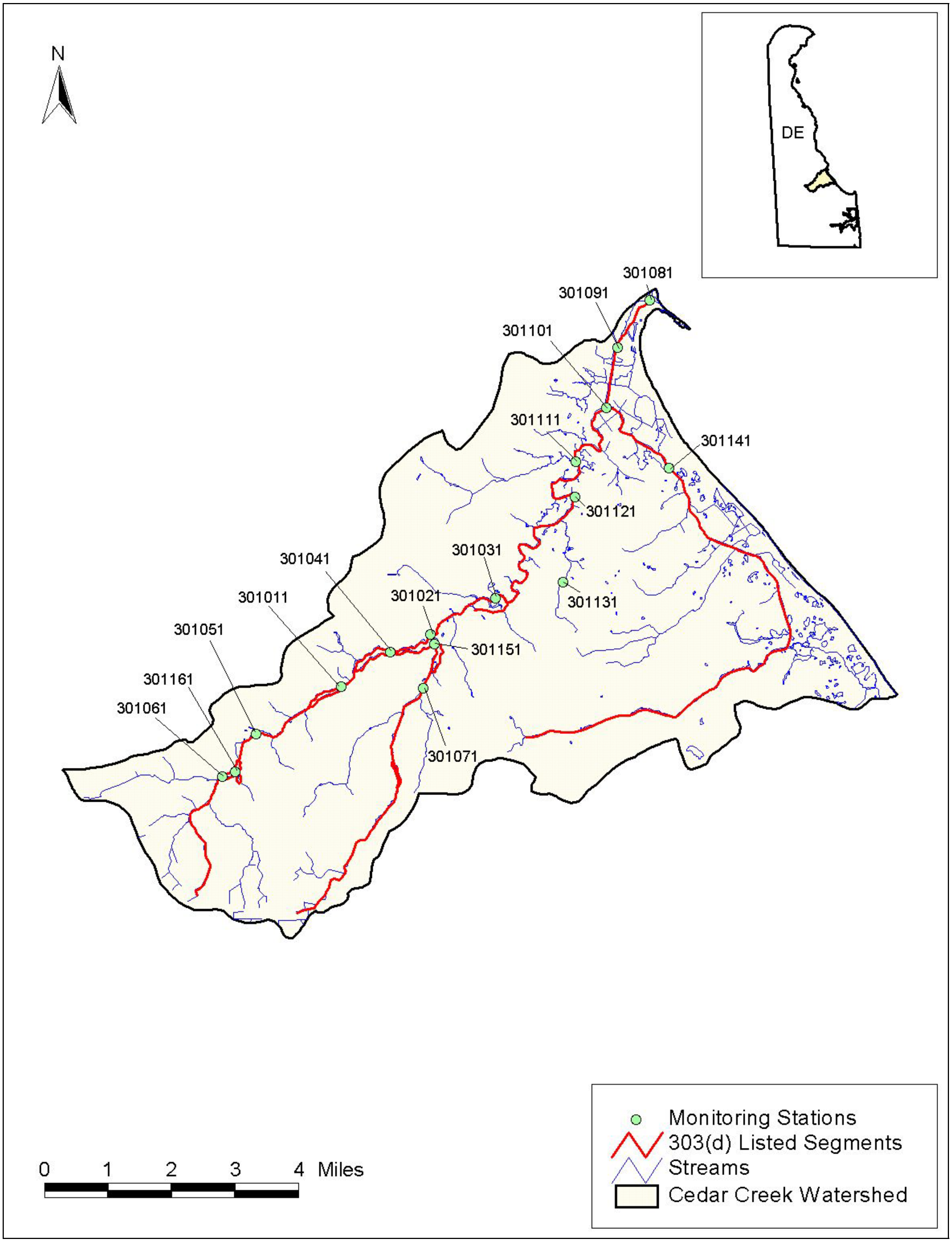

Figure 2-2. Sampling sites in the Cedar Creek watershed.

2.2.1 Dissolved Oxygen

The DO impaired waters in the Mispillion River watershed include the lower and upper Mispillion River (including the headwaters), King's Causeway Branch, Haven Lake, and Abbotts Mill Pond. DO data for the Mispillion River watershed are available from 35 monitoring stations, including data from DNREC, USGS, and STORET.

Twenty-one of the stations were considered to be on the mainstem and associated ponds along the Mispillion River. DO data are available for 17 of these stations. Figure 2-3 shows the average, minimum, and maximum DO concentrations at these stations moving downstream along the Mispillion River. It should be noted that these data don't necessarily represent the same time periods at each station and, therefore, conditions are not necessarily identical. The instantaneous minimum DO criterion (of 4.0 mg/L) is shown for comparison purposes.

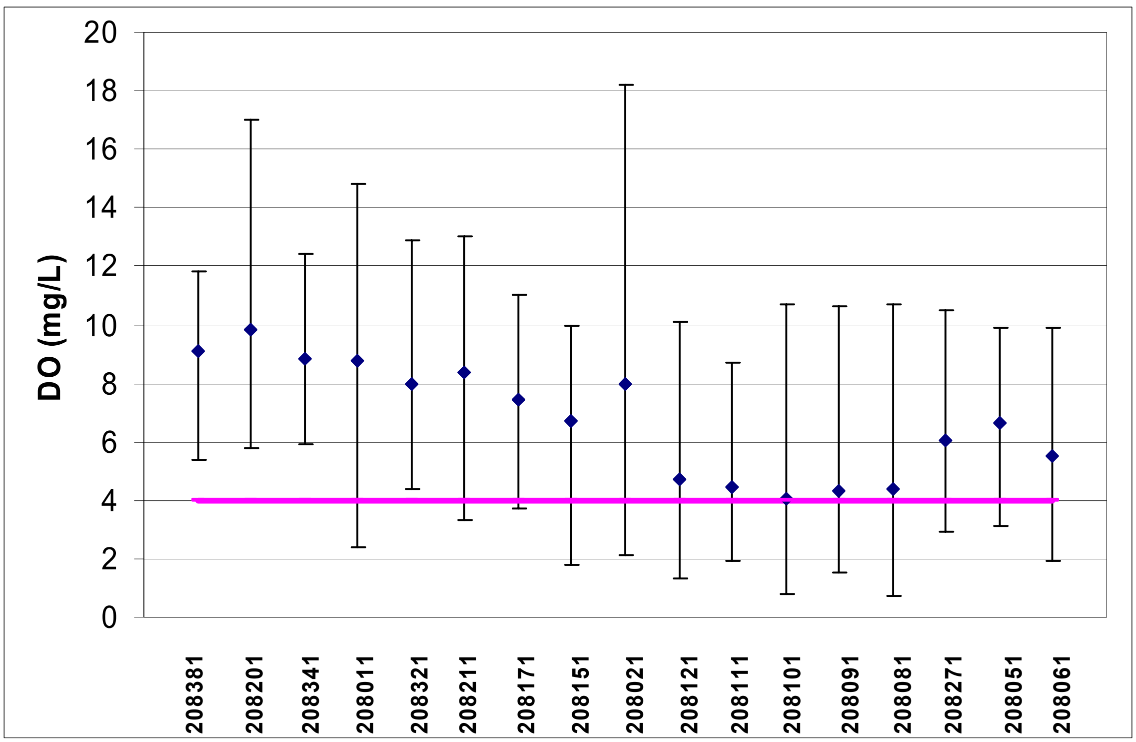

Figure 2-3. Average, maximum, and minimum DO concentrations along the Mispillion River mainstem, from upstream to downstream.

The low DO impaired waters in the Cedar Creek watershed include lower and upper Cedar Creek (including the headwaters, Church Branch, Cedar Mill Pond, Cubbage Pond, Clendaniel Pond, and Hudson Pond), and Slaughter Creek.

DO data for the Cedar Creek watershed are available from 16 monitoring stations, including data from DNREC, USGS, and STORET. Thirteen of the monitoring stations were considered to be along the mainstem of Cedar Creek, all of which have DO data. Figure 2-4 shows the average, minimum, and maximum DO concentrations at these stations moving downstream along Cedar

Creek. The instantaneous minimum DO criterion (of 4 mg/L) is shown for comparison purposes. DO concentrations are fairly low at the upstream station (301061), but tend to increase downstream until station 301151, at which point Church Branch and Upper Cedar Creek join at Cedar Creek Mill Pond. Then DO continues to decrease going downstream station by station.

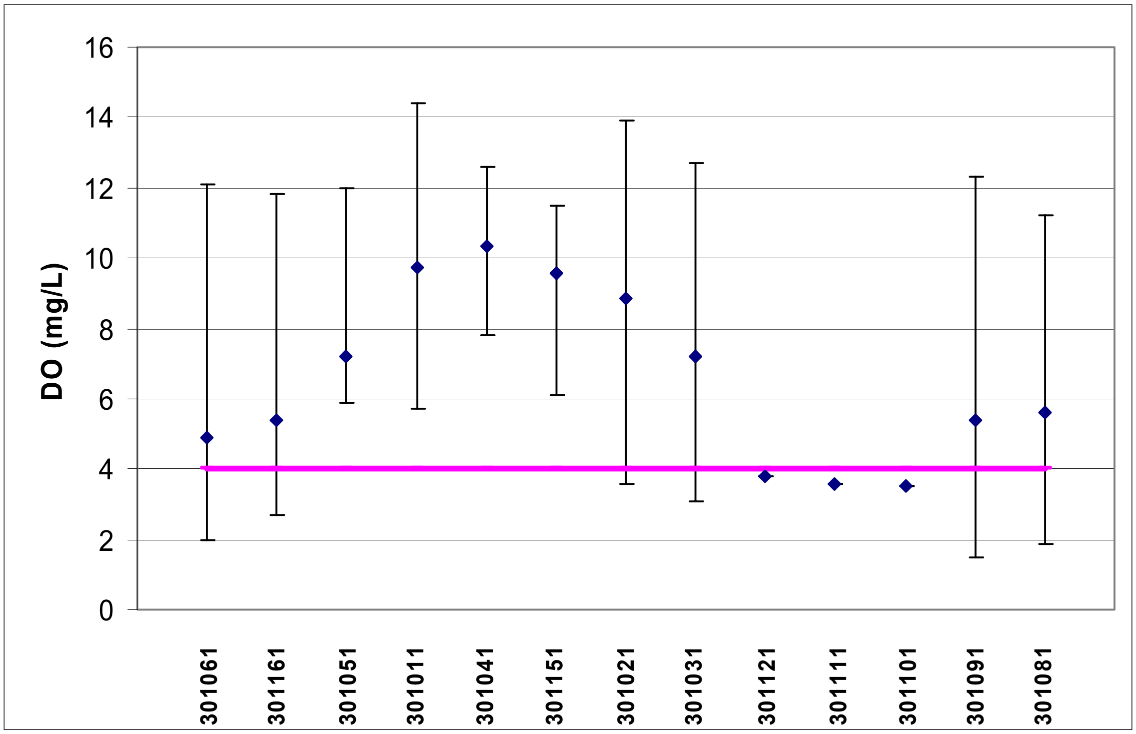

Figure 2-4. Average, maximum, and minimum DO concentrations along the Cedar Creek mainstem, from upstream to downstream.

DO data at selected stations were further assessed in order to gain more insight into DO impairment trends in the Cedar Creek watershed. The highest DO concentrations are observed during the spring and winter months and lowest are during the summer and early fall, when flow is lowest and temperatures are highest.

2.2.2 Nutrients

Waterbodies in the Mispillion River watershed that are impaired for nutrients include the upper and lower Mispillion River (including the headwaters), Tub Mill Pond, Silver Lake, Haven Lake, Griffith Lake, Blairs Pond, and Abbotts Mill Pond. A variety of nutrients data are available for 37 monitoring stations in the Mispillion River watershed.

Twenty-one monitoring stations are considered to be on the mainstem and associated ponds along the Mispillion River. TN data are available for 11 of these stations and TP data are available for 17 of the stations. Figures 2-5 and 2-6 show the average, minimum, and maximum TN and TP concentrations, respectively, at these stations moving downstream along the Mispillion River. It should be noted that these data don't necessarily represent the same time periods at each station and, therefore, conditions are not necessarily identical. The maximum targets are shown in each figure for comparison purposes.

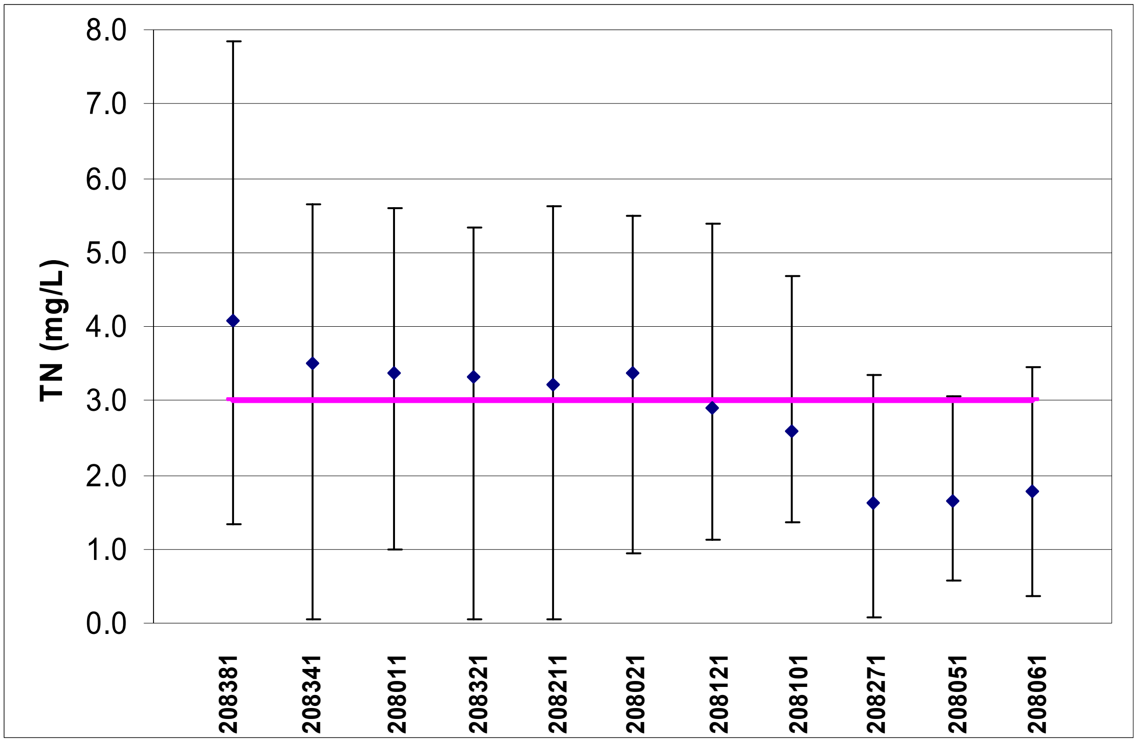

Figure 2-5. Average, maximum, and minimum TN concentrations along the Mispillion River mainstem, from upstream to downstream.

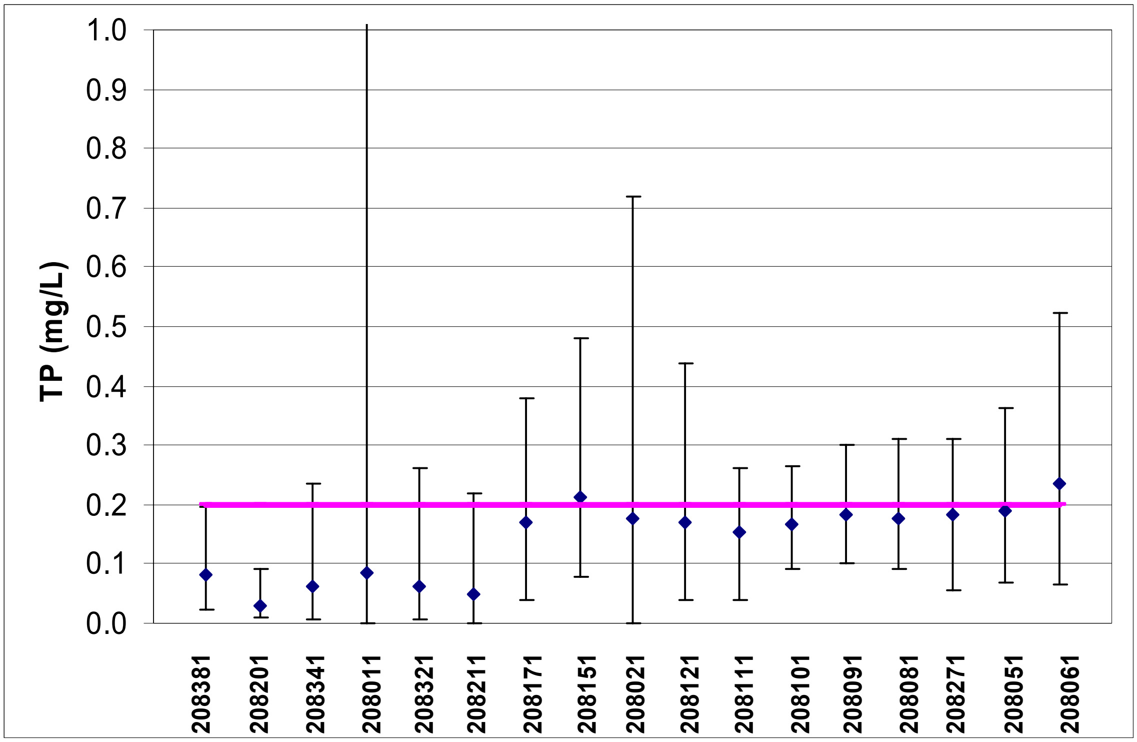

Figure 2-6. Average, maximum, and minimum TP concentrations along the Mispillion River mainstem, from upstream to downstream.

The waterbodies in the Cedar Creek watershed that are listed for nutrient impairments include lower and upper Cedar Creek (including the headwaters, Church Branch, Cedar Mill Pond, Cubbage Pond, Clendaniel Pond, and Hudson Pond). Sampling data are available for several nutrients at 16 monitoring stations in the Cedar Creek watershed.

Thirteen monitoring stations are considered to be along the mainstem of Cedar Creek. TN data are available for ten of these stations and TP data are available for 13 of the stations. Figures 2-7 and 2-8 show the average, minimum, and maximum TN and TP concentrations, respectively, at these stations moving downstream along Cedar Creek. These data don't necessarily represent the same time periods at each station and, therefore, conditions are not necessarily identical. The maximum criteria are shown in each figure for comparison purposes.

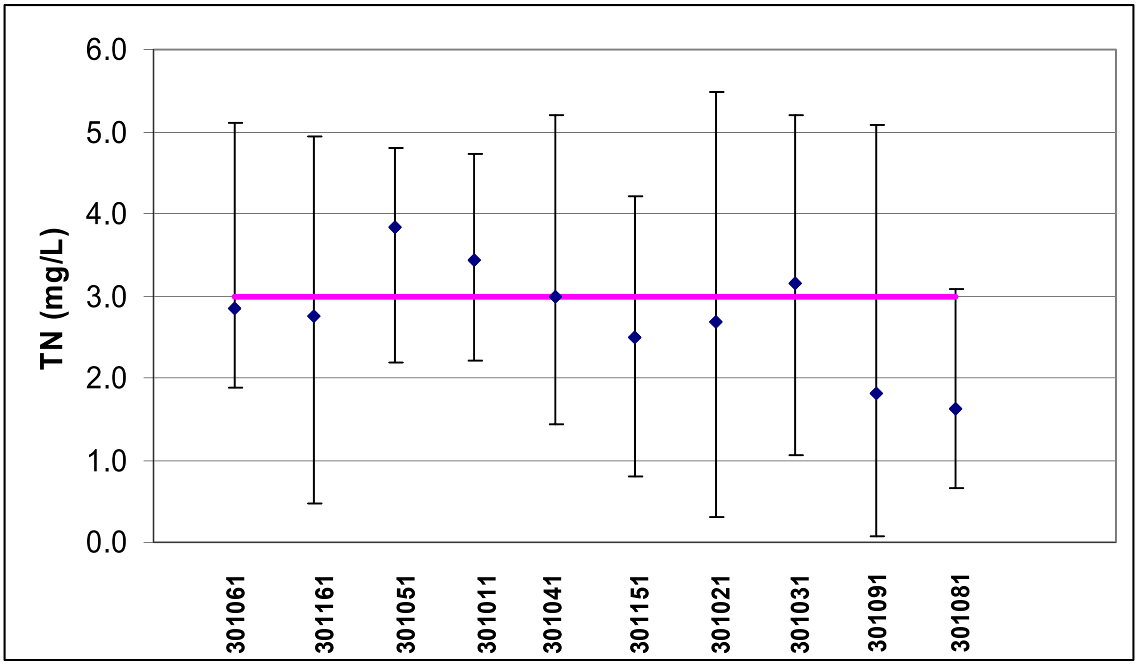

Figure 2-7. Average, maximum, and minimum TN concentrations along the Cedar Creek mainstem, from upstream to downstream.

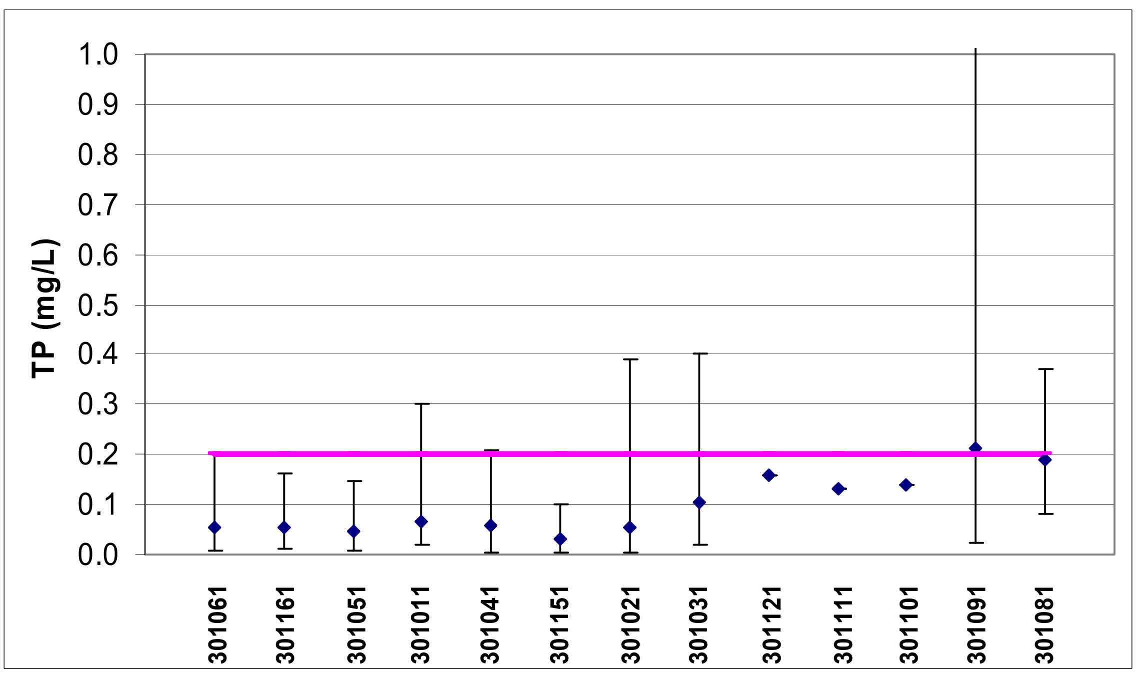

Figure 2-8. Average, maximum, and minimum TP concentrations along the Cedar Creek mainstem, from upstream to downstream.

Seasonal trend assessments of nutrients data were conducted for several stations in the impaired watersheds. Chlorophyll-a levels at most stations are indicative of eutrophic conditions and algae impacts on depressed DO levels are probable. TP measurements tend to increase in the spring and summer and decrease in the fall. Some correlate well with the flow measurements, which indicates probable surface water/landscape contributions. This trend is possibly due to increased runoff from rain events and the scheduling of agricultural practices, such as fertilizer application. The TN trend follows a similar pattern as that of the TP, with values high in the spring and decreasing in the summer, and correlating well with flow. Exceedances of the TMDL targets (3.0 mg/L for TN and 0.2 mg/L of TP) are substantial and frequent in the impaired watersheds.

2.2.3 Bacteria

Several waterbodies in the Mispillion River are listed as impaired for high bacteria. These include the lower and upper Mispillion River (including the headwaters), Silver Lake, Blairs Pond, and Abbotts Mill Pond. Enterococcus data for the Mispillion River watershed are available from 30 monitoring stations. Lower Cedar Creek (tidal segment from Cedar Creek Mill Pond to the mouth) and Upper Cedar Creek (from the headwaters to Cedar Creek Mill Pond, including Church Branch and Cedar Mill Pond, Cubbage Pond, Clendaniel Pond, and Hudson Pond) are listed for bacteria impairment. Enterococcus data for the Cedar Creek watershed are available from 15 monitoring stations.

Twenty-one monitoring stations are considered to be along the mainstem of the Mispillion River. Enerococcus data are available for 13 of these stations. Figure 2-9 shows the average, minimum, and maximum enterococcus concentrations at these stations moving downstream along the Mispillion River. These data don't necessarily represent the same time periods at each station and, therefore, conditions are not necessarily identical. The maximum criterion for freshwater is shown for comparison purposes.

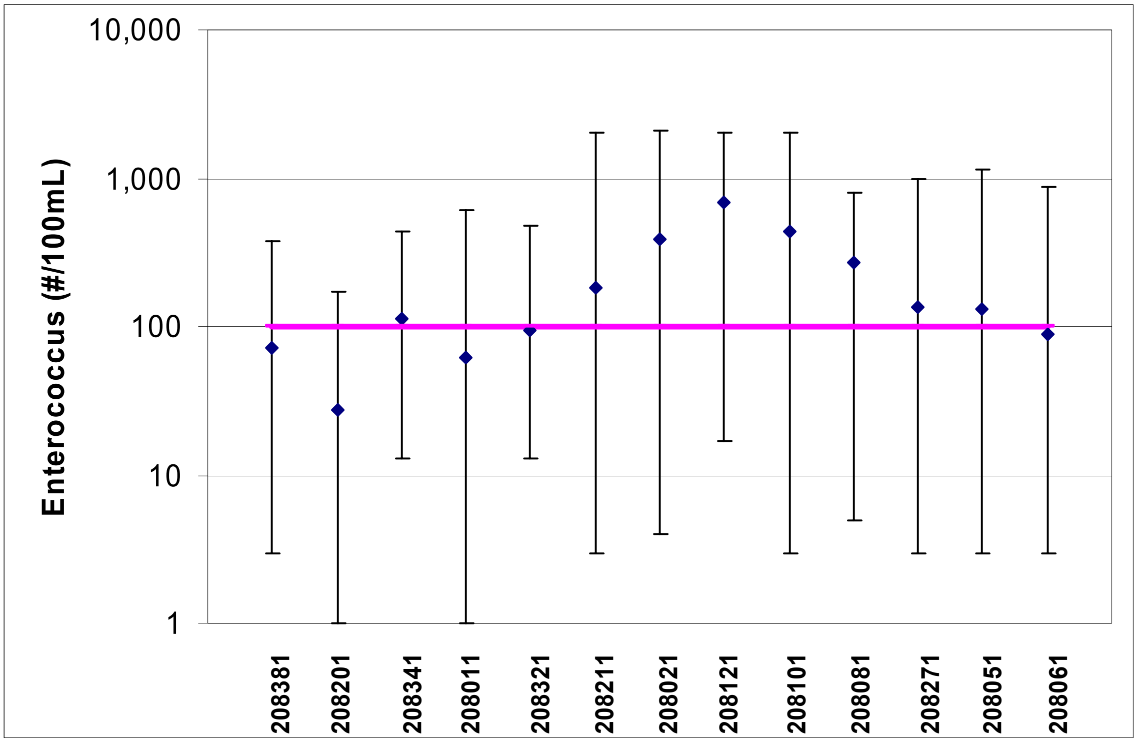

Figure 2-9. Average, maximum, and minimum enterococcus concentrations along the Mispillion River mainstem, from upstream to downstream.

Thirteen monitoring stations are considered to be along the mainstem of Cedar Creek. Enterococcus data are available for all thirteen of these stations. Figure 2-10 shows the average, minimum, and maximum enterococcus concentrations at these stations moving downstream along Cedar Creek. These data don't necessarily represent the same time periods at each station and, therefore, conditions are not necessarily identical. The maximum criterion for freshwater is shown for comparison purposes.

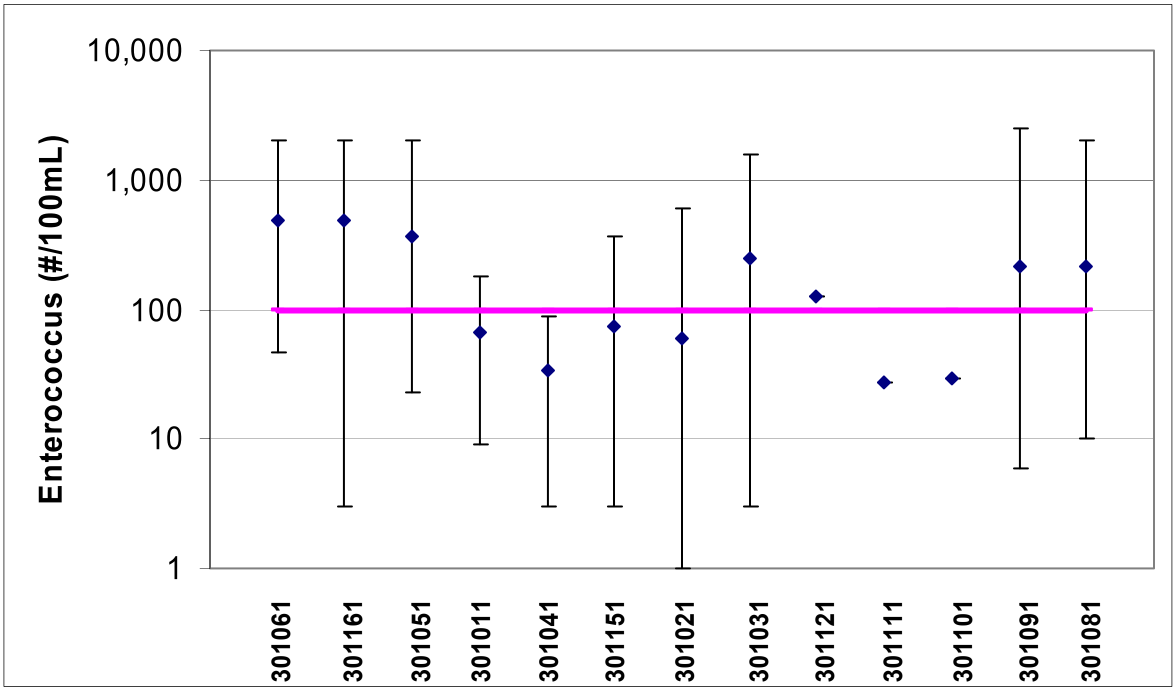

Figure 2-10. Average, maximum, and minimum enterococcus concentrations along the Cedar Creek mainstem, from upstream to downstream.

Seasonal trend assessments found that bacteria levels are highest in the summer months and much lower, but variable throughout the rest of the year. Bacteria levels tend to be highest during high flow conditions and during moderate flow levels. This indicates that levels may be influenced by a combination of low-flow sources (e.g., wildlife or direct contributions from livestock) and high-flow sources (e.g., storm-driven septic failure or washoff of manure from the land).

2.3 Source Identification

Several nutrient and bacteria sources were identified throughout the data assessment and modeling efforts. Sources can be divided into two categories – point sources and nonpoint sources.

2.3.1 Point Sources

Point sources include sources of pollutants from a concentrated originating point like a pipe from a factory or a large registered feedlot with a specific point of discharge. These types of pollutants are permitted and regulated by federal, state and local laws.

There are two currently permitted facilities located in the Mispillion River watershed and none in the Cedar Creek watershed (Figure 2-11). The permitted facilities are DE0051047 (Baltimore Aircoil Milford Plant) and DE0051098 (Sea Watch International). DE0051047 has a permit for cooling water and stormwater (Table 2-2) and DE0051098 has a stormwater permit. On 2/23/03, a General Industrial Storm Water Permit was issued for this facility, which does not include limits for stormwater discharge, but does require monitoring of various constituents. Discharge monitoring data are available for both permitted facilities and are summarized in Table 2-3.

DE0051047 does not discharge any of the pollutants being evaluated; however, monitoring data for DE0051098 indicate high concentrations of nutrients and bacteria in this facility's discharge. This is a source of historically high levels of nutrients and bacteria in the Mispillion River watershed.

Table 2-2. NPDES permit limit for DE0051047 (Baltimore Air Coil) in the Mispillion River watershed.

Outfall	Parameter Description	Modification Period Start & End Dates	Frequency	Quantity Avg Limit	Quantity Max Limit	Concentration Min Limit	Concentration Avg Limit	Concentration Max Limit
001	Water Temperature	12/01/1999 - 11/30/2004	Weekly	-	-	-	-	94 deg F
001	pH		Weekly	-	-	6 s.u.	-	9 s.u.
002	pH		Annually	-	-	6 s.u.	-	9 s.u.
003	pH		Annually	-	-	6 s.u.	-	9 s.u.
001	TSS		Quarterly	2 lbs/day	3 lbs/day	-	30 mg/L	45 mg/L
001	Oil & Grease		Quarterly	0.67 lbs/day	1 lbs/day	-	10 mg/L	15 mg/L
001	Flow		Weekly	0.008 MGD	-	-	-	-

Note: All samples to be measured as effluent gross values.

Table 2-3. NPDES DMR data in the Mispillion River watershed.

Permit ID	Parameter	Start Date	End Date	Count	Avg	Min	Max
DE0051047 (Baltimore Air Coil)	Flow (MGD)	10/31/94	10/31/03	218	0.032	0.0001	2.300
	Lead, Total (ug/L as Pb)	10/31/02	10/31/02	2	0.02	0.02	0.02
	Oil & Grease (mg/L)	11/30/95	12/31/02	18	10.44	1.80	23.00
	pH (s.u.)	10/31/94	10/31/03	218	7.24	6.00	8.60
	Total Recoverable Petroleum Hydrocarbons (mg/L)	10/31/02	10/31/02	2	8.30	8.30	8.30
	Total Zinc (ug/L as Zn)	1/31/01	10/31/02	12	1.33	0.20	3.08
	TSS (mg/L)	12/31/94	9/30/01	20	11.70	2.00	47.00
	Water Temperature (deg F)	10/31/94	10/31/03	204	68.04	42.00	94.00
DE0051098 (Sea Watch International)	COD (mg/L)	8/31/98	6/16/05	33	55.40	18.00	225.00
	Enterococcus (#/100mL)	8/31/98	7/31/00	24	13,779	3,000	29,000
	Fecal Coliform (#/100mL)	7/14/00	7/14/00	2	19,675	10,350	29,000
	Fecal Enterococcus (#/100mL)	4/25/02	6/16/05	6	42,255	1,720	127,273
	Flow (gal/min)	8/31/98	7/31/00	24	194.917	120.000	980.000
	Nitrate Nitrogen (mg/L as N)	8/31/98	6/16/05	33	2.09	0.28	11.80
	Nitrite Nitrogen (mg/L as N)	8/31/98	6/16/05	33	0.07	0.05	0.17
	Oil & Grease (mg/L)	6/16/05	6/16/05	2	2.00	2.00	2.00
	pH (s.u.)	8/31/98	7/31/00	24	6.28	5.90	7.40
	Total Ammonia Nitrogen (mg/L as N)	8/31/98	6/16/05	31	1.60	0.11	9.54
	Total Chloride (mg/L)	8/31/98	6/16/05	31	48.60	3.00	190.00
	TKN (mg/L)	7/14/00	6/16/05	9	7.46	1.59	45.20
	Total Organic Nitrogen (mg/L as N)	8/31/98	6/16/05	31	4.20	0.53	35.70
	Total Phosphorus (mg/L as P)	8/31/98	7/31/00	33	0.63	0.15	4.21

Permit ID	Parameter	Start Date	End Date	Count	Avg	Min	Max
	Total Sodium (mg/L as Na)	8/31/98	6/16/05	31	33.11	4.70	130.00
	TSS (mg/L)	8/31/98	7/31/00	33	121.18	8.00	760.00
	Water Temperature (deg F)	8/31/98	7/31/00	24	70.83	56.00	79.00

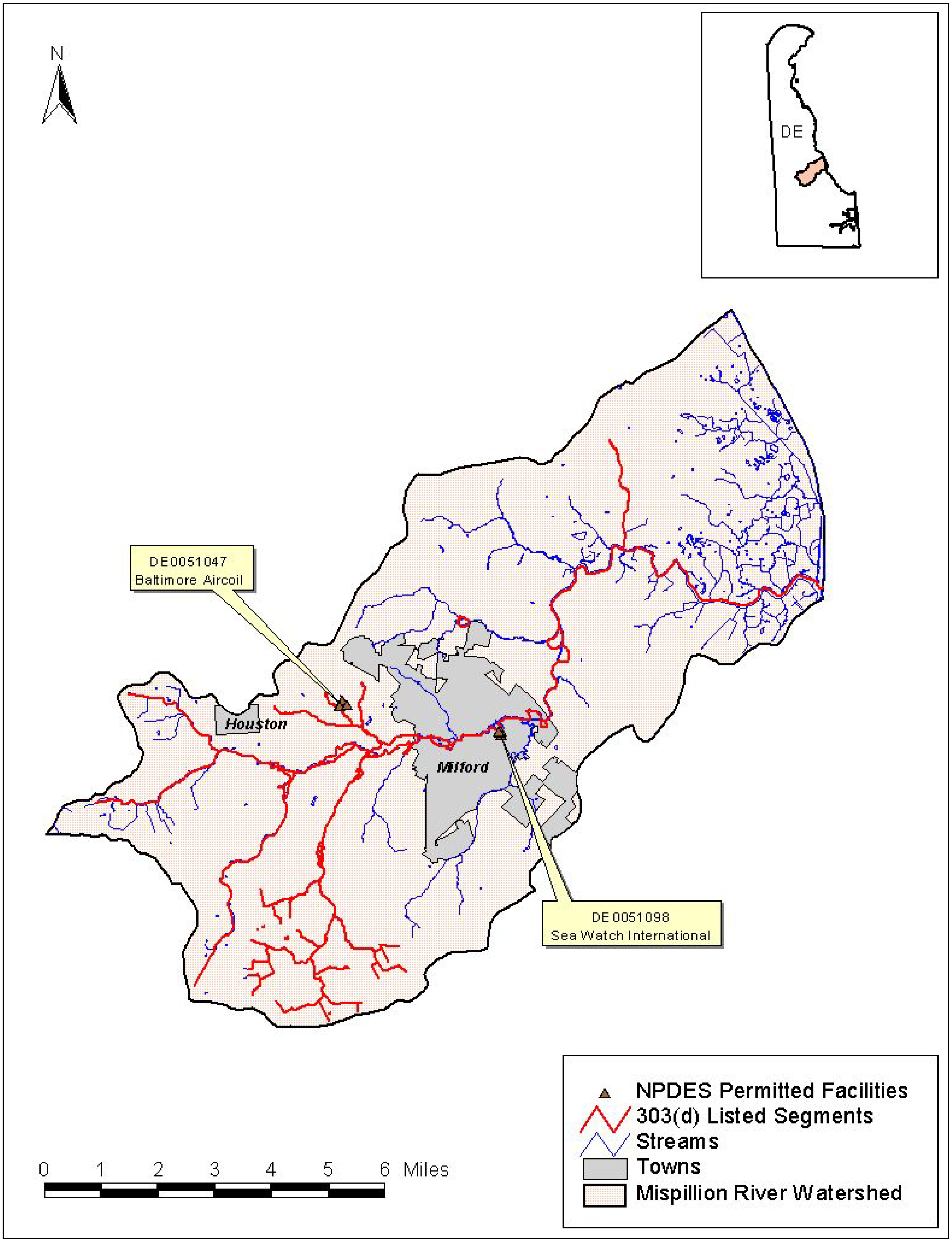

Figure 2-11. NPDES permitted facilities in the Mispillion River watershed.

2.3.2 Nonpoint Sources

Nonpoint source pollutants are generally defined as those pollutants that are a result of common, widespread activities, such as urban or agricultural runoff. Several nonpoint sources exist in both impaired watersheds, such as agricultural areas, groundwater contamination and discharge to the surface waters, septic systems, wetlands, and urban influences.

Urban and suburban areas in watersheds are potential sources of bacteria and nutrients to streams. Contaminants may build up on impervious surfaces and washoff to streams when rain events occur. Some sources associated with urban areas include failing/leaking sewage systems, industrial wastes, non-agricultural (i.e., lawn) fertilization, runoff from construction sites, and domestic pet wastes. Urban runoff may also contain high levels of organic matter that can lead to depleted oxygen levels in water upon decomposition.

Agricultural areas also can be a significant source of pollutants in terms of runoff and/or direct contributions of contaminants to streams. The 1998 305(b) report identifies nonpoint source activities in the Mispillion River and Cedar Creek watersheds that have the potential to impact groundwater and surface waters. In the Mispillion River watershed, agriculture is listed as a likely source of contamination. The report states that the concentration of animal production is high and there is some vegetable production. The runoff from concentrated areas of animal production contributes bacteria and nutrients to the water resources in this watershed. Other sources of contamination identified include septic systems (due to the lack of sewered areas) and construction/urban runoff. Potentially problematic nonpoint source activities in the Cedar Creek watershed include many of the same issues. Agriculture areas with high concentrations of animal production are a likely source of contamination. Septic systems are also a possible issue and it was noted previously that Ellendale (a town in the headwaters) had a high on-site system failure rate. Construction/urban runoff is not as much of a concern because this watershed is sparsely populated.

General land use and land cover data for the Mispillion River and Cedar Creek watersheds were extracted from a 2002 Land use and Land Cover (LULC) data set for the State of Delaware. This data set is based on the 1997 land use data for the State and 2002 false color infrared digital orthophotography at a scale of 1:2400. Cropland is the dominant land use/land cover in both watersheds, followed by wetlands. Small percentages of other land cover types are also present, including various types of forest and developed areas.

Figure 2-12 and Tables 2-4 and 2-5 show the land use distribution for each watershed. As stated, both the Mispillion River and Cedar Creek watersheds are largely comprised of agricultural areas. Livestock and other farm animals can contribute pollutants directly to the streams or animal wastes can wash-off the land during storm events. Additionally, land practices, such as fertilizer and manure application practices of croplands and other agricultural lands can contribute pollutants to waterways. The 1998 305(b) report discusses agricultural influences in each watershed. In terms of crops, for the Mispillion River watershed, the report states that there is some vegetable production, and mostly corn-soybean-small grain rotation. It also states that the concentration of animal production is high. The report states that concentrations of animal production are also high in the Cedar Creek watershed. Crops in this watershed include some vegetable production rotated with corn-soybean-small grain production. Land uses, as applied to the model, are discussed further in later sections.

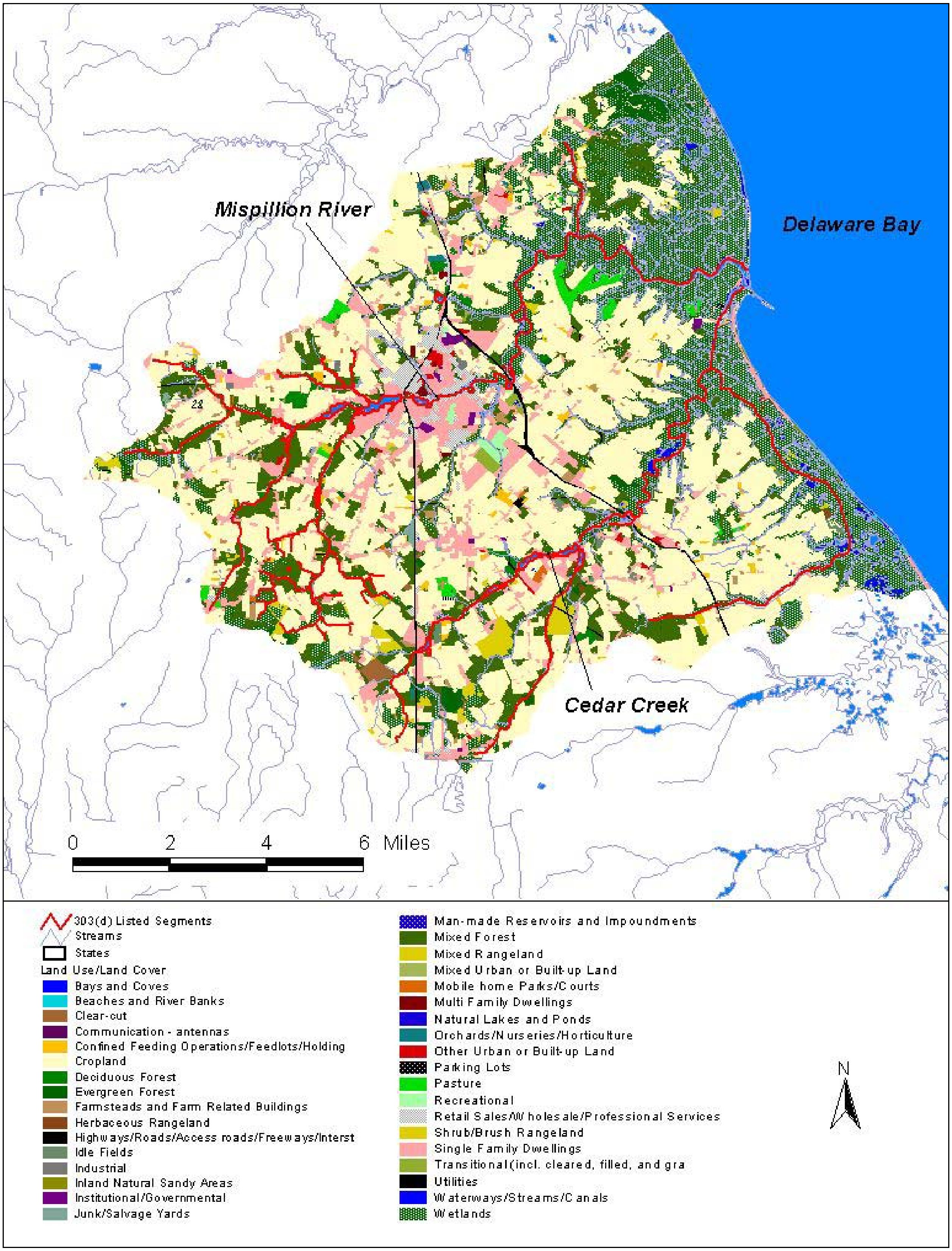

Figure 2-12. Land use and land cover in the Mispillion River and Cedar Creek watersheds.

Table 2-4. Land use and land cover in the Mispillion River watershed.

Land Use/ Land Cover	Area		Percent of Watershed
	Square Miles	Acres	
Cropland	32.96	21,097	43.1%
Wetlands	17.12	10,960	22.4%
Mixed Forest	9.35	5,983	12.2%
Single Family Dwellings	7.68	4,914	10.0%
Retail Sales/Wholesale/Professional Services	1.49	953	1.9%
Pasture	0.88	566	1.2%
Evergreen Forest	0.87	554	1.1%
Sum of all other LU/LC categories (<1% area)	6.07	3,886	7.9%
Total	76.43	48,912	100.0%

Table 2-5. Land use and land cover in the Cedar Creek watershed.

Land Use/ Land Cover	Area		Percent of Watershed
	Square Miles	Acres	
Cropland	26.16	16,739	50.1%
Wetlands	11.16	7,141	21.4%
Mixed Forest	5.56	3,556	10.6%
Single Family Dwellings	3.50	2,241	6.7%
Shrub/Brush Rangeland	1.21	776	2.3%
Bays and Coves	1.13	724	2.2%
Sum of all other LU/LC categories (<1% area)	3.53	2,262	6.8%
Total	52.25	33,439	100.0%

Septic systems are another potential source of contamination because nutrients and bacteria from the systems can reach the surface water through groundwater. It is important to maintain septic systems to prevent leakage and ensure proper waste treatment. There are approximately 3,900 septic systems in the Mispillion River watershed and approximately 2,400 in the Cedar Creek watershed (Figure 2-13). These have the potential to contaminate local water resources if not up-kept properly. It was noted in the 1998 305(b) report for the Cedar Creek watershed that Ellendale, which is a town in the upstream portion of the watershed, has a high on-site system failure rate as a result of poor soils. Additional discussions of source representation follow in Section 4.1.

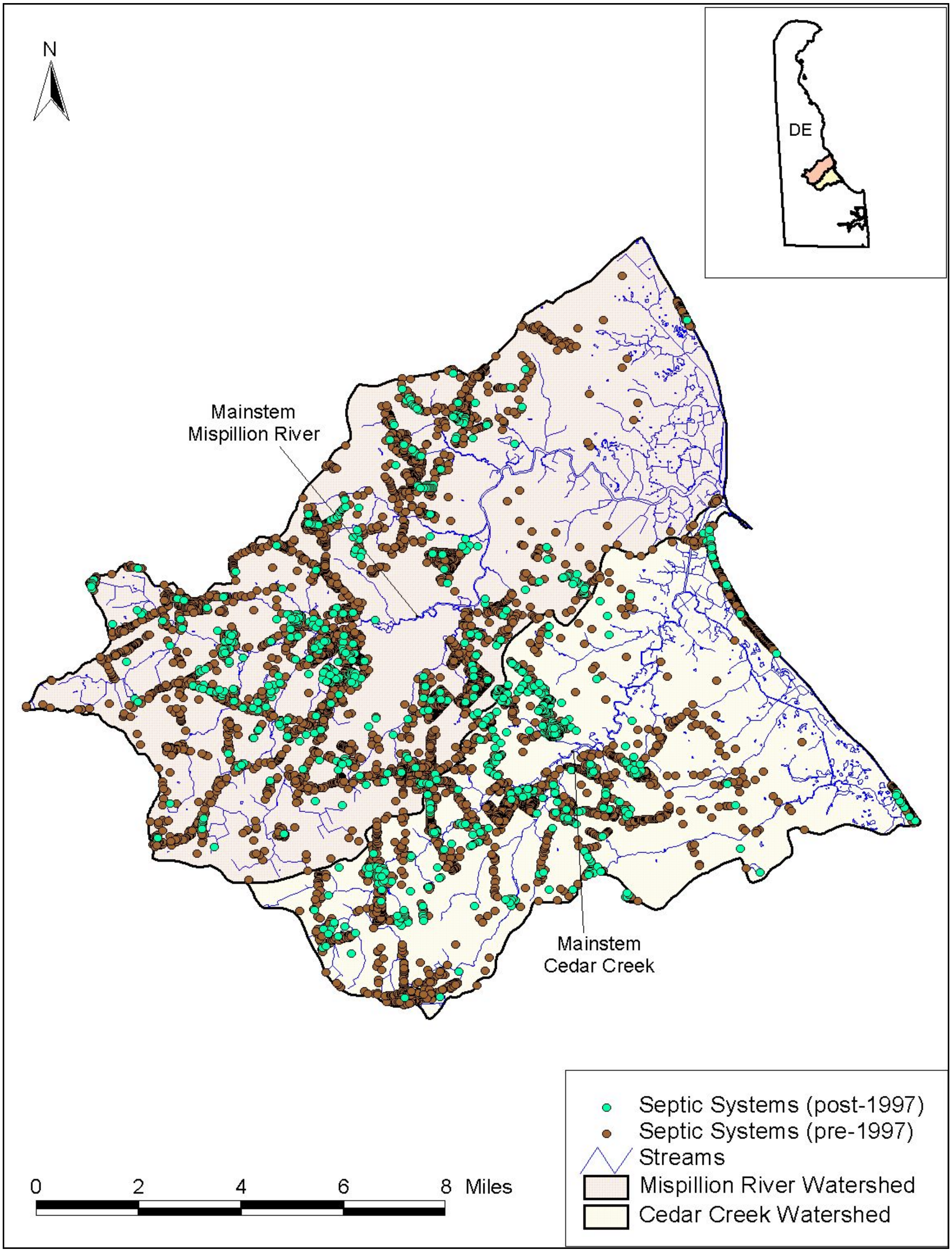

Figure 2-13. Septic systems in the Mispillion River and Cedar Creek watersheds.

3.0 TMDL ENDPOINT DETERMINATION

TMDL targets for the 303d-listed water quality constituents are based on the criteria and targets described earlier in this document (Table 3-1). These targets represent a number where the applicable water quality is achieved and maintained in the waterbody. Numeric criteria have been identified for DO and Enterococcus. These targets must be met throughout the entire length of the impaired waters under all conditions (including critical conditions). Critical conditions are the set of environmental conditions for which controls designed to protect water quality will ensure attainment of objectives for all other conditions. This is typically the period of time in which the waterbody exhibits the most vulnerability. Achieving these instream numeric water quality criteria will ensure that the designated uses (agricultural and industrial water supplies, fish and aquatic life use, wildlife use and habitat, and primary and secondary contact recreation) of waters in the basins are supported at all times. Numeric targets have also been identified for nutrients and represent DNREC's goal for TMDL development. Although these targets are goals for TMDL development, there may be situations where they are not achievable at all times under the TMDL. These exceedances are acceptable as long as the narrative water quality criteria (identified in Section 1.3.2) are still met.

Table 3-1. Summary of TMDL endpoints for the Mispillion River and Cedar Creek watersheds.

Parameter	Comments	Target Limit			
		Average	Minimum	Maximum	30-Day Geometric Mean
Dissolved Oxygen (mg/L)	Fresh waters	5.5	4.0	-	-
	Marine waters	5.0	4.0	-	-
Total Nitrogen (mg/L)	(target for the purpose of TMDL development)	-	-	3.0	-
Total Phosphorus (mg/L)	(target for the purpose of TMDL development)	-	-	0.2	-
Enterococcus (#/100mL)	Primary Contact Recreation Fresh Waters	-	-	-	100
	Primary Contact Recreation Marine Waters	-	-	-	35

Note: Fresh waters are defined as those waters with salinity less than 5.0 ppt; marine waters are those waters with salinity greater than or equal to 5.0 ppt.

Based on an evaluation of salinity data, the main stem of the Mispillion River upstream of Station 208121 (and its tributaries) and the main stem of Cedar Creek upstream of Station 301031 (and its tributaries) are considered fresh waters. The main stems of both rivers downstream of these stations are considered marine waters. The evaluation of salinity data for these locations (Stations 208121 and 301031) indicated that observed salinity values are below 5 parts per thousand more than 50% of the time. Stations downstream exhibited salinity values greater than 5 parts per thousand more than 50% of the time.

The modeling framework used to develop the TMDLs (described in Section 4.0) is capable of predicting time-variable (hourly or more frequently) water quality conditions and thus can be compared directly to the TMDL targets. Even averaging periods, such as the geometric mean calculation required by DE's water quality standards for bacteria, can be accommodated. The Mispillion River and Cedar Creek models are run for a length of time that covers a range of potential hydrologic conditions, in order to ensure that critical conditions are sufficiently represented. Time-series model results for the entire system are first compared to the prescribed water quality targets (i.e., state water quality criteria) and reviewed to identify water quality target exceedance locations and time periods.

Throughout the modeling process, the critical influences on water column water quality are identified and provide a basis for selecting appropriate inputs to reduce. Once the impairment locations and time periods are identified for each constituent, and the most sensitive input parameters are identified, load reduction scenarios are simulated. These scenarios focus on load reductions to nonpoint and point sources, in an effort to achieve water quality criteria for all impairments.

4.0 TMDL METHODOLOGY

The following sections discuss the methodology used for TMDL development and results in terms of TMDLs and required load reductions for each stream segment listed on Delaware's 303(d) list as impaired due to DO, nutrients, and bacteria. The selected methodology considers specific impacts and conditions determined necessary for accurate source representation and system response.

In order to support TMDL development for the Mispillion River and Cedar Creek systems, the need for a linked watershed-receiving water modeling framework was identified. The "Data Review and Modeling Approach – Mispillion River and Cedar Creek TMDL Development" proposed an approach to link a dynamic watershed model (Loading Simulation Program C++ (LSPC)) to a dynamic receiving water model (Environmental Fluid Dynamics Code (EFDC)) through transfer of relevant time-variable flow and water quality information. This approach is most appropriate for these waters due to a host of technical, regulatory, and user criteria, and was approved by DNREC.

LSPC simulates watershed hydrology and bacteria and nutrient accumulation and washoff on land, as well as flow, bacteria, nutrients, and DO in streams and impoundments. The watershed model contains a subset of the algorithms in Hydrologic Simulation Program—Fortran (HSPF), and it is capable of dynamic (time-variable) simulation at a sufficiently high resolution for developing TMDLs. A key benefit of applying LSPC is its ability to link directly to EFDC, the advanced hydrodynamic and water quality model proposed for receiving water simulation.

Flow and water quality characteristics from LSPC are applied directly to the EFDC receiving water model. EFDC is a comprehensive 1-, 2-, or 3-dimensional model capable of simulating hydrodynamics, salinity, temperature, suspended sediment, water quality, algae, and the fate of toxic materials (Hamrick, 1996). The model uses stretched or sigma vertical coordinates and Cartesian or curvilinear, orthogonal horizontal coordinates to represent the physical characteristics of a waterbody. The hydrodynamic portion of the model solves three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motion for a variable-density fluid. Dynamically-coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity and temperature are also solved. The EFDC model allows for drying and wetting in shallow areas, such as tidal marsh, by a mass conservation numerical scheme. The physics of the EFDC model and many aspects of the computational scheme are equivalent to the widely used Blumberg-Mellor model (Blumberg & Mellor, 1987).

The water quality portion of the model simulates the spatial and temporal distributions of 22 water quality parameters including DO, suspended algae (3 groups), attached algae, various components of carbon, nitrogen, phosphorus and silica cycles, and bacteria, such as fecal coliform and enterococci. Salinity, water temperature, and total suspended solids are needed for computation of the twenty-two state variables, and they are provided by the hydrodynamic model. The kinetic processes included in this model use the Chesapeake Bay three-dimensional water quality model, CE-QUAL-ICM (Cerco & Cole, 1994).

A sediment process model with 27 state variables is also included in the EFDC model. It uses a slightly modified version of the Chesapeake Bay three-dimensional model (DiToro & Fitzpatrick, 1993). The sediment process model, upon receiving the particulate organic matter deposited from the overlying water column, simulates their diagenesis and the resulting fluxes of inorganic substances (ammonium, nitrate, phosphate and silica) and sediment oxygen demand back to the water column. The coupling of the sediment process model with the water quality model not only enhances the model's predictive capability of water quality parameters but also enables it to simulate the long-term changes in water quality conditions in response to changes in nutrient loads.

The LSPC watershed model is used for modeling land processes, non-tidal channels, and impoundments. LSPC uses precipitation as the main driving force for the land processes and is not capable of simulating the areas submerged under water due to high tide. Similarly, LSPC is not capable of modeling streams under tidal influence. The flow directions in streams and impoundments in LSPC are uni-directional.

The EFDC model is used for the channel portions with tidal influences (downstream of Silver Lake on the Mispillion River and Cedar Creek Mill Pond/Swiggetts Pond on Cedar Creek). In addition to the tidal channel, tidal marsh areas near the bay experience wetting and drying along with the change of tidal elevation. Tidal marsh areas are considered as part of the waterbody with wetting and drying properties in EFDC. The Mispillion River and Cedar Creek conjoin at the mouth and enter Delaware Bay through a long and narrow jetty. To consider the influence of Delaware Bay, the EFDC model grid extends into the bay.

4.1 Watershed Model

The LSPC model was configured for the Mispillion River and Cedar Creek watersheds and was used to simulate each watershed as a series of hydrologically-connected subwatersheds. The specific constituents modeled by LSPC were flow, DO, temperature, algae, CBOD, nitrite/nitrate, ammonia nitrogen, dissolved orthophosphate (PO_4), and Enterococcus, which served as load for the EFDC receiving water model. The watershed model was also used as a platform for representing load reduction scenarios to achieve TMDL targets. Development and application of the watershed model to address the project objectives involved two important steps:

1. Configuration of Key Model Components
2. Model Calibration and Validation

4.1.1 Configuration of Key Model Components

4.1.1.1 Watershed Segmentation

Watershed segmentation refers to the subdivision of the impaired watersheds into smaller, discrete subwatersheds for modeling and analysis. This subdivision was primarily based on the stream networks and topographic variability, 7.5-minute United States Geologic Survey (USGS) topographic quadrangles, stream connectivity, locations of flow and water quality monitoring stations, and existing watershed delineations (from data provided by DNREC). To represent loadings and predict concentrations of nutrients, bacteria and DO at multiple locations, the Mispillion River watershed was divided into 28 subwatersheds and the Cedar Creek watershed was divided into 24 subwatersheds (Figure 4-1).

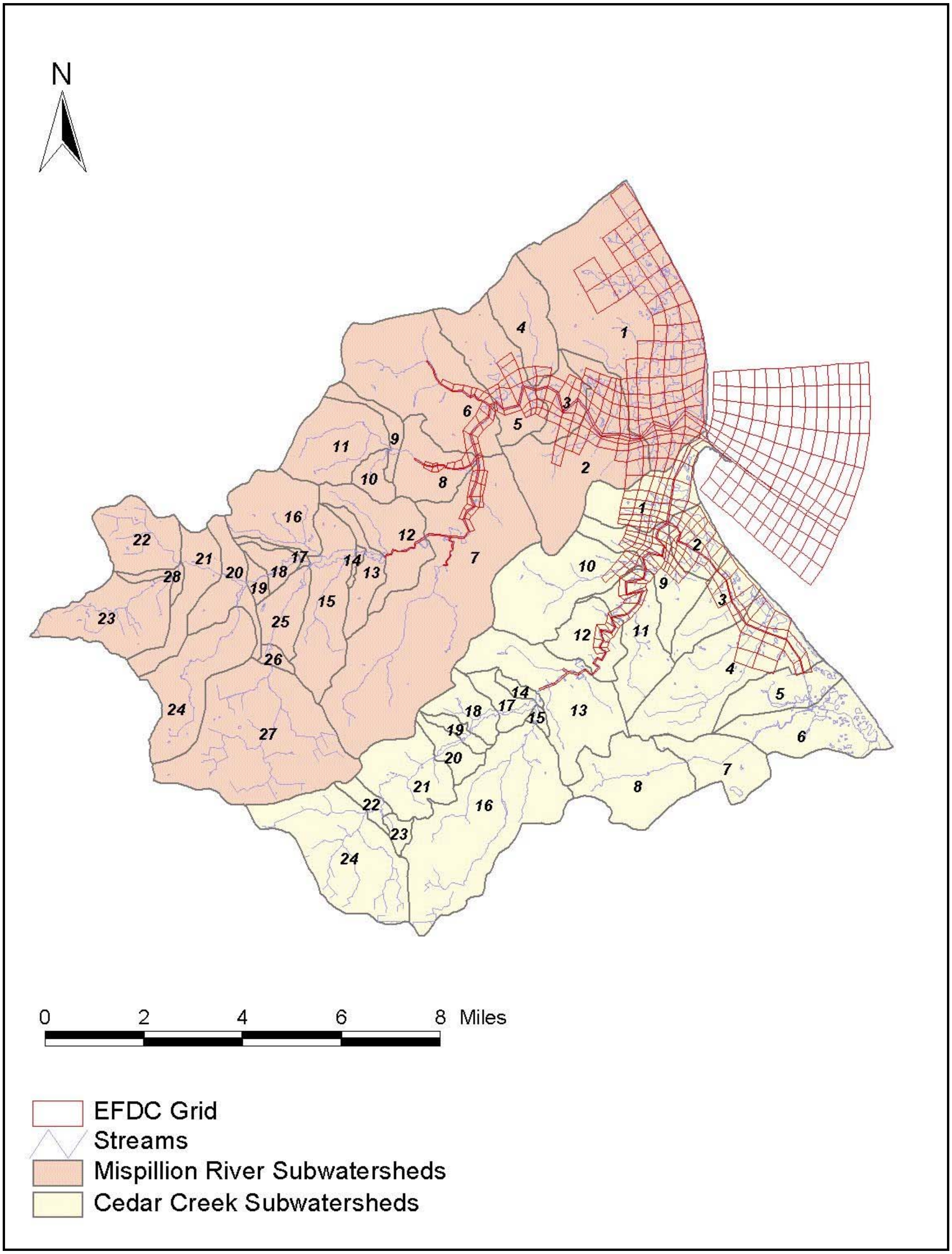

Figure 4-1. Modeled subwatersheds in the Mispillion and Cedar Creek watersheds.

4.1.1.2 Land Use Representation

The land use representation provides the basis for distributing soils and pollutant loading characteristics throughout the basin. The watershed model requires a basis for distributing hydrologic and pollutant loading parameters to appropriately represent hydrologic variability throughout the basin, which is influenced by land surface and subsurface characteristics. It is also necessary to represent variability in pollutant loading, which is highly correlated to land practices. The basis for this distribution was provided by land use coverage of each watershed. Land use data used to configure the LSPC model were obtained from the 2002 Land Use and Land Cover data set for the State of Delaware based on the 1997 land-use data of the State and 2002 false color infrared digital orthophotography.

Although the multiple categories in the land use coverage provide much detail regarding spatial representation of land practices in the watershed, such resolution is unnecessary for watershed modeling if many of the categories share hydrologic or pollutant loading characteristics. Therefore, many land use categories were grouped into similar classifications, resulting in a subset of 16 categories for modeling. Table 4-1 shows the original land use categories and the corresponding LSPC grouping. These land use data provide a foundation upon which the significance of nonpoint sources can be estimated.

LSPC algorithms require that land use categories be divided into separate pervious and impervious land units for modeling. This division was made for the appropriate land uses (primarily urban) to represent impervious and pervious areas separately. LSPC model algorithms that simulate hydrologic and pollutant loading processes for pervious and impervious lands were then applied to the corresponding land units.

Table 4-1. Land use code conversion from MRLC to LSPC.

Original Land Use Category	LSPC Land Use Category
Cropland	Agriculture
Farmsteads Farm Related Buildings	Agriculture
Idle Fields	Agriculture
Orchards/Nurseries/Horticulture	Agriculture
Beaches and River Banks	Barren
Extraction	Barren
Inland Natural Sandy Areas	Barren
Transitional	Barren
Herbaceous Rangeland	Brushland/Rangeland
Mixed Rangeland	Brushland/Rangeland
Shrub/Brush Rangeland	Brushland/Rangeland
Junk/Salvage Yards	Commercial
Other Commercial	Commercial
Retail Sales/Wholesale/Professional Services	Commercial
Vehicle Related Activities	Commercial
Warehouses and Temporary Storage	Commercial
Clearcut	Forest
Deciduous Forest	Forest

Original Land Use Category	LSPC Land Use Category
Evergreen Forest	Forest
Mixed Forest	Forest
Industrial	Industrial
Institutional/Governmental	Institutional/Government
Mixed Urban or Built-up Land	Mixed Urban/Built-Up
Other Urban or Built-up Land	Other Urban
CAFOS/Feedlots/Holding	Pastures
Pasture	Pastures
Recreational	Recreation
Mobile home Parks/Courts	Residential
Multi Family Dwellings	Residential
Single Family Dwellings	Residential
Communication antennas	Transportation/Communication
Highways/Roads/Access roads/Freeways/Interstates	Transportation/Communication
Marinas/Port Facilities/Docks	Transportation/Communication
Parking Lots	Transportation/Communication
Utilities	Utilities
Bays and Coves	Water
Man-made Reservoirs and Impoundments	Water
Natural Lakes and Ponds	Water
Waterways/Streams/Canals	Water
Wetlands	Wetland

4.1.1.3 Hydrology Representation

Hydrologic representation refers to the LSPC modules or algorithms used to simulate hydrologic processes (e.g., surface runoff, evapotranspiration, and infiltration). The LSPC PWATER (water budget simulation for pervious land segments) and IWATER (water budget simulation for impervious land segments) modules, which are consistent with those in HSPF, were used to represent hydrology for all pervious and impervious land units (Bicknell et al., 1996). Designation of key hydrologic parameters in the PWATER and IWATER modules of LSPC were required. These parameters are associated with infiltration, groundwater flow, and overland flow. USDA's STATSGO Soils Database served as a starting point for designation of infiltration and groundwater flow parameters. For parameter values not easily derived from these sources, documentation on past HSPF applications were accessed, particularly the recent modeling studies performed in Delaware (e.g., Delaware Inland Bays watershed model). Starting values were refined through the hydrologic calibration process (described later in this report).

Soil detachment by rainfall on the contributing land uses is simulated in the LSPC model. Soils data were obtained from STATSGO. Detached sediment is removed by surface flow and is washed off into the stream reach where it eventually settles and is available for resuspension into the water column.

4.1.1.4 Pollutant Representation

Based on an analysis of the water quality data in the impaired watersheds as well as a review of previous studies, possible nonpoint sources of pollutants include urban and suburban areas, leaking septic systems, agricultural runoff, wetlands, and wildlife. There is currently one NPDES permitted point source (DE0051047, Baltimore Aircoil) and one formerly permitted stormwater discharge (DE0051098, Sea Watch International) in the Mispillion River watershed. Discharge from the Baltimore Aircoil facility is not anticipated to affect pollutants of concern based on a review of the current permit and historical monitoring data (as discussed in Section 2.3.1). High bacteria levels have been recorded in the stormwater discharge from Sea Watch International. This source is included in the EFDC model, based on its location, for model calibration.

The primary pollutants represented in the watershed model to estimate loadings to Mispillion River and Cedar Creek included CBOD, nutrients, and bacteria. Loading processes for pollutants were represented for each land unit using the LSPC PQUAL (simulation of quality constituents for pervious land segments) and IQUAL (simulation of quality constituents for impervious land segments) modules, which are consistent with those in HSPF. CBOD, nitrite/nitrate, ammonia, and bacteria are assumed to accumulate on land surface with specified monthly variable accumulation rates. Due to the decay processes on the land, storage limits for the pollutants are calculated to a maximum level of accumulation. PO_4 is assumed to be washed off together with sediment particles since PO_4 is usually attached to sediment particles under aerobic conditions. Initial parameter values used to estimate washoff coefficients and exponents for sediment scour from the watershed were estimated based on literature values, such as those in the Delaware Inland Bays watershed model (Gutierrez-Magness & Raffensperger, 2003). These starting values served as baseline conditions for sediment and water quality calibration; the appropriateness of these values to the impaired watersheds was validated through comparison to local water quality data during the calibration process (described in the next section).

Atmospheric deposition of nitrogen was represented in two ways. For dry deposition, the deposition rates of ammonia and nitrate were included in the land accumulation rates. For wet deposition, ammonia and nitrate contributions were modeled using “base” concentrations in the surface runoff. That is, an additional nutrient flux was added based on a set concentration (associated with rainfall volume represented in the model). The dry deposition rates were based on Scudlark and Church (2001) and are 1.08, 0.33, and 0.46 kg N/ha/yr for nitrate, ammonium, and organic nitrogen, respectively. The concentrations of ammonia and nitrate in precipitation were obtained from USGS National Atmospheric Deposition Program monitoring station DE99 data are 0.63 and 0.19 mg/L for nitrate and ammonium, respectively.

Water quality simulations include two main processes, land surface processes and in-stream processes. On the land, CBOD, nitrite/nitrate, ammonia, and bacteria are assumed to be in the dissolved phase. Overland flow directly carries them into streams. PO_4, which is usually associated with sediment, is modeled using a potency factor to sediment. Literature values of accumulation rates for CBOD, nitrite/nitrate, and ammonia were used initially. After CBOD and nutrients enter streams, various reactions occur. The LSPC model uses algorithms consistent with those in the HSPF model for the in-stream processes. The main in-stream processes include

CBOD decay, DO reaeration, nitrification, denitrification, and algal growth. The main rates are listed in Table 4-2.

Table 4-2. Reaction rates for CBOD/DO, nutrients, and eutrophication.

	Component	Value
kCBOD20	CBOD decay rate at 20 deg C (1/hr)	0.01
tcCBOD	temperature coefficient for CBOD decay	1.075
kodset		0
supsat	maximum allowable DO supersaturation (as a multiple of the DO saturation concentration)	1.25
tcginv	temperature coefficient for surface gas invasion	1.024
reak	empirical constant used to calculate the reaeration coefficient (1/hr)	0.54
expred	exponent to depth in the reaeration coefficient equation	-1.5
exprev	exponent to velocity in the reaeration coefficient equation	0.5
cforea	cforea	1
cvbo	conversion from milligrams biomass to milligrams oxygen (mg/mg)	1.98
cvbpc	conversion from biomass expressed as phosphorus to carbon (mols/mol)	106
cvbpn	conversion from biomass expressed as phosphorus to nitrogen (mols/mol)	16
bpcntc	percentage of biomass which is carbon (by weight)	49
ktam20	nitrification rate of ammonia at 20 degrees C (1/hr)	0.2
kno220	nitrification rate of nitrite at 20 degrees C (1/hr)	0.2
tcnit	temperature correction coefficient for nitrification	1.07
kno320	nitrate denitrification rate at 20 degrees C (1/hr)	0
tcden	temperature correction coefficient for denitrification	1.07
denoxt	dissolved oxygen concentration threshold for denitrification (mg/l)	2
anaer	concentration of DO below which anaerobic conditions are assumed to exist (mg/l)	0.005
ratclp	ratio of chlorophyll-a content of biomass to phosphorus content	0.6
nonref	non-refractory fraction of algae and zooplankton biomass	0.5
litsed	multiplication factor to total sediment concentration to determine sediment contribution to light extinction (l/mg/ft)	0
alnpr	fraction of nitrogen requirements for phytoplankton growth that is satisfied by nitrate	1
extb	base extinction coefficient for light (1/m)	0.1
malgr	maximum unit algal growth rate (1/hr)	0.3
cmmlt	Michaelis-Menten constant for light limited growth (lay/min)	0.033
cmmn	nitrate Michaelis-Menten constant for nitrogen limited growth (mg/l)	0.045
cmmnp	nitrate Michaelis-Menten constant for phosphorus limited growth (mg/l)	0.028
cmmp	phosphate Michaelis-Menten constant for phosphorus limited growth (mg/l)	0.015
talgrh	temperature above which algal growth ceases (deg C)	35
talgrl	temperature below which algal growth ceases (deg C)	5
talgrm	temperature below which algal growth is retarded (deg C)	25
alr20	algal unit respiration rate at 20 deg C (1/hr)	0.004
aldh	high algal unit death rate (1/hr)	0.01
aldl	low algal unit death rate (1/hr)	0.001
oxald	increment to phytoplankton unit death rate due to anaerobic conditions (1/hr)	0.03
naldh	inorganic nitrogen concentration below which high algal death rate occurs (as N) (mg/L)	0
paldh	inorganic phosphorus concentration below which high algal death rate occurs (as P) (mg/L)	0

For bacteria, the EPA Bacterial Indicator Tool (http://www.epa.gov/waterscience/ftp/basins/system/BASINS3/bit.htm) was used to obtain the accumulation rates on land surface. Two main sources of bacteria are considered including manure application and animal direct discharge on land, and septic tank failure. For manure application and animal direct discharge on land, livestock estimates were provided by DNREC. With determined livestock amount, the daily enterococci generated from different animals were estimated using literature values, such as those used in TMDL development for the Christina River (USEPA, 2005) as shown in Table 4-3.

Table 4-3. Agricultural animal counts and bacteria generation.

Animals	Animal Count by Watershed		Bacteria Generation
	Cedar	Mispillion	enterococci (count/animal/day)
Chickens	906,683	2,611,353	2.90E+08
Beef Cattle	182	30	6.60E+09
Dairy Cattle	220	300	1.70E+10
Horses	17	0	9.80E+09
Swine (Hogs)	0	0	1.90E+09

Source: DNREC NPS Program.

Failing septic systems are also potential sources of enterococci. The bacteria from septic tank leakage was modeled through land surface accumulation. To estimate the enterococci loading rates from failed septic tanks, the number of septic tanks, the failure rate, and the concentration of enterococci in the discharge of failed septic tanks are required. There are 3,922 septic tanks in the Mispillion River watershed and 2,406 septic tanks in the Cedar Creek watershed. A buffer analysis was first performed to examine the distances from the locations of septic tanks to nearby streams to determine whether direct deposition or surface accumulation should be used to represent the failed septic tanks. It was found that there are very few septic tanks within 50 to 100 feet of the streams. Therefore, enterococci from leaking septic tanks were assumed to accumulate on the land surface and be subsequently carried into streams by overland flow.

The septic failure rate directly controls the amount of septic load contributing enterococci bacteria to streams. DNREC conducted an investigation of the failure rates in the impaired watersheds. Based on the results of that investigation, as well as national failure rates, a failure rate of 15% was implemented. The resultant accumulation rates of enterococci are listed in Table 4-4.

Table 4-4. Septic accumulation rates by watershed.

Parameters	Mispillion	Cedar
Number of septics	3,922	2,406
Residential area (acre)	5,022	2,219
Unit area septic (septics/acre)	0.78	1.08
Total # people served	3,000	3,000
# people served per septic tank	0.76	1.25
Failure rate	15%	15%
Failing septic per acre	0.12	0.16
Septic flow per person (gal)	70	70

Parameters	Mispillion	Cedar
Total septic flow (gal) per acre	6.27	14.20
Enterococci concentration (#/100mL) in septic discharge	8.00E+05	8.00E+05
Accumulation rate (#/day/acre)	1.90E+08	4.30E+08

After the bacteria enter streams and impoundments, a first-order decay rate is used to calculate the die-off of bacteria. Water temperature is used to adjust the die-off rate for different seasons.

Water temperature is an important factor controlling various in-stream reaction rates. LSPC calculates the water temperature considering both the heat carried by overland flow and heat processes in streams. On the land, temperatures in surface runoff, interflow, and groundwater flow are related to air temperature. After heat is carried into streams by runoff, heat transport is calculated. Finally, heat exchange between air and water is calculated to update the water temperature.

4.1.1.5 Meteorological Representation

Meteorological data are a critical component of the watershed model, and appropriate representation of precipitation, wind speed, potential evapotranspiration, cloud cover, temperature, and dew point are required to develop a valid modeling system. These data provide necessary input to LSPC algorithms for hydrologic and water quality representation. Meteorological data were collected by the Delaware National Estuarine Research Reserve at a station approximately 10 miles north of the watersheds, in central Kent County, on the St. Jones River (Figure 4-2).

LSPC requires appropriate representation of precipitation and potential evapotranspiration. In general, hourly precipitation data are recommended for hydrologic modeling to assist in assessment of pollutant loading (although in some cases, such as small, flashy, highly urbanized watersheds 15-minute data may be necessary). Rainfall-runoff processes for each subwatershed were driven by precipitation data from the St. Jones River station.

Evapotranspiration time series data are not usually monitored at weather stations. The evapotranspiration data for the Mispillion and Cedar LSPC model were estimated using three widely applied methods: the Hammon, Jensen, and Penman methods. The Jensen method provides the best flow results and water budget balance and, therefore, was selected.

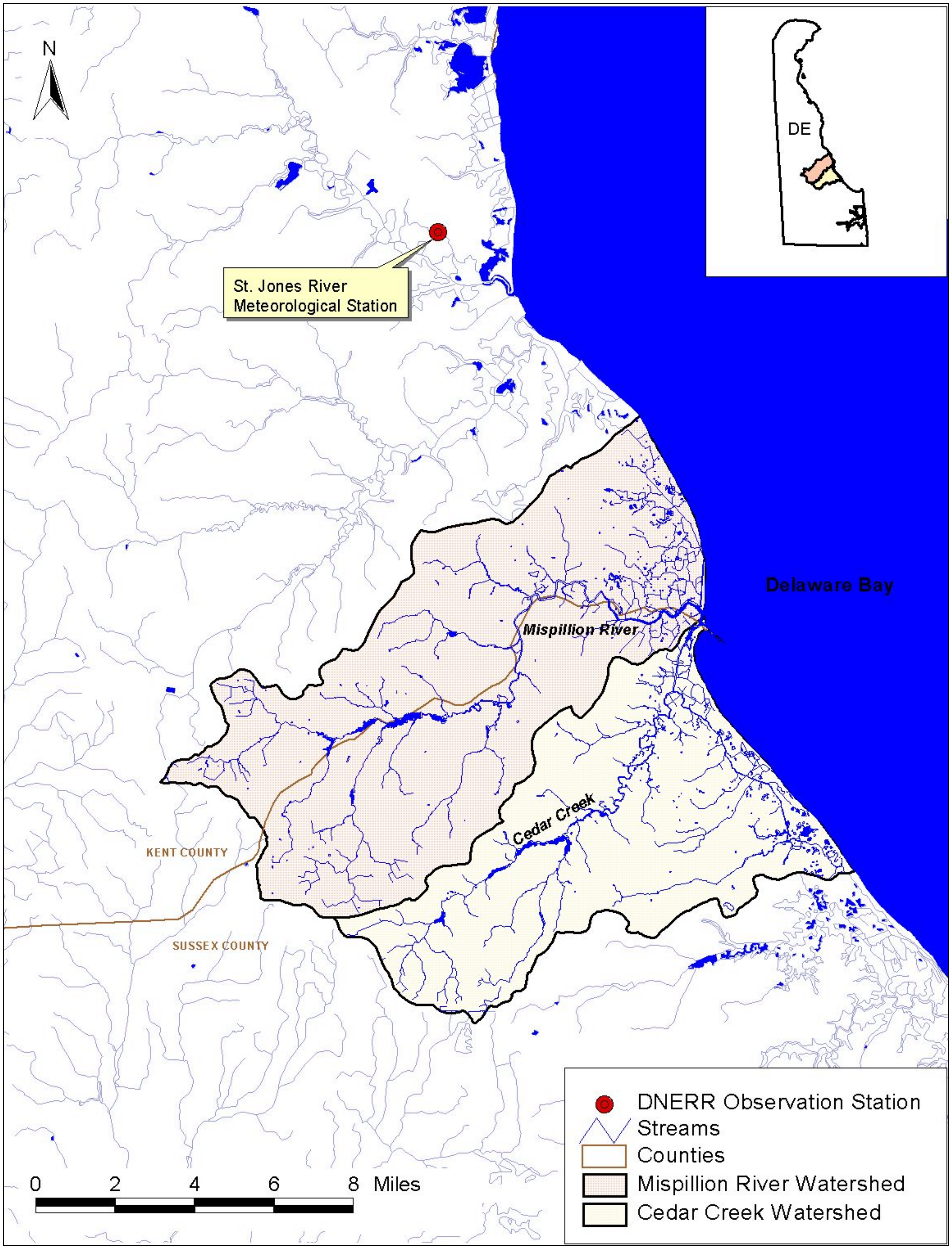

Figure 4-2. Delaware NERR climate station north of the impaired watersheds.

4.1.1.6 Waterbody Representation

Waterbody representation refers to LSPC modules or algorithms used to simulate flow and pollutant transport through streams and rivers. Each delineated subwatershed was represented with a single stream assumed to be a completely mixed cell. The stream reach network provided by DNREC was used to determine the representative stream reach for each subwatershed. Once the representative reach was identified, slopes were estimated based on DEM data and topographic maps, and stream lengths measured from the original stream coverage. In addition to stream slope and length, and channel widths are required to route flow and pollutants through the hydrologically connected subwatersheds. Channel widths were estimated using field observations, aerial photos, and topographic maps.

In addition to the streams, which route flow and transport pollutants through the modeled stream network, impoundments exist in both the Mispillion River and Cedar Creek watersheds that are large enough to impound a significant quantity of flow and pollutants. To represent these impoundments in the watershed model, the length, width, maximum depth, and spillway height and width were obtained for each reservoir (as shown in Tables 4-5 and 4-6). The reservoirs impound all upstream flow until the water depth exceeds the spillway height, causing overflow and thus contributing to downstream flow and reduced pollutant loading.

Table 4-5. Impoundments in the Mispillion River watershed.

Impoundment	Reach ID	Initial Depth (ft)	Length (mi)	Bank Full Depth (ft)	Width (ft)	Weir Crest (ft)
Tub Mill Pond	9	1.9	0.228	2.9	500	25
Silver Lake	13	3.0	0.472	4.0	500	70
Haven Lake	15	1.9	1.327	2.9	650	61
Griffith Lake	18	2.1	0.802	3.1	400	35
Blairs Pond	20	2.0	1.077	3.0	350	10
Abbotts Pond	26	1.7	0.448	2.7	280	50

Table 4-6. Impoundments in the Cedar Creek watershed.

Impoundment	Reach ID	Initial Depth (ft)	Length (mi)	Bank Full Depth (ft)	Width (ft)	Weir Crest (ft)
Cedar Creek Mill Pond/ Swiggetts Pond	15	5.0	0.385	6.0	450	25
Cedar Creek Mill Pond/ Swiggetts Pond	17	5.0	0.877	6.0	350	25
Cubbage Pond	18	5.0	0.791	6.0	350	31
Clendaniel Pond	20	3.0	0.664	4.0	320	6
Hudson Pond	22	3.5	0.443	4.5	350	15

Modeling each of the impaired watersheds requires routing flow and pollutants through a stream network. The stream networks connect all of the subwatersheds represented in the watershed model. Routing required development of rating curves as HSPF FTables for major streams in the networks, in order for the model to simulate hydraulic processes. The rating curves consist of a representative depth-outflow-volume-surface area relationship. The LSPC internal routing function was applied to generate the rating curves. In-stream flow calculations were made using the HYDR (hydraulic behavior simulation) module in LSPC, which is consistent with the HYDR module in HSPF. In-stream pollutant transport was performed using the ADVECT (advective calculations for constituents) and GQUAL (generalized quality constituent simulation) modules.

For downstream segments of the impaired watersheds, impacted by the hydraulics of wetlands and Delaware Bay, a separate hydrodynamic receiving water model was implemented (as noted earlier). A complete description of this receiving water model is provided in Section 4.2.

4.1.2 Watershed Model Calibration and Validation

After initially configuring the Mispillion River and Cedar Creek watershed models, model calibration and validation were performed. This is generally a two-phase process, with hydrology calibration and validation completed before repeating the process for water quality since water quality modeling is dependent on an accurate hydrology simulation. Calibration refers to the adjustment or fine-tuning of modeling parameters to reproduce observations. Validation involves applying the calibrated parameters to an independent dataset (normally a separate time period) and comparing predictions to observations, without further adjustment. Output from the watershed model was produced in the form of daily average flow for each of the subwatersheds, to match the USGS reporting interval. After comparing the results, key hydrologic parameters were adjusted and additional model simulations were performed.

Calibration of the hydrologic model was accomplished by adjusting model parameters until the simulated and observed water budgets matched. Then the intensity and arrival time of storm peaks was calibrated. For this part of the calibration, the parameters influencing flow peak characteristics were adjusted until the comparison could no longer be improved without degrading the water budget comparison. This iterative process was repeated until the simulated results closely represented the system and reproduced observed flow patterns and magnitudes.

USGS 01484100 is the only flow gage in the Mispillion River watershed. Data from this location were used to calibrate the simulated hydrology considering the overall water budget, as well as storm peak and recession characteristics of the hydrograph. Two criteria for goodness of fit were used for calibration: graphical comparison and the relative error method. Graphical comparisons are extremely useful for judging the results of model calibration; time-variable plots of observed versus modeled flow provided insight into the model's representation of storm hydrographs, baseflow recession, time distributions, and other pertinent factors often overlooked by statistical comparisons. The model's accuracy was primarily assessed through interpretation of the time-variable plots. The relative error method was used to support the goodness of fit evaluation through a quantitative comparison. A small relative error indicates a better goodness of fit for calibration.

The calibration and validation years (2002 and 2003, respectively) were selected based primarily upon the availability of observation data, and an examination of climate conditions to ensure that a range of hydrologic conditions (i.e., low, mean, and high flow) was experienced during that period. Model testing for these conditions is necessary to ensure that the model will accurately predict a range of conditions for a longer period of time.

LSPC hydrology was calibrated using flow data at USGS 01484100 in the Mispillion River watershed (the only location with data). Before applying the St. Jones weather data to the Mispillion River and Cedar watersheds, daily flow records were compared from USGS 01483700 in the St. Jones River watershed and from USGS 01484100 in the Mispillion River watershed. This was done in order to determine if the weather data recorded at St. Jones were representative of that in the Mispillion River and Cedar Creek watersheds. It was found that the flow patterns were quite different in 2001, but were similar in 2002 and 2003. Therefore, 2002 and 2003 were selected for calibration and validation, respectively, based on these factors and the fact that this time period represents a range of conditions (both a dry and wet year). The results of the hydrology calibration and validation were presented in the appendices to the "Model Configuration and Calibration Results – Mispillion River and Cedar Creek Models for TMDL Development" report.

Key considerations in the hydrology calibration include the overall water balance, the high-flow-low-flow distribution, storm flows, and seasonal variation. Both graphical comparison and the relative error method were used to gage the calibration. Graphical comparisons were used to judge the results of model calibration; time-variable plots of observed versus modeled flow provide insight into the model's representation of storm hydrographs, baseflow recession, time distributions, and other pertinent factors often overlooked by statistical comparisons. The model's accuracy was primarily assessed through interpretation of the time-variable plots and achievement of acceptable error statistics.

Overall, the model predicts storm volumes and storm peaks well. Since the runoff and resulting streamflow are highly dependent on rainfall, occasional storms were over-predicted or under-predicted due to the spatial variability of the meteorological and gage stations. For example, in March and November of 2003, it appears that there were localized storms that were under-predicted in the model and in April of 2003 it appears that the model over-predicted flow due to a storm near the weather station.

After the model was calibrated and validated for hydrology, water quality simulations were performed. Water quality data recorded during all seasons at various stations throughout each watershed were used to calibrate the water quality component of the LSPC model. The objective of the process was to best represent water quality constituent concentrations at monitoring stations throughout the region. Table 4-7 shows the locations at which water quality calibration of the watershed model was performed for each watershed. Data from 8 stations (on 6 reaches) in the Cedar Creek watershed and 19 stations (on 13 reaches) in the Mispillion River watershed were used for calibration of the LSPC model. Calibration was focused on stations on the impaired segments. Note that stations listed in italics indicate that the station is not on an impaired segment and, therefore, calibration plots for these stations were not shown in the modeling report. Figures 4-3 and 4-4 show the locations of the monitoring stations. The stations below were selected because they were on the modeled reaches and have relevant data. All other stations either did not have relevant data or will be covered in discussions about the EFDC model.

Table 4-7. Water quality monitoring stations used in LSPC calibration.

Watershed	Station	Location	Subwatershed/Reach ID
Cedar	301151	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	15
	301071	On Church Branch, at Cubbage Pond Rd (or Rd 214)	16
	301021	Cedar Creek, Mill Pond at Rd 212	17
	301041	At Cubbage Pond Rd (or Rd 214), downstream from Cubbage Pond outfall	18
	301011	At Clendaniel Pond Rd (or Rd 38), downstream from Clendaniel Pond outfall	20
	301051	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	21
	301161	Middle of Hudson Pond	22
	301061	Upstream side of Rt. 113 bridge, upstream of Hudson Pond	24
Mispillion	208281	On Causeway Branch, at Stratham Lane (Rd 123)	4
	208131	*At confluence of Swan Creek and Mispillion River*	*8*
	208031	On Swan Creek, downstream side of Route 113, downstream of Tub Mill Pond	9
	208311	Middle of Tub Mill Pond	9
	208221	*Tubmill Pond; Tubmill Branch at Rd 404*	*11*
	208211	Mispillion River, Silver Lake at DE Route 36, Milford	13
	208321	Middle of Silver Lake	13
	208011	Mispillion River, Haven Lake at US Route 113 bridge	15
	208341	Middle of Haven Lake	15
	208351	*On Bowman Branch (a tributary to Haven Lake), at Meadow Brook Lane (Rd 634), west of Milford*	*15*
	208361	On Lednum Branch (a tributary to Haven Lake), at Williamsville Rd (Rd 443)	16
	208381	Middle of Griffith Lake	18
	208191	Blairs Pond off Rd 443, at the Boat Ramp	20
	208391	Middle of Blairs Pond on Beaverdam Branch, at Williamsville Rd (Rd 443)	20
	208231	Blairs Pond; Beaverdam Branch at Rd 384 (USGS 01484100)	23
	208241	Upstream Blairs Pond, on Tantrough Branch, at Abbotts Pond Rd (Rd 442 or Rd 620)	24
	208371	*Downstream side of Rd 633 (or Griffiths Rd or Rd 451), downstream from Griffith Lake outfall*	*25*
	208181	Abbotts Pond at Rd.620	26
	208401	Middle of Abbotts Pond	26
	208261	*Upstream of Abbotts Pond, on Johnson Branch, at Route 36*	*27*

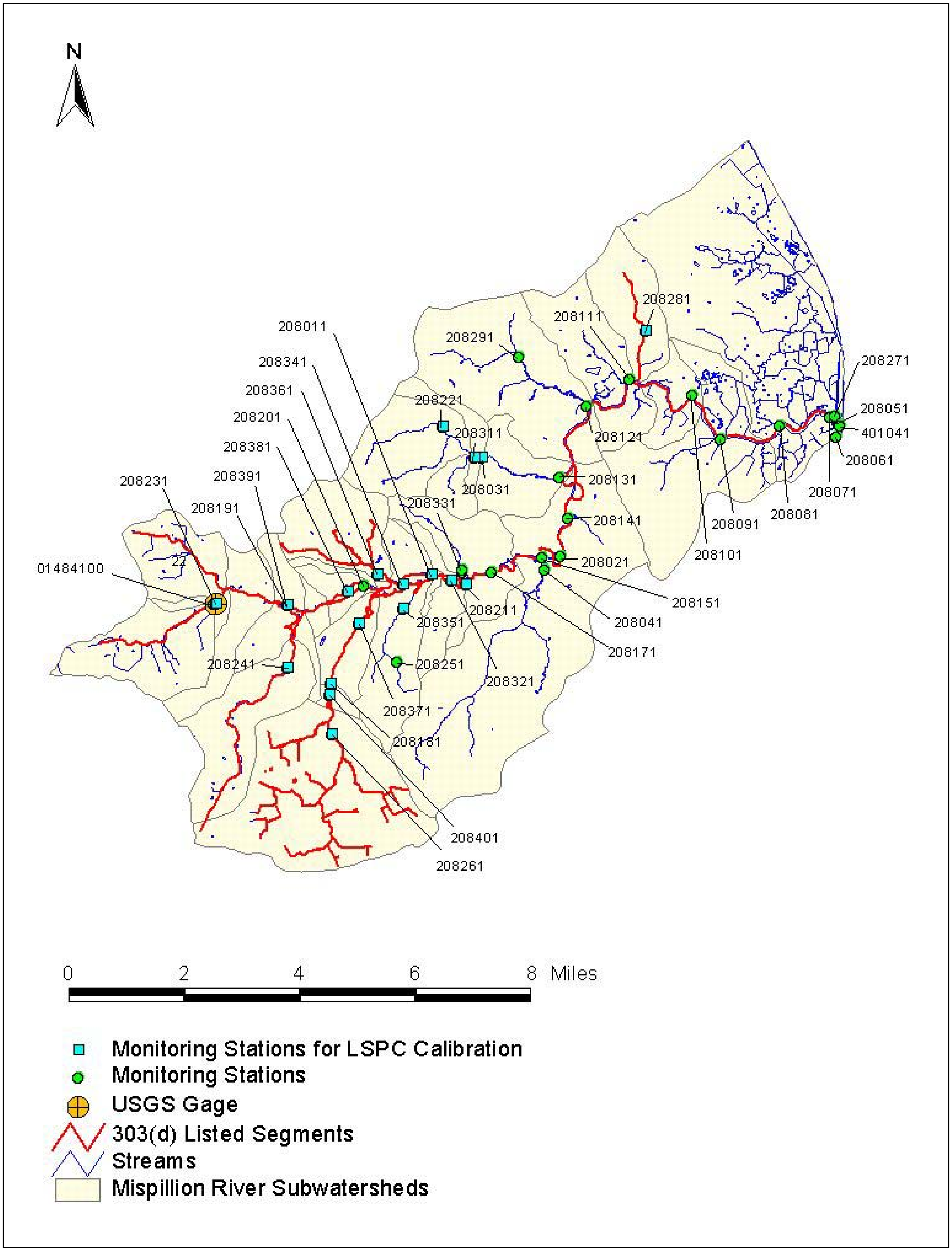

Figure 4-3. Location of monitoring stations used for calibration of the Mispillion River watershed model.

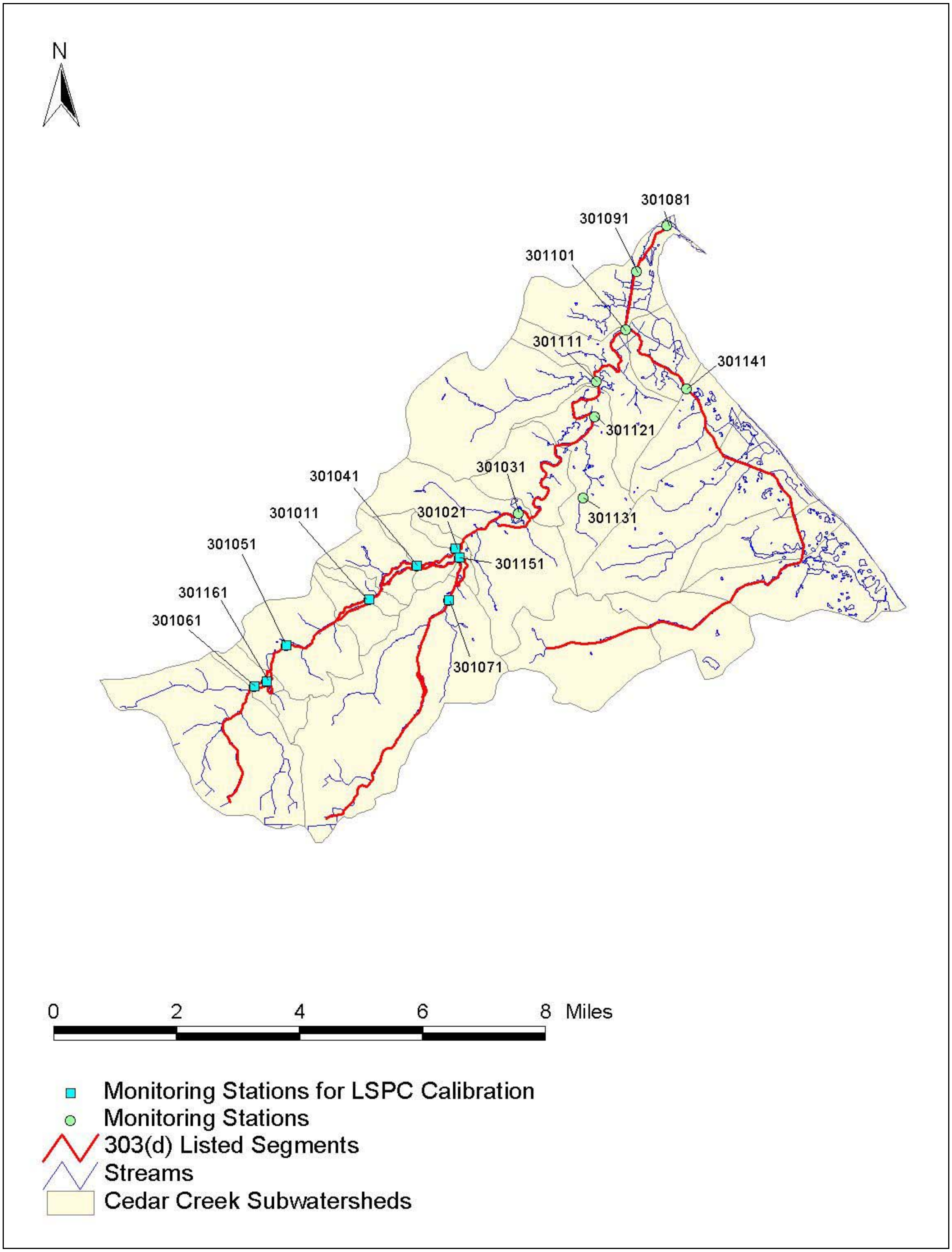

Figure 4-4. Location of monitoring stations used for calibration of the Cedar Creek watershed model.

The watershed calibration and validation plots for DO, CBOD, chlorophyll-a, TN, TP, and Enterococcus were presented in the appendices to the "Model Configuration and Calibration Results – Mispillion River and Cedar Creek Models for TMDL Development" report. However, example plots for DO and nutrients calibration for one station in each watershed are shown below (Figures 4-5 through 4-10).

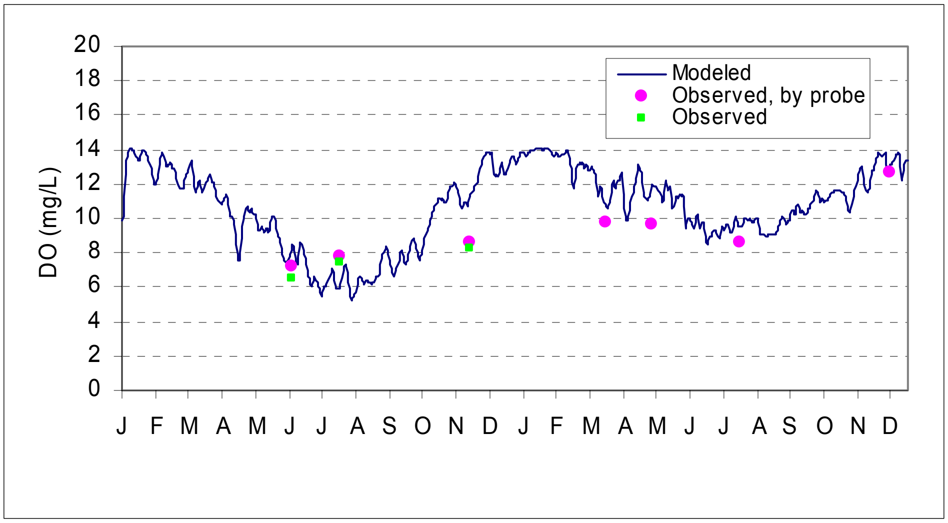

Figure 4-5. LSPC DO calibration for Mispillion River Reach 15 (Stations 208011 & 208341, Haven Lake).

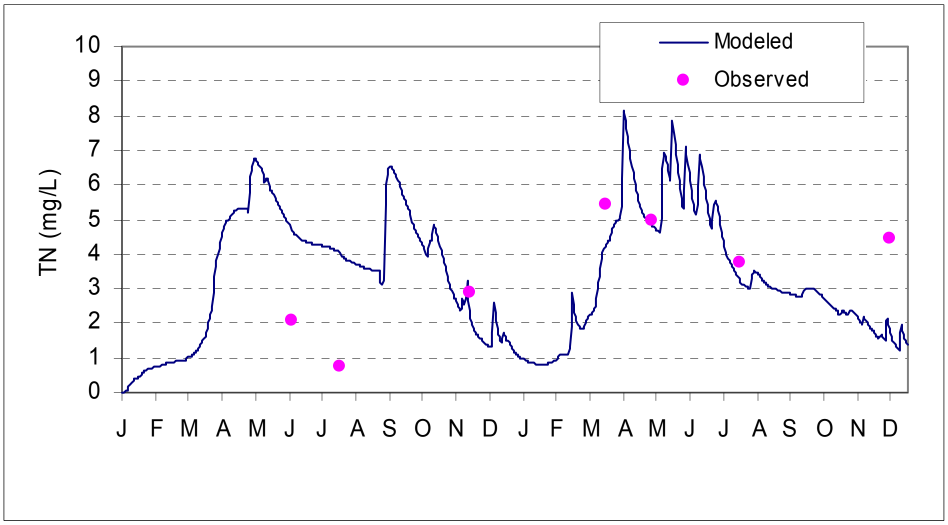

Figure 4-6. LSPC TN calibration for Mispillion River Reach 15 (Stations 208011 & 208341, Haven Lake).

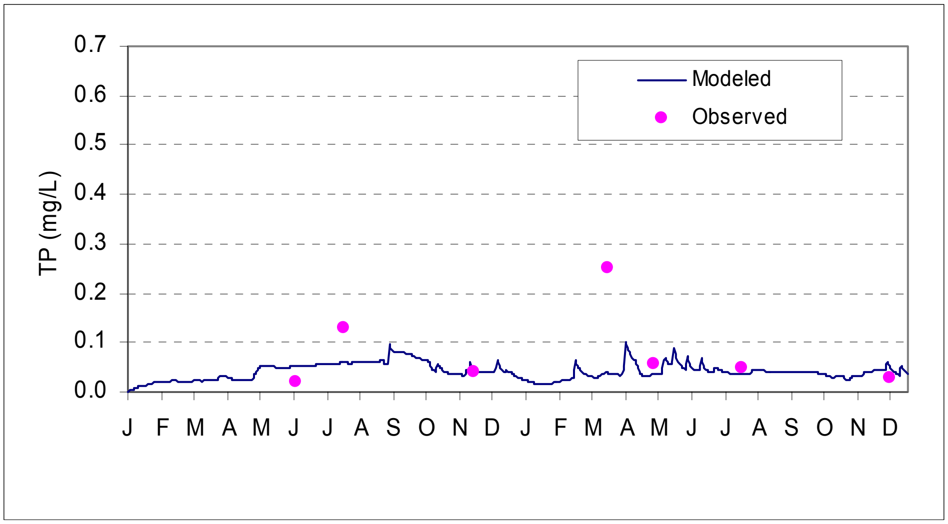

Figure 4-7. LSPC TP calibration for Mispillion River Reach 15 (Stations 208011 & 208341, Haven Lake).

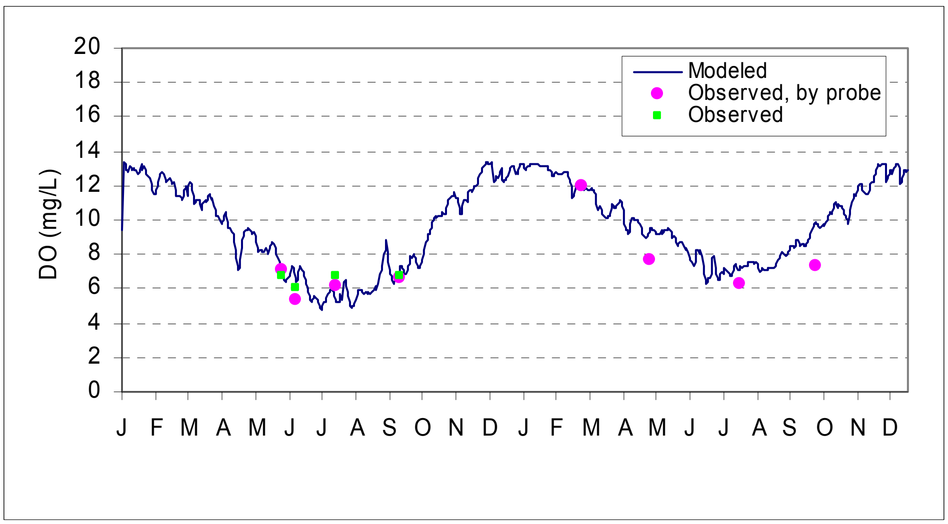

Figure 4-8. LSPC DO calibration for Cedar Creek Reach 21 (Station 301051, Hudson Pond outlet).

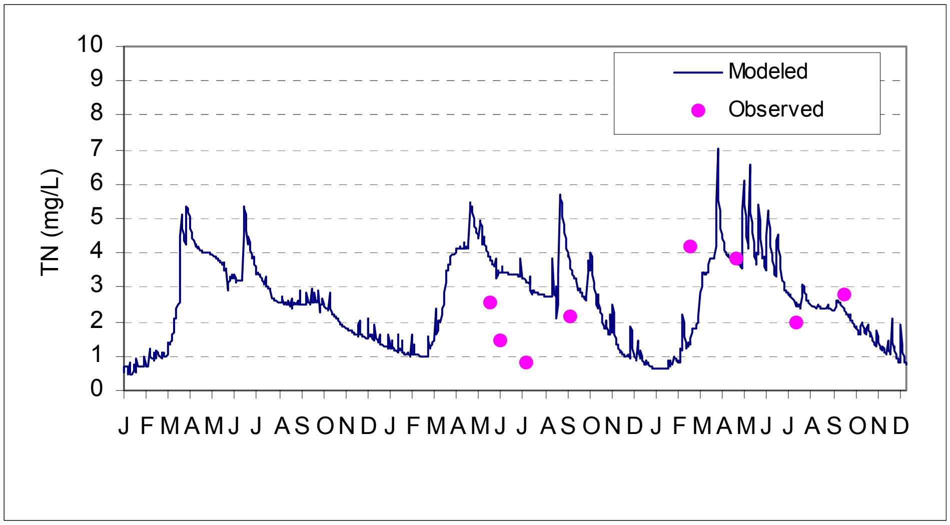

Figure 4-9. LSPC TN calibration for Cedar Creek Reach 21 (Station 301051, Hudson Pond outlet).

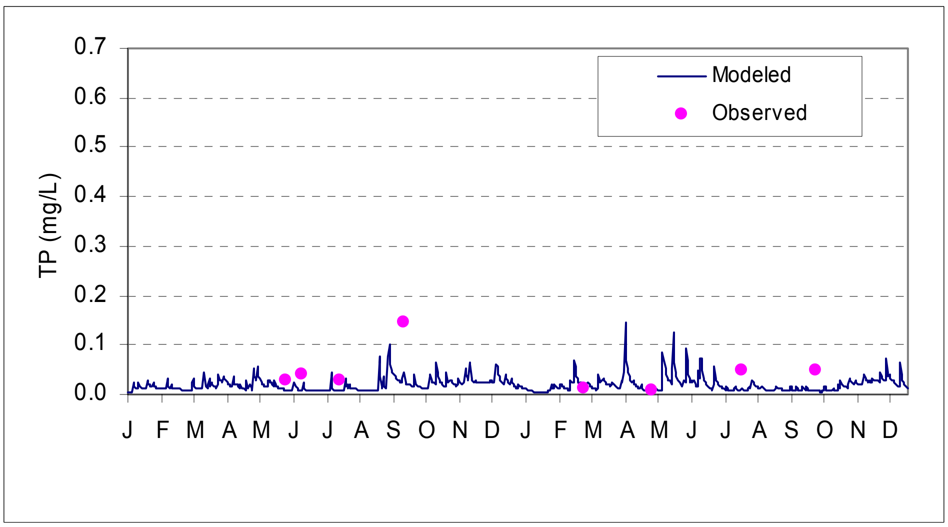

Figure 4-10. LSPC TP calibration for Cedar Creek Reach 21 (Station 301051, Hudson Pond outlet).

4.2 Receiving Water Model Configuration

Configuration of the EFDC receiving water model involved processing bathymetric data, developing a model grid, assigning initial hydrodynamic and water quality conditions in the water column, defining boundary conditions at the water surface, and linkage to the watershed model for up-stream and lateral inputs. The following discussion provides more detail regarding model configuration and application.

4.2.1 Grid Generation

The first step to configure EFDC for the Mispillion River and Cedar Creek was to discretize the area into a computational grid, in order to solve the model's governing equations. A boundary-fit curvilinear grid was developed to most truly represent the shape of the river. Significant hydraulic features (including watershed inflows, dams, and major bathymetric variability) and their locations were considered in preparing the grid. The grid consists of 634 curvilinear grid cells. Each cell is represented by one vertical layer. The bottom elevations on the channels are determined by the ADCP data from DNREC. The bottom elevations of both the Mispillion River and Cedar Creek do not change significantly. Average bottom elevations of 2.65 meters and 2.50 meters below sea level are used for the main channels and tributaries of the Mispillion River and Cedar Creek, respectively. The main channel and tributaries of the two rivers are surrounded by large area of tidal marsh. The tidal marshes are physically linked with the river channels and active exchange of water and nutrients exist between the river waters and the tidal marshes. To reasonably simulate the dynamic linkage of the flow and water quality interaction between the river channels and tidal marshes, the tidal marshes are configured as active computational grids and fully linked with the river channel grids. All the processes, such as hydrodynamics, nutrient cycling, phytoplankton dynamics, and sediment-water interactions, are simulated for both the river channels and the marshes. In addition, macrophyte simulation is configured for the marsh to track the role played by the macrophyte in the marsh. Although subjected to uncertainties in terms of marsh geometric representation and macrophyte characterizations, to include marsh system as an active system in the water quality model allows the most reasonable representation of the prototype given the available data. Furthermore, with more data being collected in the future, the model can be conveniently extended and tested for more accurate representation of the system. Figure 4-11 presents the computational grid of the Mispillion River and Cedar Creek model.

An important issue in grid development is to determine the proper open boundary locations. If the boundary is far away from the modeling domain, unnecessary cells are added and computational time is increased. If the boundary is too close to the modeling domain, the boundary conditions may not be independent of conditions in the modeling domain. In addition, for practical purposes, observation data should be available at the open boundary. In this project, the open boundaries were set approximately 4 km away from the mouth of the jetties. The large volume of Delaware Bay dilutes materials from the Mispillion River and Cedar Creek quickly during the ebb period, and the river does not significantly impact the water quality concentrations at the open boundary cells. It should be noted that this grid was developed and refined through an iterative process wherein model resolution, accuracy, and simulation time were optimized.

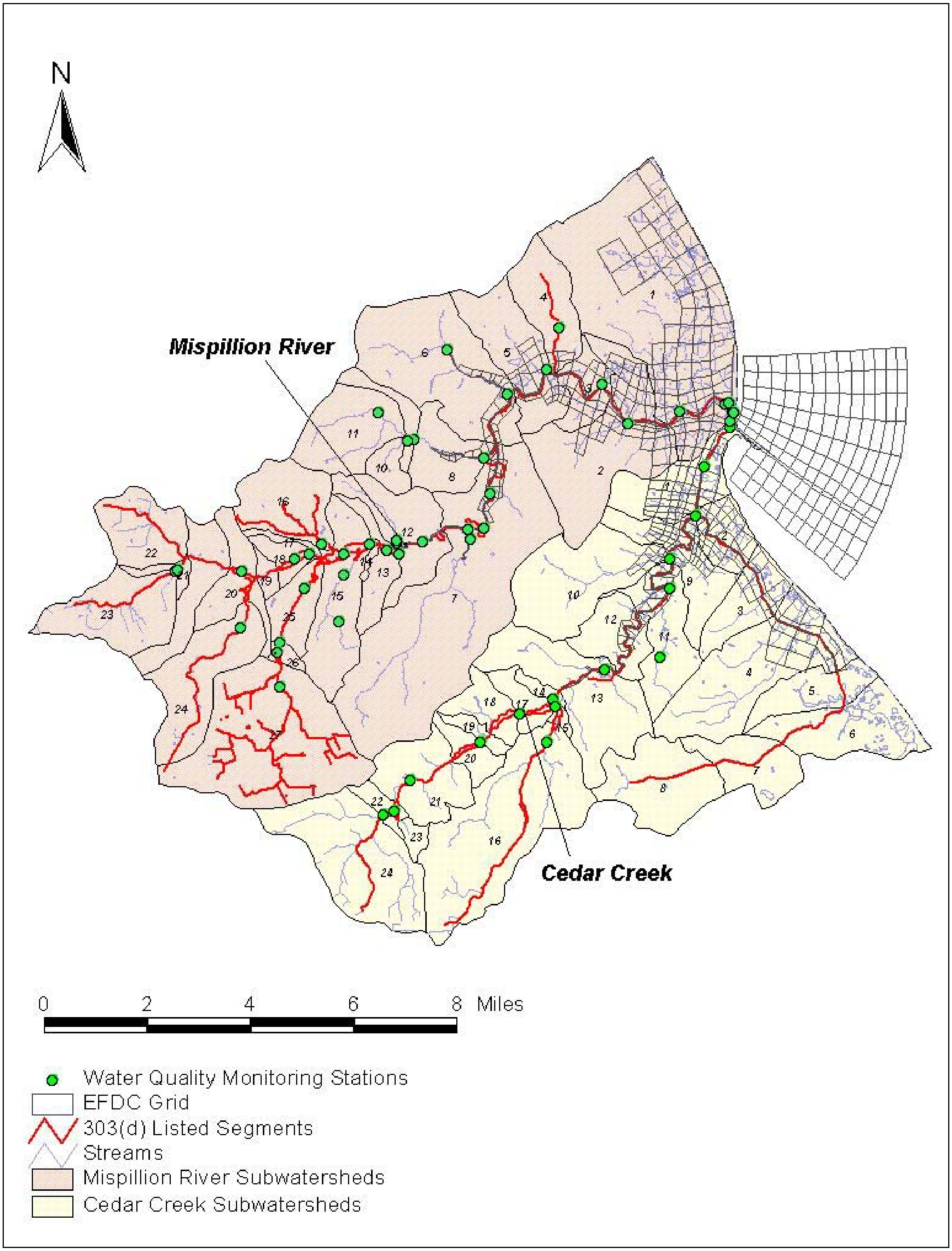

Figure 4-11. Computational grid of the Mispillion River and Cedar Creek EFDC receiving water model.

4.2.2 Water Quality Model Structure

In order to most accurately represent the complex chemical and biological interactions exhibited by the impaired waterbodies, a detailed water quality framework was instituted. The EFDC model was configured to represent algae, the limiting effects of different nutrients, and nutrient fate and transport within the water column and between the water column and sediment. The water column state variables simulated in the water quality model are:

i. Algae biomass
ii. Dissolved organic carbon
iii. Labile particulate organic carbon
iv. Refractory particulate organic carbon
v. Dissolved organic phosphorus
vi. Labile particulate organic phosphorus
vii. Refractory particulate organic phosphorus
viii. Orthophosphate
ix. Dissolved organic nitrogen
x. Labile particulate organic nitrogen
xi. Refractory particulate organic nitrogen
xii. Ammonia
xiii. Nitrite/nitrate
xiv. Dissolved oxygen

In addition to representation of chemical and biological interactions within the water column, a sediment diagenesis model is used to link the water column and sediment bed. The sediment diagenesis model enables the prediction of linked sediment nutrient flux, oxygen demand, and internal loading of nutrients for not only historical conditions, but also for nutrient management scenarios. This predictive capability overcomes the inherent limitation in many water quality models of statically setting sediment nutrient impacts. This capability is particularly useful during TMDL analysis, where loading scenarios should (and in reality, would) have a direct impact on sediment nutrient contributions to the water column.

Enterococci bacteria are modeled using the toxic module of EFDC. The kinetics are modified to include the die-off rate adjusted by water temperature, salinity, and solar radiation.

4.2.3 Boundary Conditions

Model boundary conditions are external driving forces applied to the modeling system. Flow gages, meteorological station data, and water quality data for the EFDC model consist of upstream/lateral boundary conditions, surface boundary conditions, and downstream open boundary conditions. The upstream/lateral boundary conditions include the inflow water and associated sediment, temperature and water quality constituents. The surface boundary condition is represented by time variable meteorological conditions including solar radiation, wind speed and direction, air temperature, atmospheric pressure, relative humidity, and cloud cover conditions. The open boundary conditions include the tidal elevation, temperature, salinity, and concentrations of water quality constituents in Delaware Bay.

In the Mispillion River and Cedar Creek models, upstream/lateral boundary conditions were configured based on the watershed modeling results. The spatial representation of the upstream/lateral boundary conditions was determined by mapping the geographical coordinates of the tributary outlets to the model grid. Flow, temperature, DO, algae, and pollutant loading time series data from the watershed model for each tributary watershed and intervening watershed were applied to corresponding grid cells within the model. Since LSPC models organic matter as CBOD, while EFDC uses TOC, a conversion factor was used based on monitored CBOD and TOC data. The average TOC to CBOD ratio was approximately 2.0. Therefore, the CBOD load generated in the watershed models was converted to TOC using a multiplier of 2.0. In EFDC, organic matter is divided into three groups: dissolved organic matter, labile particulate organic matter, and refractory particulate organic matter. In this model, TOC was equally divided into these three groups. Other constituents including DO, nitrite/nitrate, ammonia, PO_4, and bacteria were input directly into EFDC.

The EFDC model requires atmospheric boundary forcing data which include atmospheric pressure, air temperature, relative humidity, precipitation, evaporation, solar radiation, cloud cover, wind speed, and wind direction to drive the hydrodynamic simulation. These data are obtained from the St. Jones River weather station operated by DNERR.

Tide is one of the main driving forces of the hydrodynamics of the tidal channel and wetting and drying of the wetlands. Tidal elevation data were obtained from NOAA station 8555889 near Brandywine Shoal Light, Delaware Bay (Figure 4-12). Figure 4-13 shows the tidal elevation for June of 2002. It shows that the typical tidal range is between 0.5 m below sea level and 2.0 m above sea level. Temperature, salinity, and concentrations of the water quality constituents including DO, TOC, nutrients, and algae are from stations 401061, 401031, and 401021 (as shown in Figure 4-12).

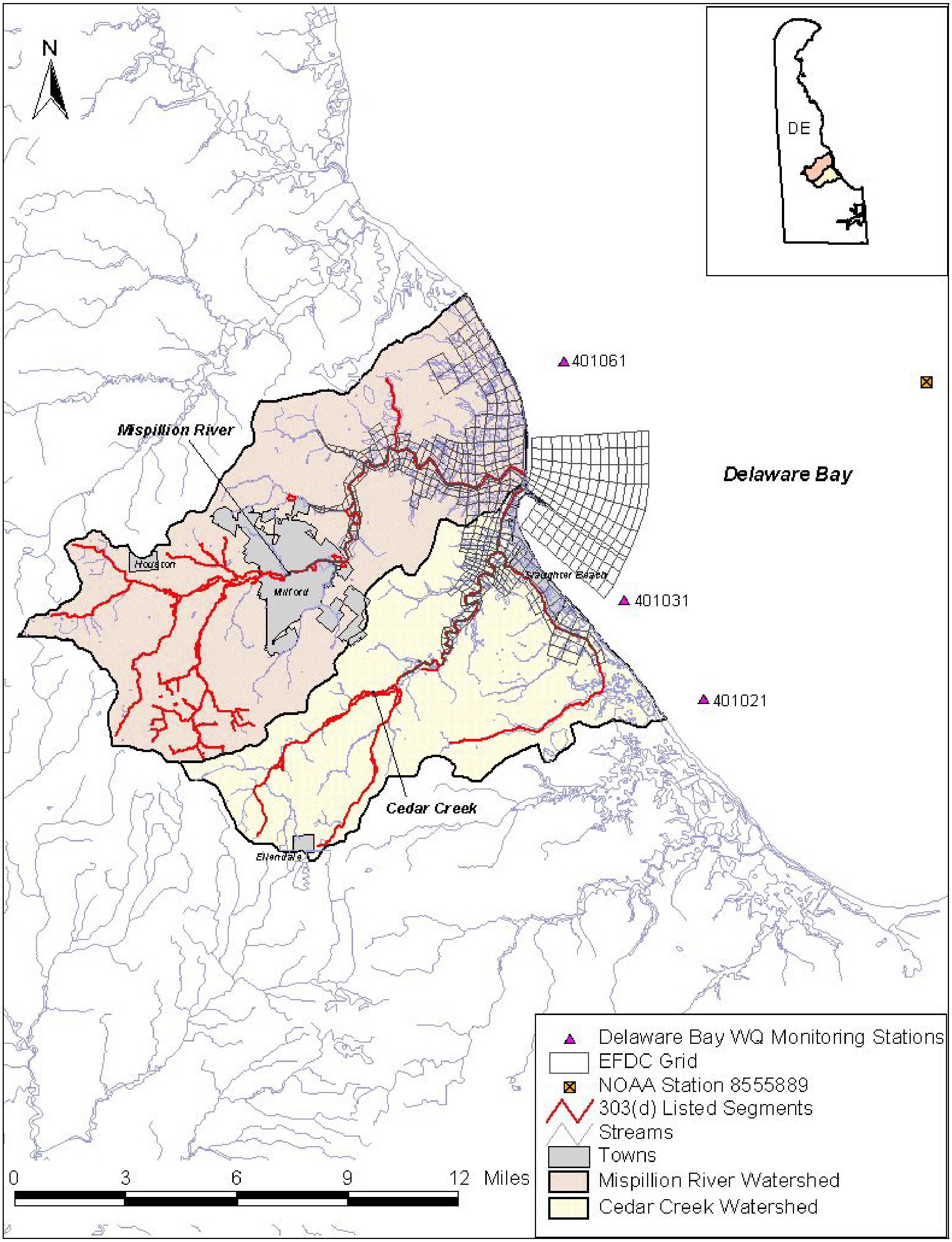

Figure 4-12. Location of NOAA station 8555889 near Brandywine Shoal Light.

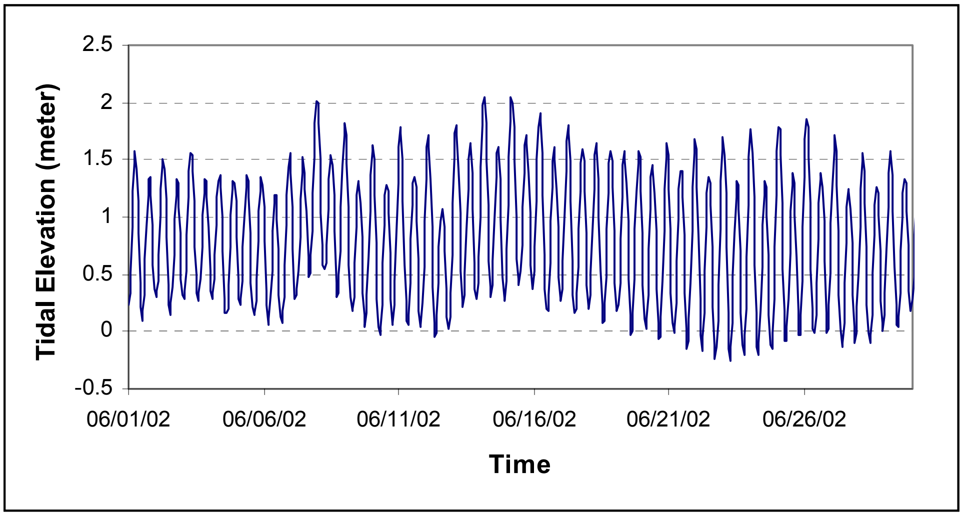

Figure 4-13. Tidal elevation data at Brandywine Shoal Light.

4.2.4 Initial Conditions

For the model, initial conditions provide a starting point for the model to march forward through time. For a dynamic system like the Mispillion River and Cedar Creek, under the impact of freshwater inflow and tides, the influence of initial conditions are decreased quickly. The modeled salinity results show that after the model simulates 30 days, salinity at all the stations represent the observed levels.

4.2.5 Model Calibration and Validation

Calibration of the EFDC hydrodynamic model was performed through a comparison of model predictions with various observed data, including salinity and temperature time series. These results are presented in the "Model Configuration and Calibration Results – Mispillion River and Cedar Creek Models for TMDL Development" report. Model velocity predictions were also compared to ADCP data at downstream locations in the system to ensure that predicted velocities reasonably match ADCP measurements. These were presented in a previous memo.

As with the ADCP velocity comparisons, the model predictions fall within an acceptable and expected range. Differences between the measurements and predictions occur due to a host of factors, including resolution of the grid (a significantly higher resolution grid may result in more accurate velocity predictions, however it would be computationally limiting for TMDL development); representation of marshes (the prototype grid representation of marshes tends to average/smooth out localized impacts that the ADCP data may pick up); and river channel bathymetry (limited cross sections were available for configuring the main channel in the model and thus detailed spatial variability may not be captured). These differences don't have a major influence on the temporal or spatial representation of water quality conditions in the system, which are pertinent for TMDL development.

Table 4-8 shows the locations at which water quality calibration of the receiving water model was performed for each watershed. Data from four stations (on three reaches) in the Cedar Creek watershed and five stations (on four reaches) in the Mispillion River watershed were used for calibration of the EFDC model. Figures 4-14 and 4-15 show the locations of the monitoring stations.

Table 4-8. Water quality monitoring stations used in EFDC calibration.

Watershed	Station	Location	Subwatershed/Reach ID
Cedar	301081	Confluence of Cedar Creek with Mispillion River	1
	301091	Cedar Creek at Rt. 36 bridge	1
	301141	On Slaughter Creek, at Slaughter Neck Rd (Rd 224)	3
	301031	Cedar Creek at DE Route 14	13
Mispillion	208051	At mouth of Mispillion River	1
	208061	Mispillion River 0.43 miles from mouth at lighthouse	1
	208101	Mispillion River, 4.64 miles from mouth	3
	208121	Mispillion River, 7.14 miles from mouth	6
	208021	Mispillion River at Delaware Route 14 bridge	7

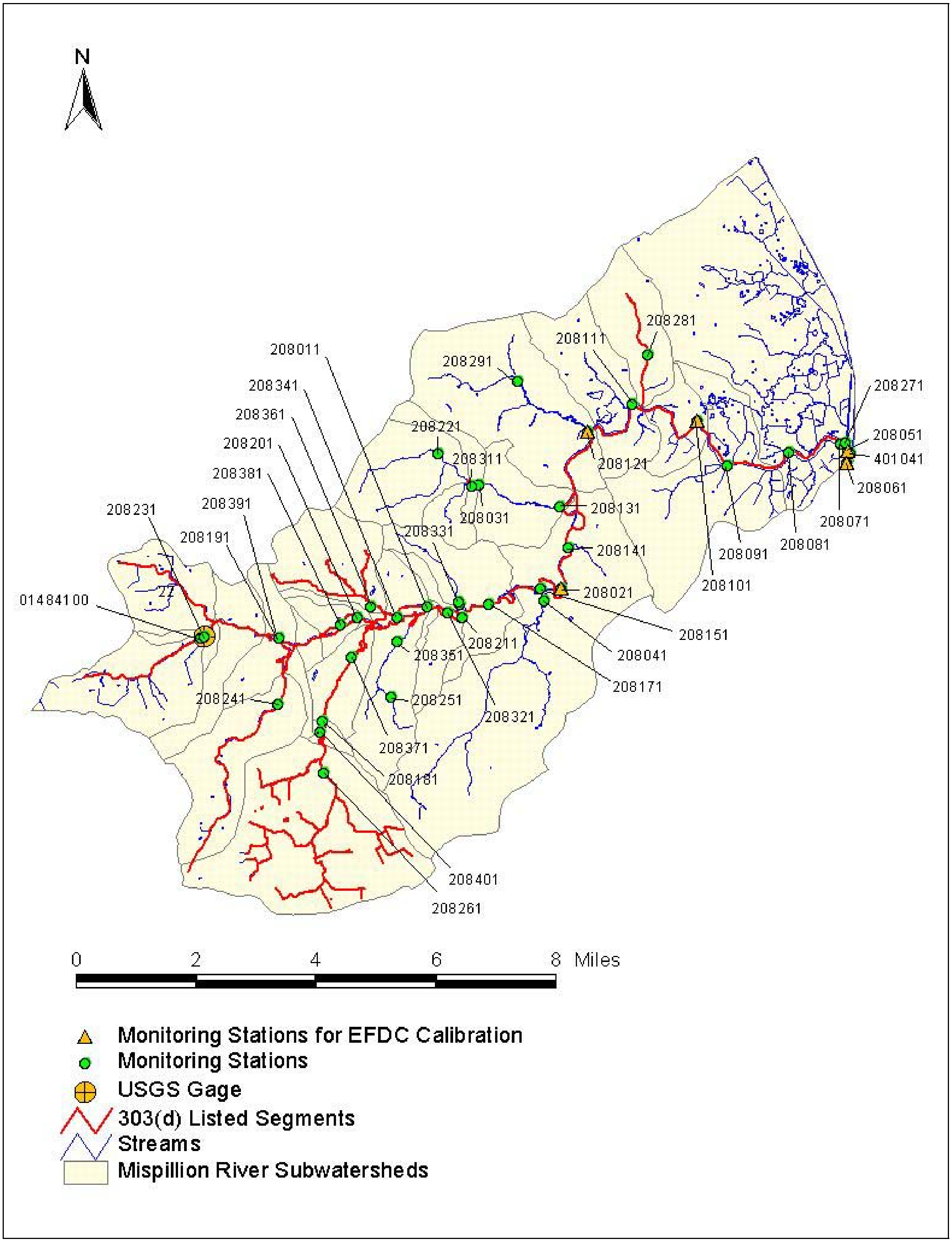

Figure 4-14. Location of monitoring stations used for calibration of the Mispillion River receiving water model.

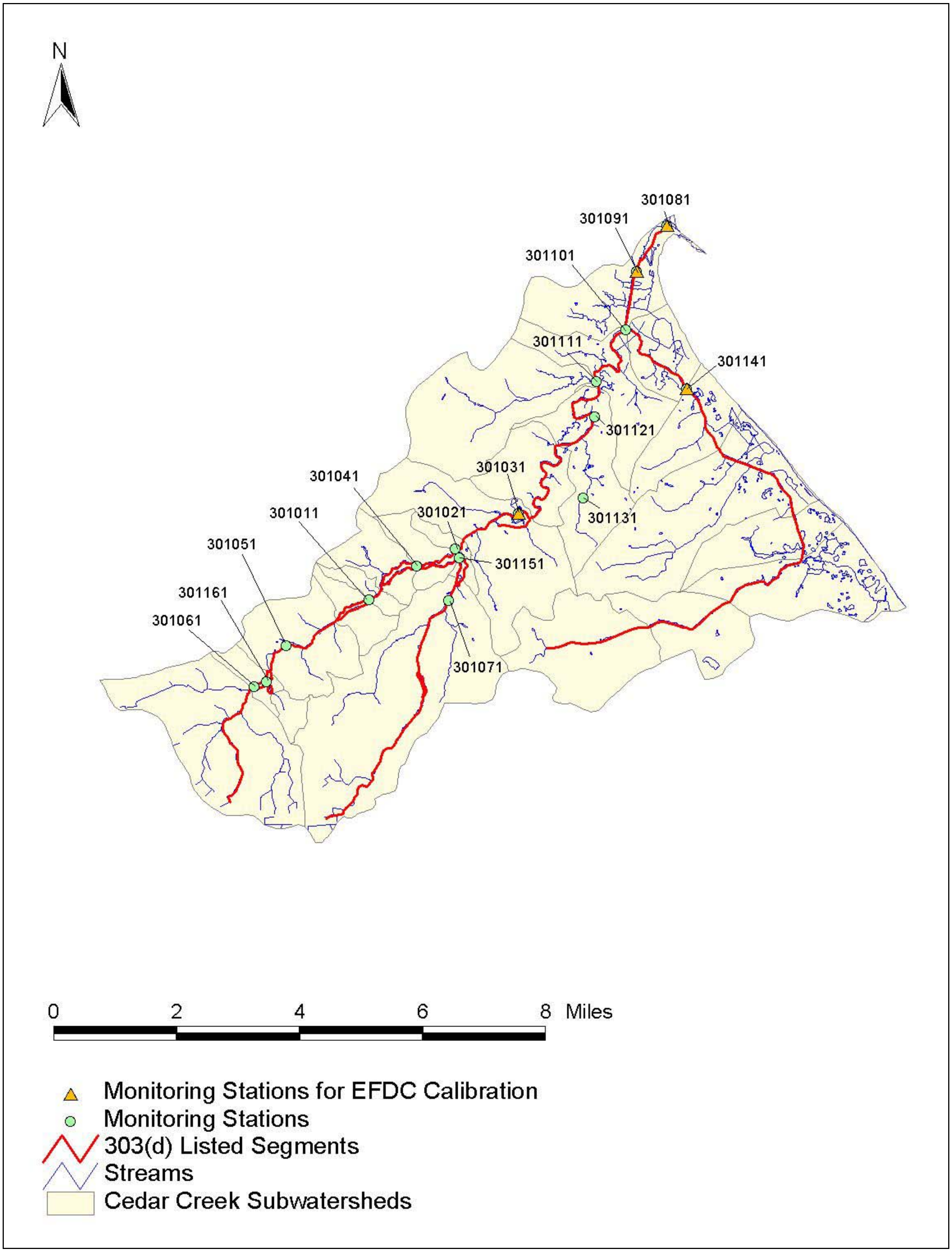

Figure 4-15. Location of monitoring stations used for calibration of the Cedar Creek receiving water model.

The receiving water model calibration and validation plots for DO, CBOD, chlorophyll-a, TN, TP, and Enterococcus were presented in the appendices to the "Model Configuration and Calibration Results – Mispillion River and Cedar Creek Models for TMDL Development" report. However, example plots for DO and nutrients calibration for one station in each watershed are shown below (Figures 4-16 through 4-21).

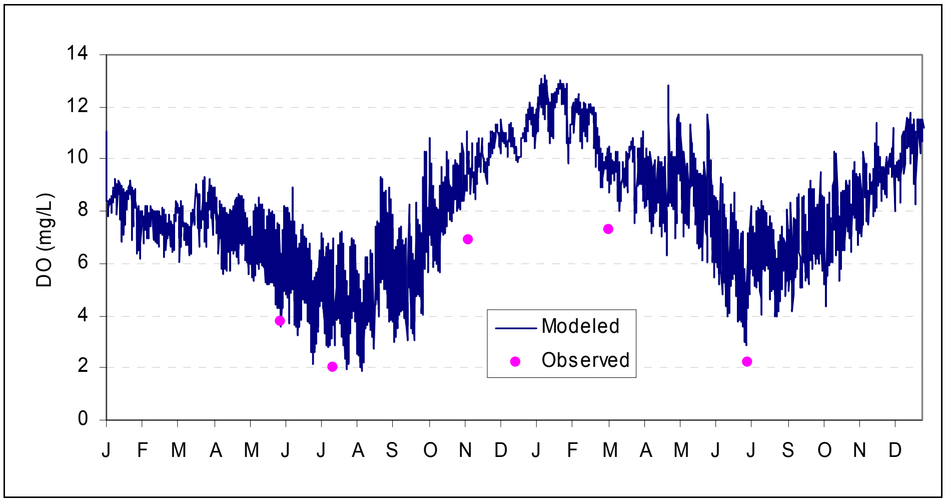

Figure 4-16. EFDC DO calibration for Mispillion River Reach 3 (Station 208101, mainstem Mispillion River).

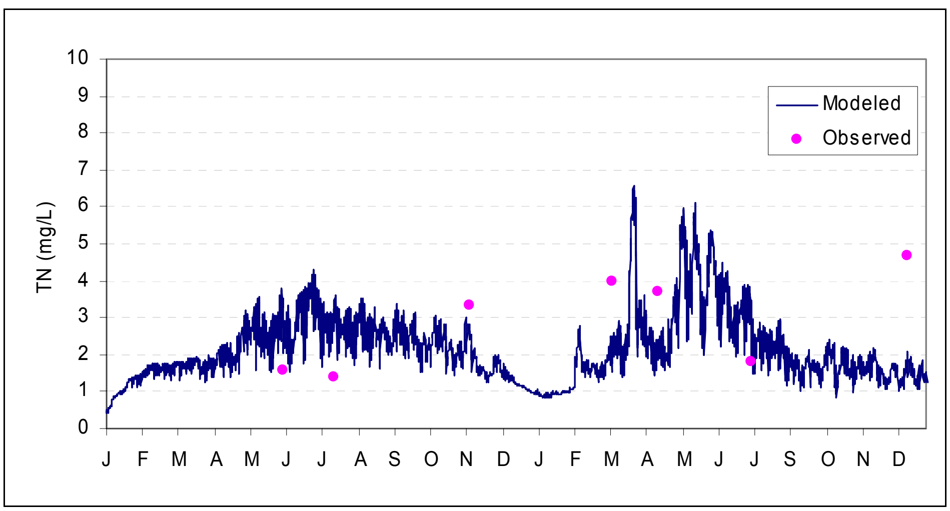

Figure 4-17. EFDC TN calibration for Mispillion River Reach 3 (Station 208101, mainstem Mispillion River).

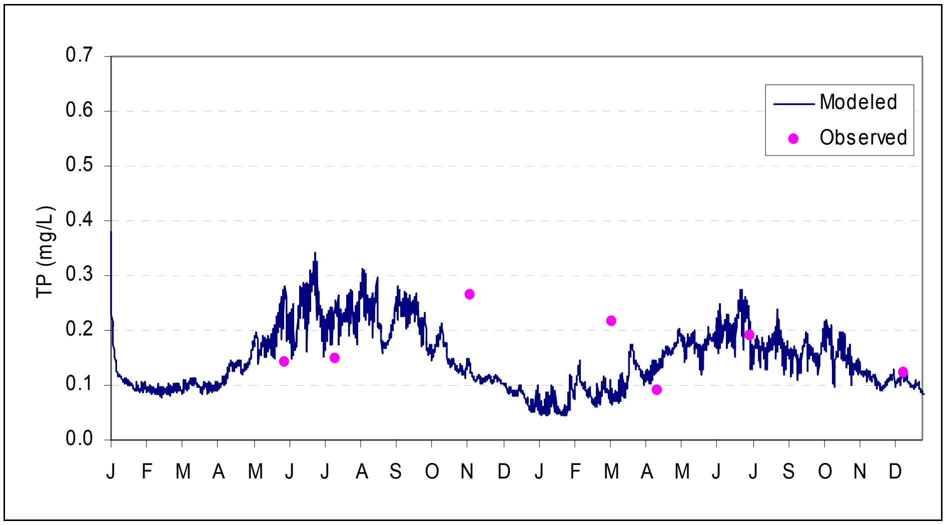

Figure 4-18. EFDC TP calibration for Mispilliion River Reach 3 (Station 208101, mainstem Mispillion River).

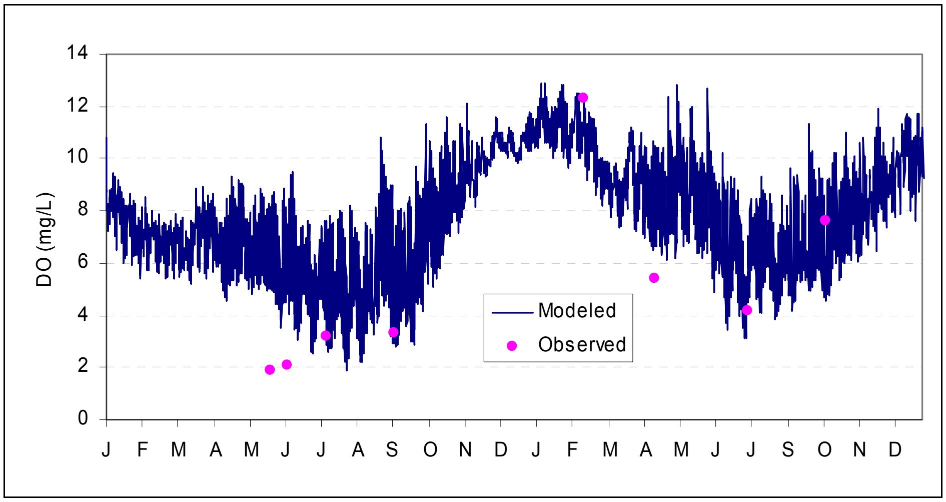

Figure 4-19. EFDC DO calibration for Cedar Creek Reach 1 (Station 301091, mainstem Cedar Creek).

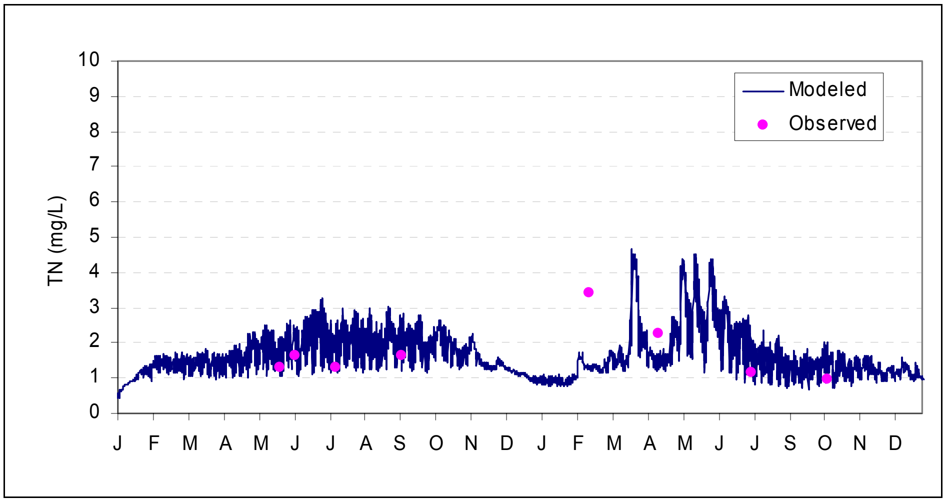

Figure 4-20. EFDC TN calibration for Cedar Creek Reach 1 (Station 301091, mainstem Cedar Creek).

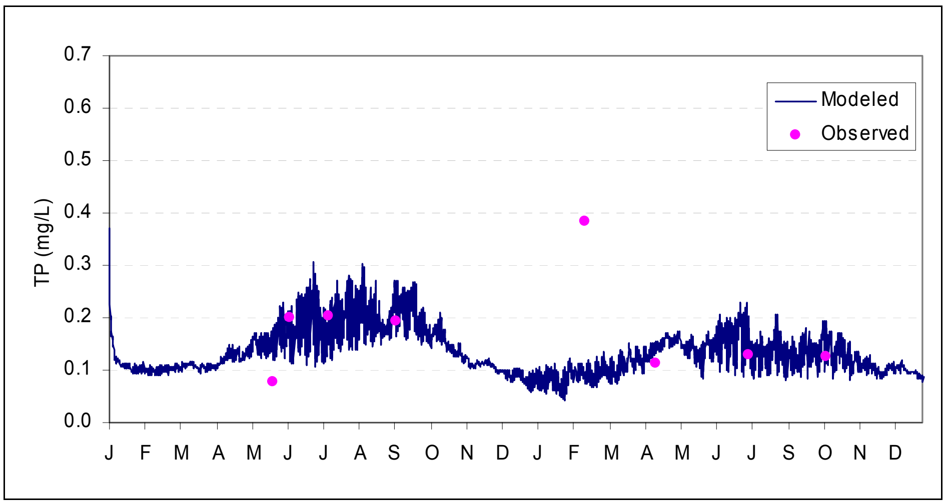

Figure 4-21. EFDC TP calibration for Cedar Creek Reach 1 (Station 301091, mainstem Cedar Creek).

4.3 Assumptions and Limitations

All mathematical water quality models are a simplified representation of the very complex real world. The Mispillion River and Cedar Creek are certainly no exception. It is important to identify critical assumptions and limitations regarding the model's predictive capability and applicability.

4.3.1 Assumptions

The major underlying assumptions associated with Mispillion River and Cedar Creek model development are as follows:

- Weather conditions do not vary significantly over the entire modeling domain. If they do, the impact on resulting water quality is assumed not to be significant.
- The impact of sediment transport and siltation on channel geometry is not significant, therefore the same bathymetric configuration can be used for all model simulations.
- One phytoplankton species and one macrophyte species are sufficient for representing the overall primary production and nutrient interactions in the system.
- All the organic matter in the water column (and that from other sources) has the same stochiometric ratio.
- The impact of zooplankton and benthic creatures is lumped into a death rate for algal dynamics and nutrient recycling.
- One major aquatic plant type will be represented for the wetland cells. The wetland ecosystem is mature and ecological evolution is minimal.
- No significant vertical stratification is assumed in the impoundments.
- Land uses and channel banks are stable throughout the modeling period.
- First-order die-off of enterococci is appropriate under the impact of temperature, salinity, and solar radiation.
- Each LSPC reach is assumed to be completely mixed for water quality parameters.
- Reactions of water quality parameters are first-order in LSPC.
- Lateral watershed inflows enter adjacent EFDC cells evenly.
- The ratio of TN and TP to the detailed species from the watershed is constant.
- Field data are reliable for calibration.

4.3.2 Limitations

A number of Mispillion River and Cedar Creek model limitations have been identified. Additional limitations may be identified over the course of the project.

- The EFDC model will not simulate multiple species of phytoplankton and macrophytes. Therefore, the model will not be suitable for evaluating competition among multiple species or evolution of the aquatic algal communities and their interaction with nutrients.
- Neither zooplankton nor benthic animals will be simulated in the EFDC model, hence, there may be some uncertainty in the simulation of algal dynamics and nutrient cycling.
- LSPC is a spatially-lumped model and does not represent the spatial variability of land uses within a subwatershed.
- EFDC will run on a horizontal two-dimensional grid. Vertical profiles will be depth-averaged.
- No growth for enterococci in sediment will be considered within EFDC, and this may under-predict sediment storage of enterococci.

5.0 TMDL RESULTS AND CALCULATIONS

By definition, a TMDL, or Total Maximum Daily Load, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. The ultimate goal of the TMDL is to determine the assimilative capacities of the Mispillion River and Cedar Creek and ensure that the waterbodies and their tributaries meet prescribed water quality criteria along their lengths. The TMDL process involves selection of appropriate targets and development of source loading scenarios that meet the targets. Although concentrations of pollutants may vary (particularly for nutrients), the overall loading that allows a waterbody to meet criteria is what is critical. In the case of bacteria, the target concentration is what has to be met (albeit for an averaging period), and the specified load results in the concentration being met at all times.

TMDLs were established for each individual segment listed on Delaware’s 303(d) list. TMDLs consist of a point source waste load allocation (WLA), a nonpoint source load allocation (LA), and a margin of safety (MOS). The TMDLs identify the sources of pollutants that cause or contribute to the impairment of the water quality criteria and allocate appropriate loadings to the various sources.

A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The equation used for TMDLs and allocations to sources is:

$$TMDL = \sum WLA + \sum LA + MOS$$

The WLA portion of this equation is the total loading assigned to point sources. The LA portion is the loading assigned to nonpoint sources. According to federal regulations (40 CFR 130.2(g)), load allocations are best estimates of the nonpoint or background loading. These allocations may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint sources should be distinguished (EPA, 2001). The MOS is the portion of loading reserved to account for any uncertainty in the data and the computational methodology used for the analysis.

The TMDL development process involved the following steps:

1. Establish Baseline Condition: The calibrated and validated model was run for a “baseline” condition. This condition was essentially the starting point for TMDL analysis. For the baseline condition, the Sea Watch International (formerly permitted facility) was represented using estimates based on monitoring data and the Baltimore Aircoil Milford Plant was considered null and not included. The Delaware Bay contributions were set to existing conditions, and the 2002 land use was used as the basis for generating flow and loads from the watershed to the receiving water models. The meteorological conditions that occurred from 2001 to 2003 were assumed representative of typical conditions in the watershed. All assumptions, values, and data used for the baseline condition were identical to those used in the calibration and validation runs. More details are available in the Modeling Report.

2. Load Reductions: Dissolved oxygen and Enterococcus bacteria concentrations predicted by the model under baseline conditions were compared directly to Delaware's water quality standards. Furthermore, nitrogen and phosphorous concentrations were compared to Delaware's nutrient target thresholds. In many situations DO levels were not at or above the criteria and enterococci and nutrient values were above relevant criteria and targets. In order to meet the DO and enterococci criteria, load reductions were required. The load reduction process involved reducing nutrient (nitrogen and phosphorus components and CBOD) and enterococci loads from the watershed until the DO and enterococci criteria were met at all locations on impaired waters throughout both the Mispillion River and Cedar Creek watersheds. Nutrient concentrations predicted by the model were also compared to nutrient targets. The only values changed during load reductions were the accumulation rates of nutrients and bacteria; all other parameters remained the same as baseline condition.

For the load reduction simulation (TMDL simulation), the model was run for a total of 9 years (3, 3-year meteorological cycles representing years 2001-2003). Only the final 3 years (7 through 9) were compared to TMDL targets. The first 6 years were necessary for the sediment diagenesis module to reach equilibrium (i.e., to accurately simulate response due to decreased loading). Watershed reductions were made equally to TOC and all nutrient components (i.e., both phosphorus and nitrogen). SOD and nutrient contributions from the sediment in the EFDC model were inherently reduced due to sediment diagenesis simulation and corresponding load reductions into the system. For the LSPC model, however, SOD rates were reduced by the same percentage as load reductions (since a predictive sediment diagenesis model is not contained within LSPC). Boundary condition DO for the EFDC model was kept at incoming levels when above water quality criteria; otherwise, it was set to minimum water quality criteria (4.0 mg/L). No change in temperature was assumed for boundary conditions.

Watershed TMDLs were developed for the Mispillion River and Cedar Creek watersheds based on Delaware's criteria for fresh and marine waters. Monthly-average values of dissolved oxygen concentration predicted by the model were compared to water quality standards of 5.5 mg/l for fresh waters and 5.0 mg/l for marine waters. In order to meet the bacteria criteria, the 30-day geometric mean of enterococci predicted by the model was required to be at or below 100 #/100 mL for fresh water and 35 #/100 mL for marine water. TN and TP daily average model predictions were converted to monthly average values (as for the DO) and compared to DNREC targets (3.0 mg/L for TN and 0.2 mg/L for TP). While the TN target was met in all locations, there were a couple exceedances of the TP target. These occasional exceedances of the TP target threshold were allowed as long as DO criteria were met, and thus the deleterious effects of eutrophication are prevented.

Model results (throughout both the LSPC and EFDC modeling domains) that show compliance with the TMDL targets are presented in Appendices A and B. Note that each plot presents the successful compliance scenario (for which the TMDL allocations were based).

5.1 Load Allocations (LAs)

The LAs for the Mispillion River and Cedar Creek are presented by subwatershed contributing to impaired segments (which are shown in Tables 5-1 and 5-2). The total TMDL for each impaired segment is the combination of all LAs for contributing subwatersheds and applicable WLAs (presented after the LAs). Loads are shown as the daily averages, based on annual and monthly loading that achieves water quality criteria throughout the year.

Table 5-1. Nutrient and DO impaired reaches and contributing subwatersheds.

Nutrient & DO Impaired Reaches	Contributing Subbasins
Mispillion River	
4 (King's Causeway Branch)	4
9 (Tub Mill Pond)	9,10,11
13 (Silver Lake)	13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28
15 (Haven Lake)	15,16,17,18,19,20,21,22,23,24,25,26,27,28
18 (Griffith Lake)	18,19,20,21,22,23,24,28
20 (Blairs Pond)	20,21,22,23,24,28
23 (Upper Mispillion River/ headwaters)	23
24 (Tantrough Branch)	24
26 (Abbotts Pond)	26,27
Cedar Creek	
15 (Swiggetts Pond/ Cedar Creek Mill Pond)	15, 16
16 (Church Branch)	16
17 (Swiggetts Pond/ Cedar Creek Mill Pond)	17,18,19,20,21,22,23,24
18 (Cubbage Pond)	18,19,20,21,22,23,24
20 (Clendaniel Pond)	20,21,22,23,24
21 (Upper Cedar Creek)	21,22,23,24
22 (Hudson Pond)	22,23,24
24 (Upper Cedar Creek)	24

Table 5-2. Bacteria impaired reaches and contributing subwatersheds.

Bacteria Impaired Reaches	Contributing Subbasins
Mispillion River	
13 (Silver Lake)	13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28
20 (Blairs Pond)	20,21,22,23,24,28
23 (Upper Mispillion River/ headwaters)	23
24 (Tantrough Branch)	24
26 (Abbotts Pond)	26,27
Cedar Creek	
15 (Swiggetts Pond/ Cedar Creek Mill Pond)	15, 16
16 (Church Branch)	16
17 (Swiggetts Pond/ Cedar Creek Mill Pond)	17,18,19,20,21,22,23,24
18 (Cubbage Pond)	18,19,20,21,22,23,24
20 (Clendaniel Pond)	20,21,22,23,24
21 (Upper Cedar Creek)	21,22,23,24
22 (Hudson Pond)	22,23,24
24 (Upper Cedar Creek)	24

Nutrient and BOD LAs and corresponding percent reductions are presented in Tables 5-3 and 5-4 on a subwatershed basis for the Mispillion River and Cedar Creek watersheds, respectively. These subwatersheds correspond with those identified in Tables 5-1 and 5-2 for each impaired reach. The subwatershed-based loads enable the in-stream DO concentrations to meet criteria under all conditions. Percent reductions (by subwatershed) necessary to meet criteria are in the following ranges for each constituent: 39-74% reduction of TP, 40-84% reduction of TN, and 33-69% reduction of BOD loadings to the Mispillion River and Cedar Creek. These reductions vary by subwatershed due to the sources present. Reductions were generally consistent by major source/land use category across the watershed, with a few exceptions due to local conditions. The implementation plan will address individual land use reductions in more detail. This is further described in Section 6.0.

Table 5-3. Nutrient and BOD baseline and allocation loads by contributing subwatershed for impaired waters of the Mispillion River watershed (daily averages based on the 2001-2003 meteorological regime).

Reach ID/Subwatershed	BOD			TN			TP		
	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction
1, Lower Mispillion River	55.78	36.16	35%	60.89	29.69	51%	1.05	0.64	39%
2, Lower Mispillion River	79.42	36.79	54%	115.21	50.27	56%	1.60	0.73	55%
3, Lower Mispillion River	10.88	4.94	55%	9.33	4.08	56%	0.19	0.09	55%
4, King's Causeway Branch	22.63	7.09	69%	28.92	4.72	84%	0.44	0.12	74%
5, Lower Mispillion River	42.30	19.49	54%	53.62	23.40	56%	0.82	0.37	55%
6, Lower Mispillion River	119.64	55.36	54%	162.06	70.72	56%	2.33	1.06	55%
7, Lower Mispillion River	276.89	129.03	53%	315.17	139.06	56%	5.16	2.39	54%
8, Lower Mispillion River	45.66	21.71	52%	39.89	17.76	55%	0.75	0.36	53%
9, Tub Mill Pond	16.75	7.88	53%	19.58	8.60	56%	0.30	0.14	54%
10, Trib. Tub Mill Pond	23.11	10.44	55%	18.93	8.34	56%	0.35	0.16	54%
11, Improvement Branch	58.22	27.88	52%	80.10	35.26	56%	1.18	0.55	53%
12, Mispillion River	113.80	50.12	56%	59.30	25.95	56%	1.57	0.70	56%
13, Silver Lake	43.36	18.92	56%	29.87	12.94	57%	0.64	0.28	56%
14, Mispillion River	3.64	1.63	55%	2.06	0.91	56%	0.06	0.03	54%
15, Haven Lake	79.93	36.95	54%	77.72	34.19	56%	1.45	0.67	54%
16, Lednum Branch	54.47	27.06	50%	70.50	31.36	56%	1.07	0.52	52%
17, Mispillion River	4.20	2.11	50%	6.00	2.67	56%	0.09	0.04	51%
18, Griffith Lake	12.36	6.28	49%	13.38	6.02	55%	0.23	0.12	51%
19, Upper Mispillion River	5.75	3.09	46%	7.78	3.52	55%	0.12	0.06	48%
20, Blairs Pond	33.84	17.20	49%	40.47	18.12	55%	0.66	0.32	51%
21, Upper Mispillion River	36.69	18.20	50%	49.16	21.83	56%	0.73	0.35	52%
22, Upper Mispillion River	46.97	23.60	50%	55.43	24.82	55%	0.88	0.43	51%
23, Upper Mispillion River	55.84	30.76	45%	74.64	34.11	54%	1.12	0.59	47%
24, Tantrough Branch	67.02	36.10	46%	80.41	36.56	55%	1.28	0.66	48%
25, Johnson Branch	25.28	13.52	47%	28.88	13.24	54%	0.49	0.25	48%
26, Abbotts Pond	4.37	2.33	47%	4.98	2.27	55%	0.08	0.04	49%
27, Johnson Branch	147.71	77.68	47%	203.02	91.37	55%	2.98	1.51	49%
28, Upper Mispillion River	7.08	3.27	54%	10.85	4.73	56%	0.15	0.07	54%

Table 5-4. Nutrient and BOD baseline and allocation loads by contributing subwatershed for impaired waters of the Cedar Creek watershed (daily averages based on the 2001-2003 meteorological regime).

Reach ID/Subwatershed	BOD			TN			TP		
	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction	Baseline (lb/day)	TMDL (lb/day)	Percent Reduction
1, Lower Cedar Creek	24.74	14.12	43%	31.49	17.51	44%	1.54	0.85	44%
2, Slaughter Creek	4.44	2.74	38%	4.74	2.74	42%	0.20	0.12	41%
3, Slaughter Creek	15.16	9.03	40%	23.76	13.31	44%	0.87	0.49	43%
4, Slaughter Creek	61.40	35.49	42%	97.83	54.47	44%	3.65	2.05	44%
5, Slaughter Creek	17.54	9.98	43%	30.81	17.09	45%	1.12	0.62	44%
6, Slaughter Creek	34.70	23.42	33%	34.38	20.68	40%	1.28	0.76	40%
7, Slaughter Creek	31.19	18.67	40%	47.92	26.91	44%	1.87	1.04	44%
8, Slaughter Creek	52.48	32.26	39%	77.65	43.68	44%	2.99	1.69	43%
9, Lower Cedar Creek	23.20	13.55	42%	39.28	21.82	44%	1.41	0.79	44%
10, Beaverdam Branch	63.54	36.40	43%	98.12	54.37	45%	3.73	2.07	44%
11, Lower Cedar Creek	34.11	19.48	43%	55.40	30.67	45%	2.06	1.14	45%
12, Lower Cedar Creek	20.33	11.98	41%	33.23	18.50	44%	1.23	0.69	44%
13, Cedar Creek	76.85	45.73	40%	96.84	54.43	44%	4.15	2.33	44%
14, Cedar Creek	4.37	2.47	43%	7.50	4.15	45%	0.27	0.15	45%
15, Swiggetts Pond/ Cedar Creek Mill Pond	2.70	1.61	40%	2.00	1.14	43%	0.09	0.05	43%
16, Church Branch	107.48	71.36	34%	137.38	79.08	42%	5.27	3.07	42%
17, Swiggetts Pond/ Cedar Creek Mill Pond	14.10	8.09	43%	17.36	9.65	44%	0.67	0.37	44%
18, Cubbage Pond	20.78	12.01	42%	24.74	13.78	44%	1.02	0.57	44%
19, Cedar Creek	6.73	3.90	42%	8.80	4.90	44%	0.34	0.19	44%
20, Clendaniel Pond	13.56	8.19	40%	17.62	9.90	44%	0.67	0.38	43%
21, Upper Cedar Creek	45.72	27.83	39%	52.03	29.42	43%	2.36	1.34	43%
22, Hudson Pond	2.71	1.54	43%	2.58	1.43	44%	0.12	0.07	45%
23, Trib. Hudson Pond	5.58	3.16	43%	9.77	5.40	45%	0.35	0.19	45%
24, Upper Cedar Creek	77.37	50.03	35%	91.42	52.53	43%	3.85	2.22	42%

Bacteria LAs are presented in Tables 5-5 and 5-6 for impaired segments of the Mispillion River and Cedar Creek watersheds, respectively. The LAs are presented by subwatershed, as they are for nutrients and BOD. Bacteria load percent reductions (by subwatershed) necessary to meet bacteria criteria range from 52 to 99 percent, varying by subwatershed due to the sources present (as for nutrients).

Table 5-5. Bacteria TMDLs and baseline loads by contributing subwatershed for impaired waters of the Mispillion River watershed (daily averages based on the 2001-2003 meteorological regime).

Reach ID/Subwatershed	Enterococcus (#/day)		Percent Reduction
	Baseline	TMDL	
1, Lower Mispillion River	1.09E+10	3.84E+09	65%
2, Lower Mispillion River	1.77E+11	2.59E+10	85%
3, Lower Mispillion River	1.56E+09	5.56E+08	64%
4, King's Causeway Branch	4.30E+10	6.47E+09	85%
5, Lower Mispillion River	7.84E+10	1.16E+10	85%

	Enterococcus (#/day)		
6, Lower Mispillion River	2.39E+11	3.51E+10	85%
7, Lower Mispillion River	4.30E+11	6.44E+10	85%
8, Lower Mispillion River	4.63E+10	7.07E+09	85%
9, Tub Mill Pond	2.74E+10	4.05E+09	85%
10, Trib. Tub Mill Pond	2.06E+10	3.07E+09	85%
11, Improvement Branch	1.42E+10	4.03E+09	72%
12, Mispillion River	6.82E+09	2.20E+09	68%
13, Silver Lake	4.14E+09	1.20E+09	71%
14, Mispillion River	3.23E+08	1.12E+08	65%
15, Haven Lake	1.37E+10	4.11E+09	70%
16, Lednum Branch	1.04E+11	1.54E+10	85%
17, Mispillion River	1.07E+09	3.01E+08	72%
18, Griffith Lake	1.90E+10	2.90E+09	85%
19, Upper Mispillion River	1.39E+09	4.11E+08	70%
20, Blairs Pond	5.84E+10	8.82E+09	85%
21, Upper Mispillion River	8.71E+09	2.48E+09	71%
22, Upper Mispillion River	7.78E+10	1.17E+10	85%
23, Upper Mispillion River	1.32E+10	3.97E+09	70%
24, Tantrough Branch	1.16E+11	1.76E+10	85%
25, Johnson Branch	4.08E+10	6.25E+09	85%
26, Abbotts Pond	9.45E+08	3.04E+08	68%
27, Johnson Branch	3.04E+11	4.55E+10	85%
28, Upper Mispillion River	1.67E+10	2.44E+09	85%

Table 5-6. Bacteria TMDLs and baseline loads by contributing subwatershed for impaired waters of the Cedar Creek watershed (daily averages based on the 2001-2003 meteorological regime).

Reach ID/Subwatershed	Enterococcus (#/day)		Percent Reduction
	Baseline	TMDL	
1, Lower Cedar Creek	5.95E+10	3.34E+09	94%
2, Slaughter Creek	2.56E+09	3.26E+08	87%
3, Slaughter Creek	4.82E+10	2.73E+09	94%
4, Slaughter Creek	2.03E+11	2.73E+09	99%
5, Slaughter Creek	1.70E+10	1.60E+09	91%
6, Slaughter Creek	1.78E+10	2.59E+09	85%
7, Slaughter Creek	2.57E+10	2.61E+09	90%
8, Slaughter Creek	4.19E+10	4.41E+09	89%
9, Lower Cedar Creek	2.17E+10	2.11E+09	90%
10, Beaverdam Branch	7.12E+09	3.45E+09	52%
11, Lower Cedar Creek	1.13E+11	6.25E+09	94%
12, Lower Cedar Creek	1.82E+10	1.79E+09	90%
13, Cedar Creek	5.15E+10	5.64E+09	89%
14, Cedar Creek	4.16E+09	3.95E+08	90%
15, Swiggetts Pond/ Cedar Creek Mill Pond	1.11E+09	1.62E+08	85%
16, Church Branch	7.40E+10	8.96E+09	88%
17, Swiggetts Pond/ Cedar Creek Mill Pond	9.67E+09	1.06E+09	89%
18, Cubbage Pond	1.35E+10	1.50E+09	92%

	Enterococcus (#/day)		
19, Cedar Creek	4.82E+09	5.23E+08	89%
20, Clendaniel Pond	3.42E+10	2.06E+09	94%
21, Upper Cedar Creek	9.95E+10	6.05E+09	94%
22, Hudson Pond	1.40E+09	1.68E+08	88%
23, Trib. Hudson Pond	5.42E+09	2.99E+08	94%
24, Upper Cedar Creek	1.70E+11	1.08E+10	94%

As discussed above, reductions were generally consistent across the watershed. The calibrated LSPC nutrients model resulted in two different "groups" (one for the Mispillion River and one for Cedar Creek) and six groups for bacteria that represented different land use-specific loading characteristics and rates. These land use-specific loading rates differed spatially due to different source characteristics. Baseline accumulation rates (model parameters) for nutrients and bacteria are presented in Appendix C, along with maps of the groups. TMDL accumulation rates and percent reductions from the baseline rates are presented for nutrients and bacteria in Appendix D.

For the TMDL simulation, it was necessary to reduce loading rates for the two watersheds to achieve the TMDL targets. Reduction rates are consistent for bacteria within each watershed (i.e., different for Mispillion River and Cedar Creek, but the same within each watershed). The same is true for nutrients, with the exception of subwatershed 4 in the Mispillion River watershed. Subwatershed 4 required a higher reduction than the rest of the Mispillion River watershed as a result of its geophysical characteristics and the tidal impact in this watershed. Due to the weak flushing at this location, constituents and pollutants tend to remain for longer periods of time (than in other subwatersheds). Therefore, it is necessary to apply a greater reduction to land-based inputs.

Reductions were made to all controllable sources, including the following: Recreation, Agriculture, Pastures, Residential, Commercial, Industrial, Institutional/Government, Mixed Urban/Built-Up, Other Urban, Transportation/Communication, and Utilities. For the nutrients and BOD in the Cedar Creek watershed, CBOD, NH_3, NO_X, PO_4 (on impervious land uses), ORN, and ORP all required a 45% reduction for all land uses listed above. For the same constituents and land uses, reductions of accumulation rates were 57% for the Mispillion River watershed (with the exception of subwatershed 4, which was 88%). No reductions for nutrients or BOD were required for the remaining land uses (Brushland/Rangeland, Forest, Wetland, and Barren).

For bacteria in the Cedar Creek watershed, 96% reductions were required from the land surfaces of the Agriculture, Pastures, and Residential land uses, and 90% reductions were required for the land surfaces of all remaining land uses. For bacteria in the Mispillion River watershed, 87% reductions were required for the land surfaces of the Agriculture, Pastures, and Residential land uses, and 80% reductions were required for the land surfaces of all remaining land uses. No reductions of bacteria were applied to interflow and groundwater flows in the land uses.

5.2 Waste Load Allocations (WLAs)

There are no permitted facilities in the Cedar Creek Watershed. There two permitted facilities in the Mispillion River watershed are DE0051047 (Baltimore Aircoil Milford Plant) and

DE0051098 (Sea Watch International), which is a stormwater permit that has no limits. DE0051047 does not discharge any of the pollutants being evaluated; therefore the WLAs for TP, TN, BOD, and enterococci are equal to zero. WLAs were not designated for DE0051098, because its stormwater contributions are already represented within the LAs presented above (as part of the watershed model). EPA's policy memo of Nov. 22, 2002 indicates that for regulatory purposes, stormwater loads from facilities that are not covered by Phase I or Phase II of the NPDES storm water program can be considered as part of nonpoint source load (LA). DE0051098 is not covered by the Phase I or Phase II of the NPDES storm water program.

5.3 Margin of Safety (MOS)

For this study, the MOS is assumed implicit through conservative assumptions used in the modeling process. These conservative assumptions include:

- Losses of land-based nutrient and organics loads for the storms along the path to the receiving waters were not explicitly represented in the model.
- The model does not consider loss of organic matter from the sediment due to high flow conditions. Therefore, all organics that settle remain available for diagenesis processes. Thus, the predicted SOD may be somewhat higher than that in reality.
- Watershed reductions were made equally to TOC and all nutrient components (i.e., both phosphorus and nitrogen) although less significant reductions to some components may still have resulted in attainment of DO criteria.
- Boundary condition DO was kept at incoming levels when above water quality criteria; otherwise, it was set to minimum water quality criteria (4.0 mg/L). DO levels would likely improve above incoming levels with watershed nutrient load reductions.

5.4 Consideration of Critical Conditions

Federal Regulations (40 CFR 130.7(c)(1)) require TMDLs to consider critical conditions for streamflow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality in waterbodies are protected during periods when they are most vulnerable. Critical conditions include combinations of environmental factors that result in attaining and maintaining the water quality criteria and have an acceptably low frequency of occurrence (USEPA, 2001).

TMDLs for the Mispillion River and Cedar Creek adequately address critical conditions through modeling three entire years (i.e., meteorological data for 2001-2003). All conditions were considered through modeling three full years, including the critical summer period when DO impairment is prevalent in the watershed. Overall, this 3-year meteorological record included dry years and wet years (on an annual basis). Because the receiving water model makes predictions at a sub-hourly timestep for the entire modeling period, it predicts constituent levels for low-flow as well as for storm events. More importantly, the model makes predictions for critical conditions overlooked by a steady-state analysis such as 7Q10 (e.g., by simulating relatively low-flow conditions that follow a storm event). A steady-state low-flow analysis assumes minimal land-based loading inputs, however, these inputs (which are typically contributed during storm events) become the most critical factor even during low flow events. Thus, the current modeling framework can be used to evaluate critical periods in more detail than a steady-state 7Q10 evaluation.

5.5 Consideration of Seasonal Variation

TMDLs for the Mispillion River and Cedar Creek adequately address seasonal variation directly through time-variable watershed and receiving water modeling. The linked modeling system simulates rainfall-runoff processes for the watershed throughout the year (for all seasons) as well as in-stream response. This approach provided insight into the time-variable nature of watershed loading and sediment diagenesis on DO levels (as well as bacteria) in the Mispillion River, Cedar Creek, and their tributaries. Rather than considering a single, extreme condition, this approach was comprehensive and represented a full seasonal analysis.

6.0 REASONABLE ASSURANCE AND IMPLEMENTATION

Reasonable assurance indicates a high degree of confidence that each WLA and load allocation in a TMDL will be implemented. According to 40 CFR 130.7(d)(2), approved TMDL loadings shall be incorporated into the state's current water quality management plans. These plans are used to direct implementation and draw upon the water quality assessments to identify priority point and nonpoint source water quality problems, consider alternative solutions, and recommend control measures. This provides further assurance that the pollutant allocations of the TMDLs will be implemented in the Mispillion River and Cedar Creek watersheds.

Development of TMDLs is only the beginning of the process for stream restoration and watershed management. Load allocations to point and nonpoint sources serve as targets for improvement, but success is determined by the level of effort put forth in making sure that those goals are achieved. Load reductions proposed by bacteria, nutrient, and dissolved oxygen TMDLs require specific watershed management measures to ensure successful implementation.

In terms of nonpoint sources, the load allocations are representative of expected pollutant loads during critical conditions from baseflow, atmospheric deposition, and traditional land-based sources. Additional site-specific information and more in-depth source assessments (e.g., detailed land use coverages and information regarding previous mitigation efforts) are to be obtained and conducted for implementation purposes.

A number of BMPs are currently present in the Mispillion River and Cedar Creek watersheds, however data for these BMPs were not sufficient for incorporation into the models. Therefore, it is likely that current watershed pollutant loadings are less than those presented in the baseline condition. DNREC expects that a portion of the reductions called for in the TMDL have already been achieved with these BMPs. A summary of current BMPs in the Mispillion River and Cedar Creek watersheds are provided in Table 6-1 (based on personal communication with DNREC, July 2005).

Further implementation of BMPs should achieve the loading reduction goals established in the TMDLs. Further ground-truthing will be performed to assess both the extent of existing BMPs, and to determine the most cost-effective and environmentally protective combination of BMPs required for meeting the bacteria and nutrient reductions outlined in this report. Delaware DNREC, in association with local citizen groups and other affected parties, will develop a Pollution Control Strategy to implement the requirements of the proposed Mispillion River and Cedar Creek TMDLs.

Table 6-1. Summary of current BMPs in the Mispillion River and Cedar Creek watersheds.

Category	Description		Mispillion River Watershed	Cedar Creek Watershed
Cover Crop	Crop (acres)	Barley	298.6	1346.3
		Rye	555.1	527.4
		Wheat	380.1	652.6
		Oats	15.5	0.0
		Clover	110.4	0.0

Category	Description		Mispillion River Watershed	Cedar Creek Watershed
		Total	*1359.7*	*2526.3*
CRP	Practice (acres)	Pond	69.5	5.0
		Grass Filter Strips	0.0	11.8
		Wildlife Habitat	142.7	37.0
		Total	*212.2*	*53.8*
CREP	Practice (acres)	Grass Filter Strips	9.3	1.3
		Riparian Buffers	11.4	0.0
		Wetland Restoration	3.5	0.0
		Wildlife Habitat	15.2	5.2
		Hardwood Trees	244.1	15.2
		Total	*283.5*	*21.7*
Poultry BMPs	Practice (#)	Sheds	33	9
		Composters	30	9
		Incinerators	0	0
		Heavy Use PA	5	3
		Windbreaks	1	0
		Total	*69*	*21*
Livestock BMPs	Practice (#)	Dairy Animal WHS	1	0
		Dairy Manure Sheds	1	0
		Bovine Manure Sheds	0	0
		Equine Manure Sheds	0	0
		Hog Manure Sheds	0	0
		Total	*2*	*0*

Source: DNREC, 2005.

7.0 PUBLIC PARTICIPATION

Public Participation is a requirement of the TMDL process and is essential to its success. DNREC held a public workshop on May 18, 2006 to review the draft TMDLs for the Mispillion River and Cedar Creek Watersheds. All comments received at the workshop and during the May 1 through 31 comment period were considered by DNREC. This report has been updated to address comments by Mid-Atlantic Environmental Law Center. The updates can be found in Sections 1, 2, and 5.

A Public Hearing is scheduled for 6:00 p.m., Tuesday, August 22, 2006 at the 104 Cannon Lab, University of Delaware College of Marine Studies, Lewes, DE to review this proposed TMDL. The comment period will remain open until September 15, 2006. This proposed TMDL will be finalized following consideration of all public comments.

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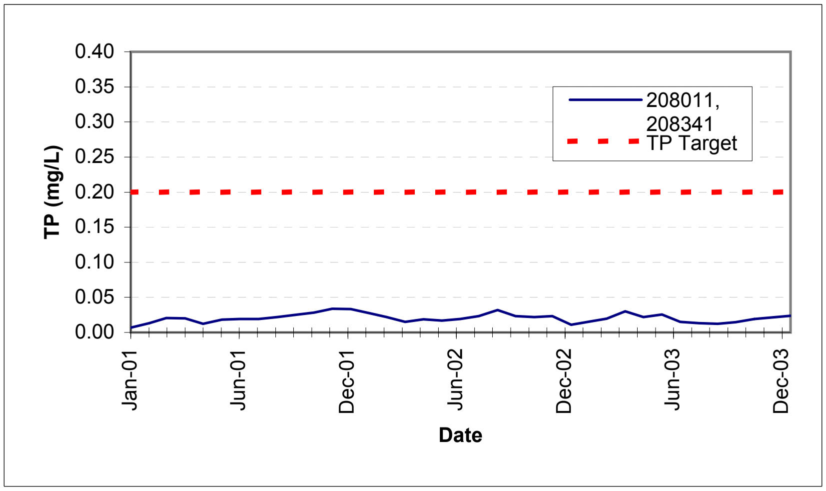
Appendix A: Nutrients and DO TMDL Modeling Results

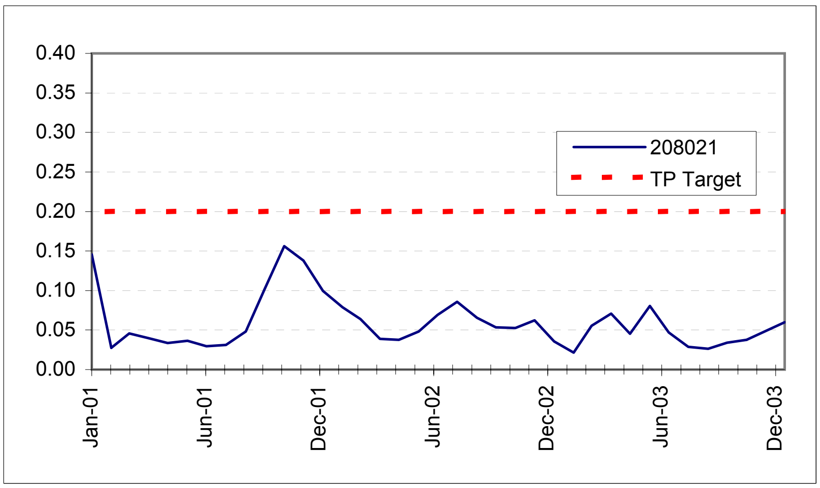
Nutrient and DO TMDL modeling results are presented for each of the locations represented in the table below.

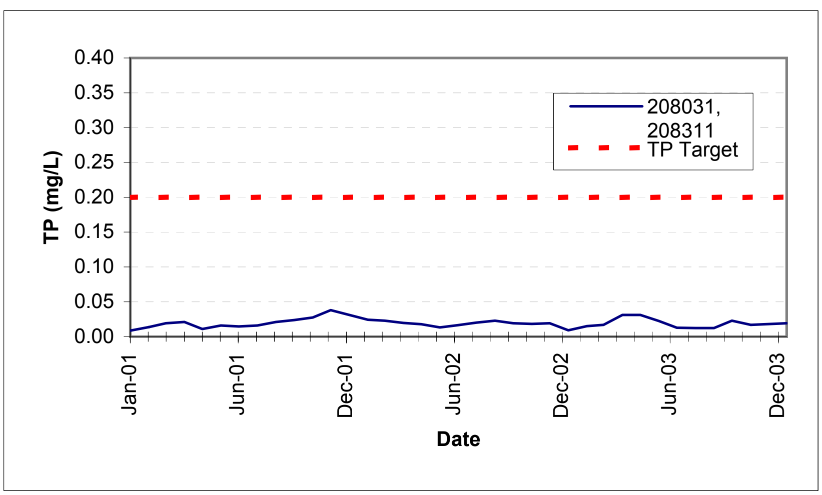
Model	Station	Location	Subwatershed/Reach ID
		Cedar Creek	
LSPC	301011	At Clendaniel Pond Rd (or Rd 38), downstream from Clendaniel Pond outfall	20
	301021	Cedar Creek, Mill Pond at Rd 212	17
	301041	At Cubbage Pond Rd (or Rd 214), downstream from Cubbage Pond outfall	18
	301051	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	21
	301061	Upstream side of Rt. 113 bridge, upstream of Hudson Pond	24
	301071	On Church Branch, at Cubbage Pond Rd (or Rd 214)	16
	301151	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	15
	301161	Middle of Hudson Pond	22
EFDC	301031	Cedar Creek at DE Route 14	13
	301081	Confluence of Cedar Creek with Mispillion River	1
	301091	Cedar Creek at Rt. 36 bridge	1
	301141	On Slaughter Creek, at Slaughter Neck Rd (Rd 224)	3
		Mispillion River	
LSPC	208011	Mispillion River, Haven Lake at US Route 113 bridge	15
	208031	On Swan Creek, downstream side of Route 113, downstream of Tub Mill Pond	9
	208181	Abbotts Pond at Rd.620	26
	208191	Blairs Pond off Rd 443, at the Boat Ramp	20
	208211	Mispillion River, Silver Lake at DE Route 36, Milford	13
	208231	Blairs Pond; Beaverdam Branch at Rd 384 (USGS 01484100)	23
	208241	Upstream Blairs Pond, on Tantrough Branch, at Abbotts Pond Rd (Rd 442 or Rd 620)	24
	208281	On Causeway Branch, at Stratham Lane (Rd 123)	4
	208311	Middle of Tub Mill Pond	9
	208321	Middle of Silver Lake	13
	208341	Middle of Haven Lake	15
	208381	Middle of Griffith Lake	18
	208391	Middle of Blairs Pond on Beaverdam Branch, at Williamsville Rd (Rd 443)	20
	208401	Middle of Abbotts Pond	26
EFDC	208021	Mispillion River at Delaware Route 14 bridge	7
	208051	At mouth of Mispillion River	1
	208061	Mispillion River 0.43 miles from mouth at lighthouse	1
	208101	Mispillion River, 4.64 miles from mouth	3
	208121	Mispillion River, 7.14 miles from mouth	6

Average Monthly Total Phosphorus (mg/L)

Mispillion River Watershed







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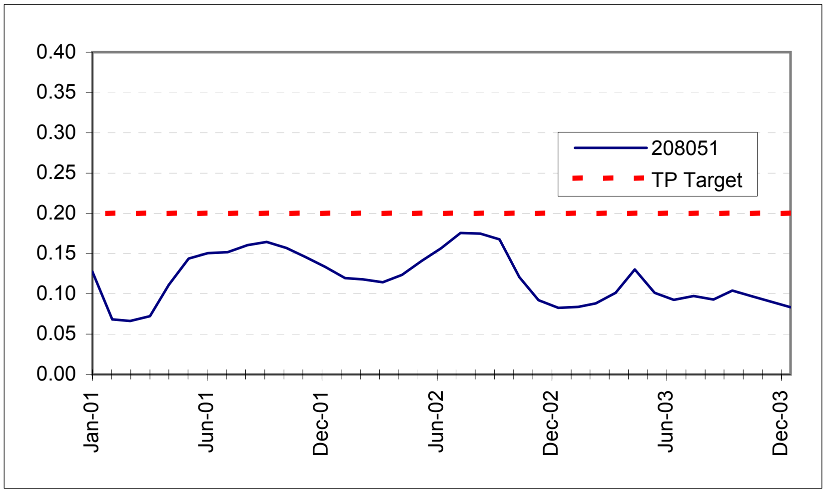

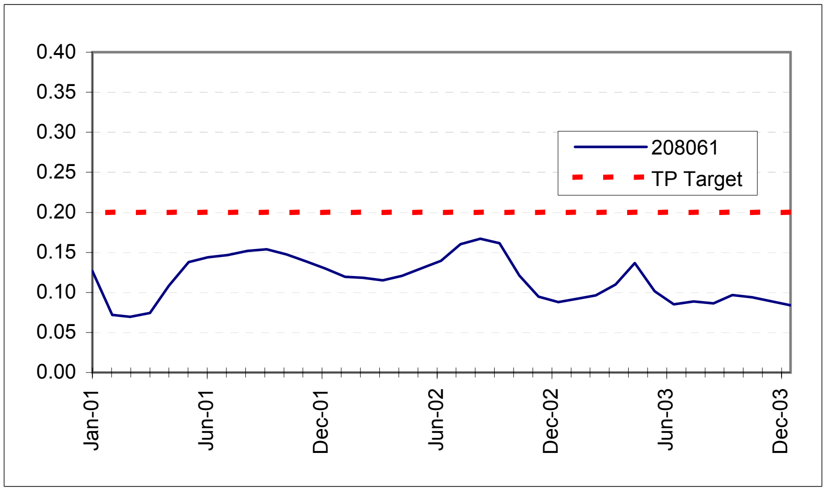

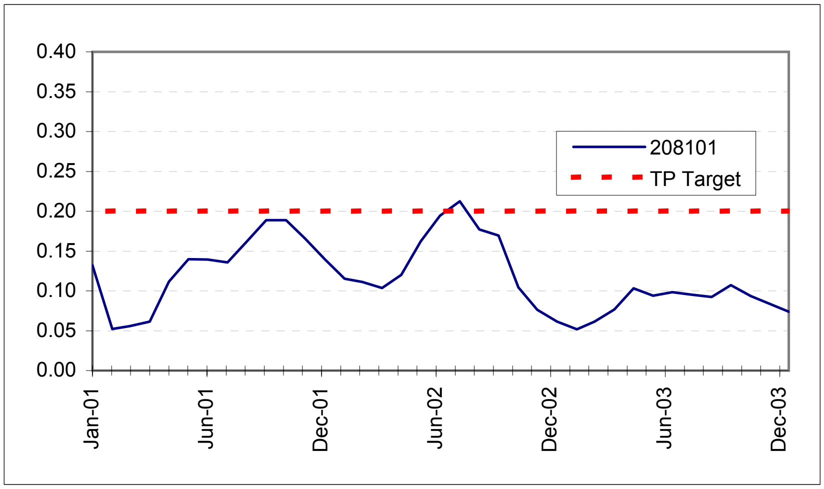

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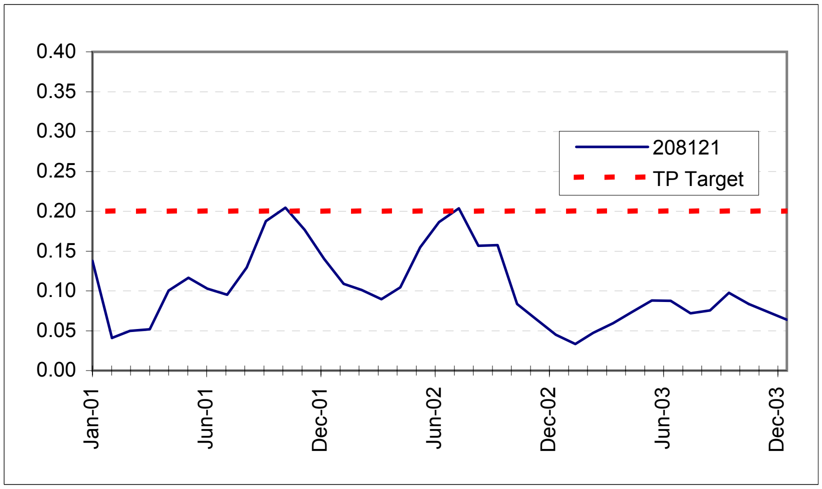

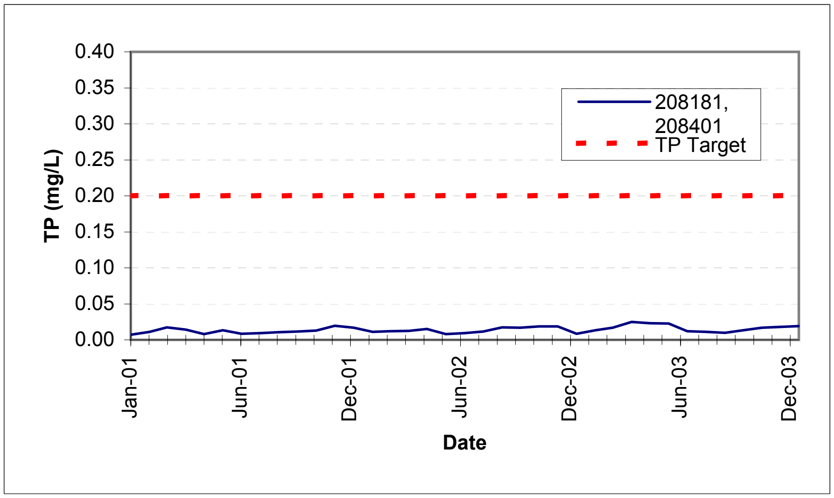

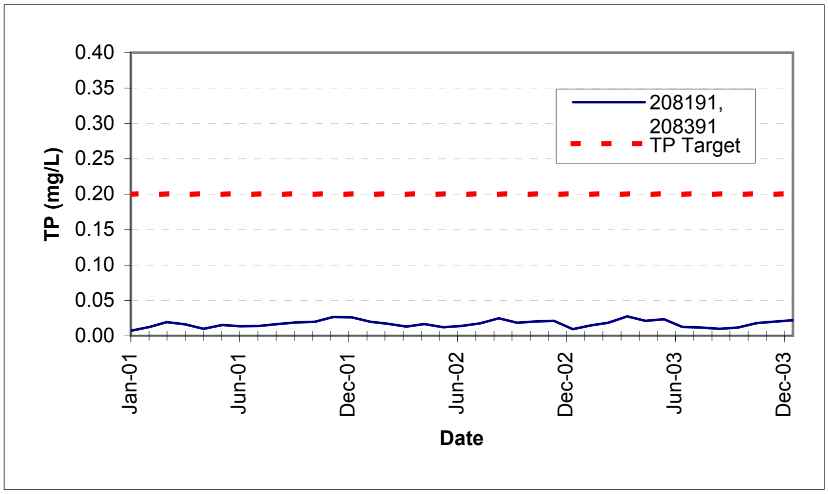

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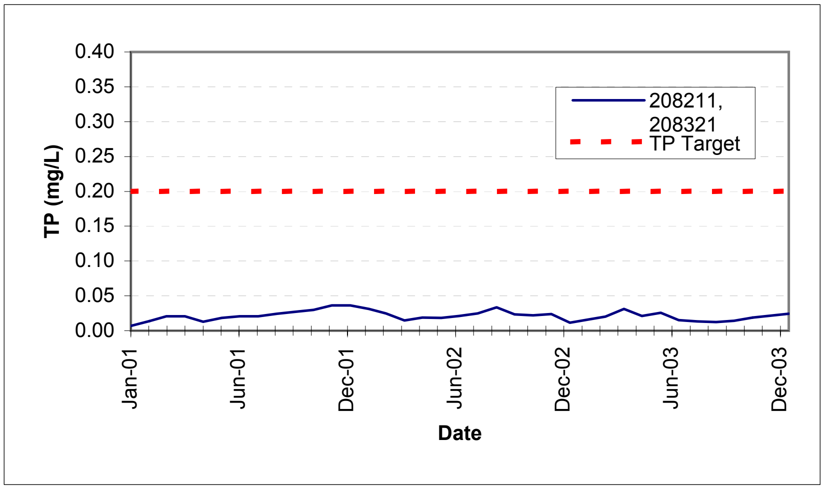

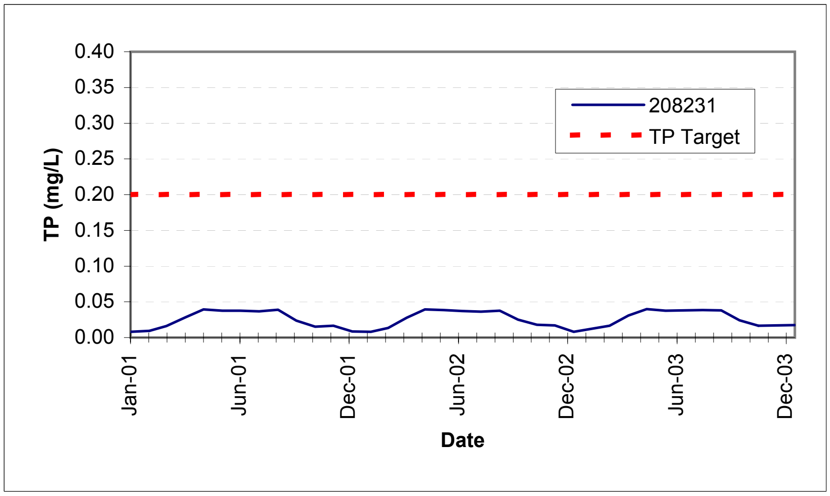

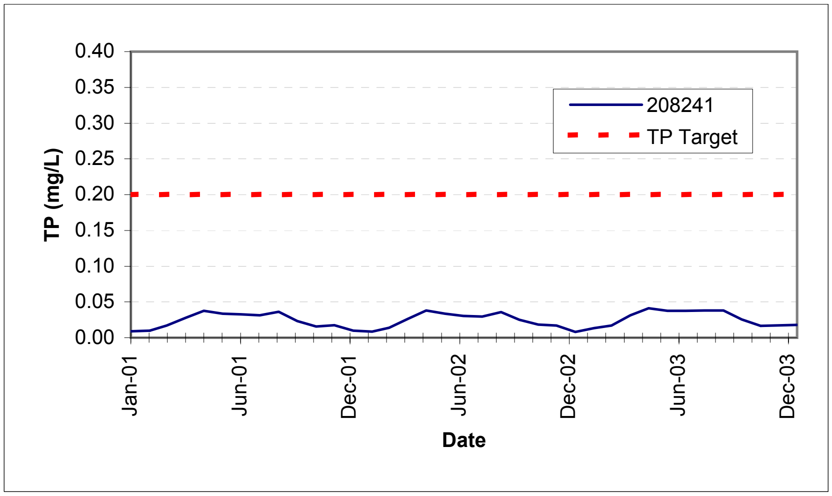

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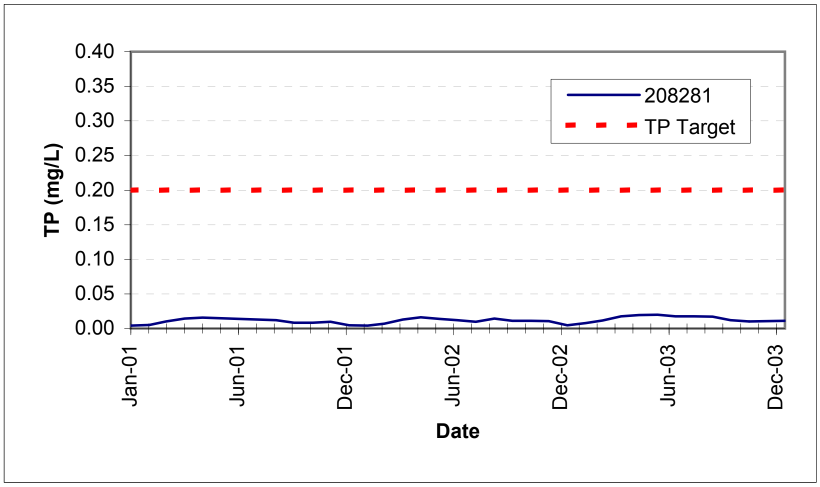
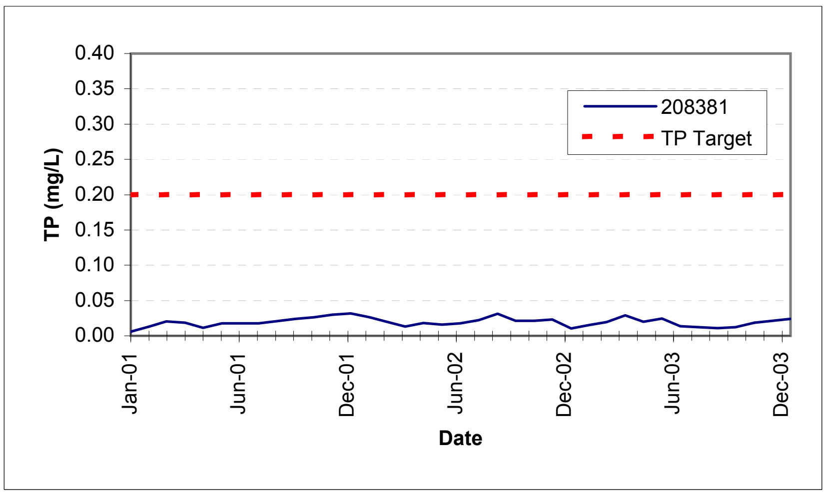
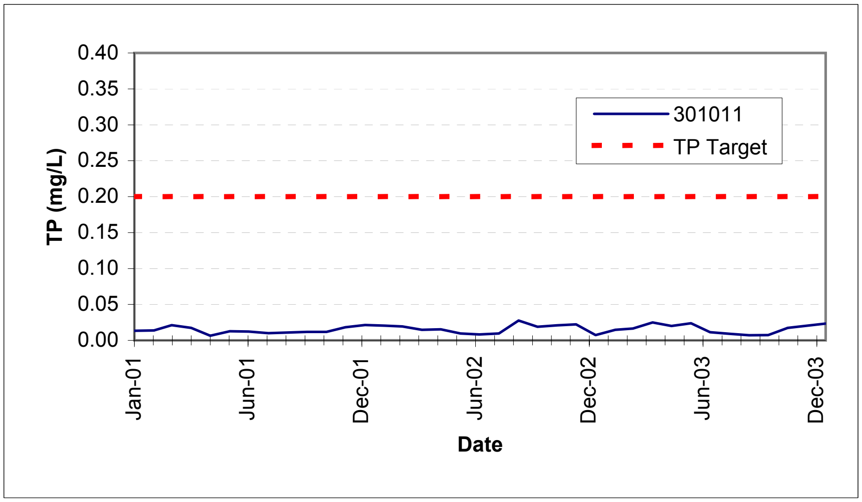
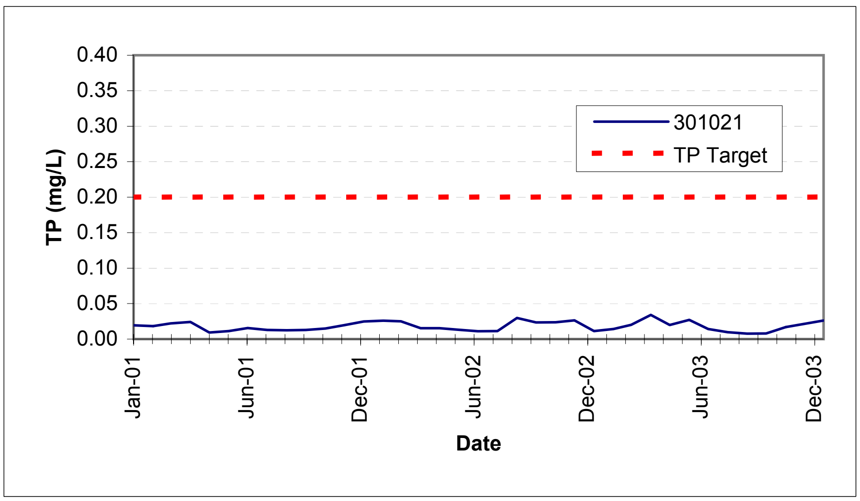


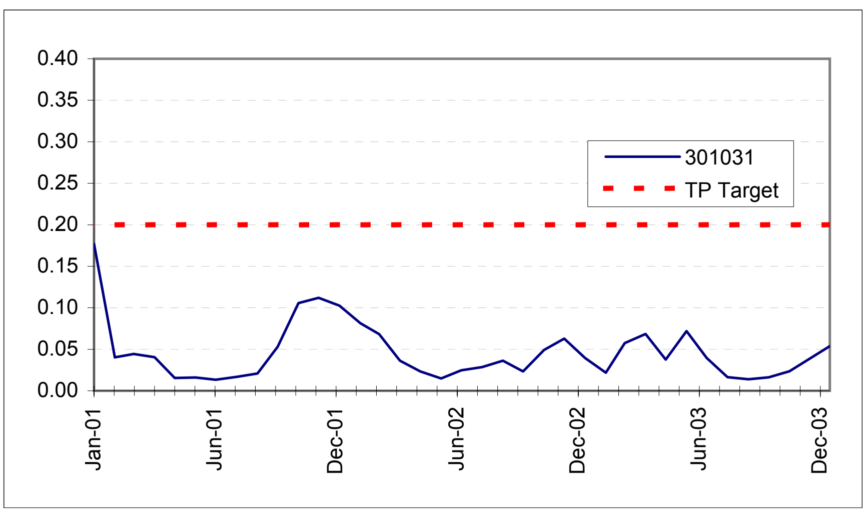


Average Monthly Total Phosphorus (mg/L)

Cedar Creek Watershed







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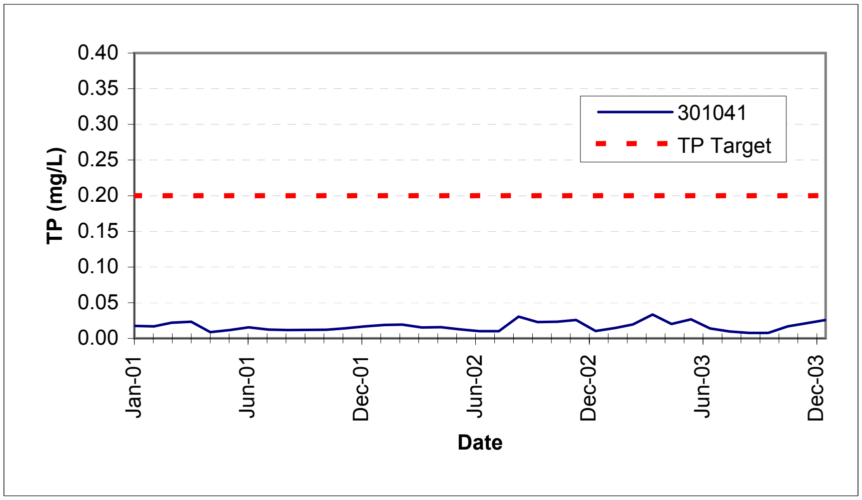

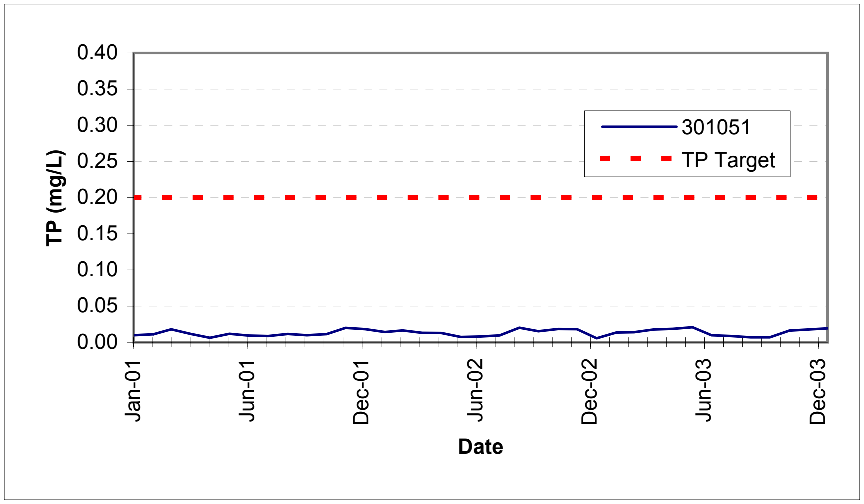

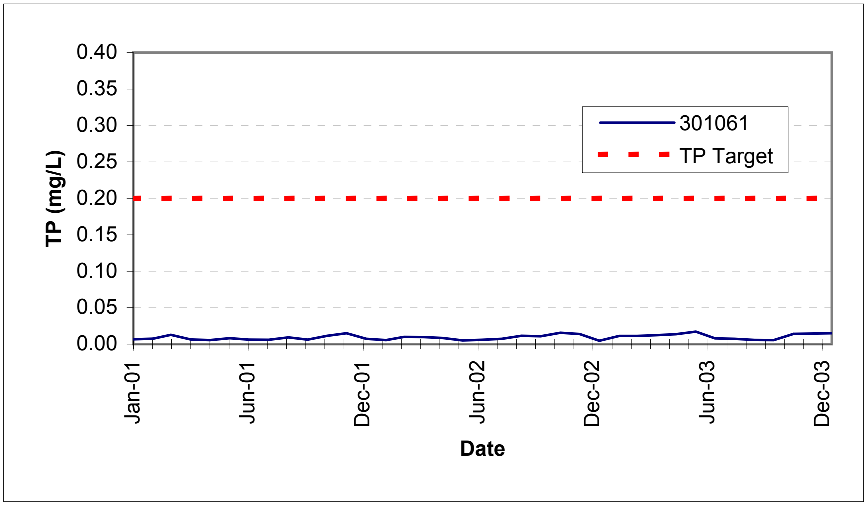

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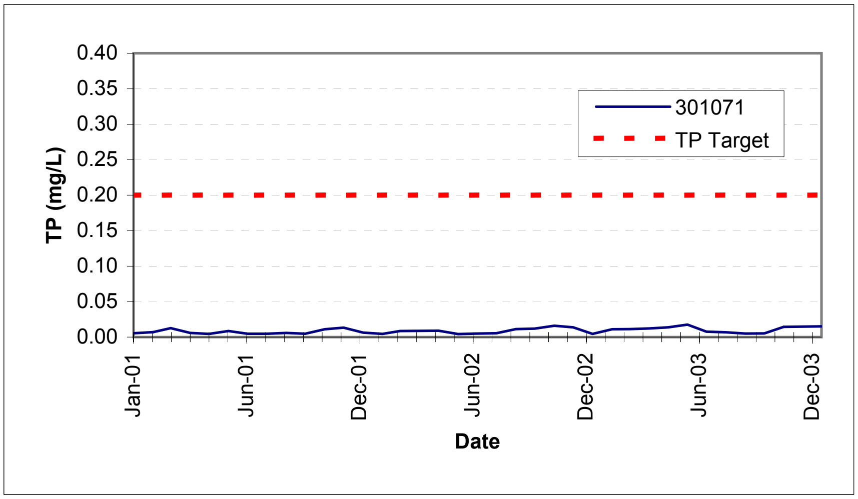
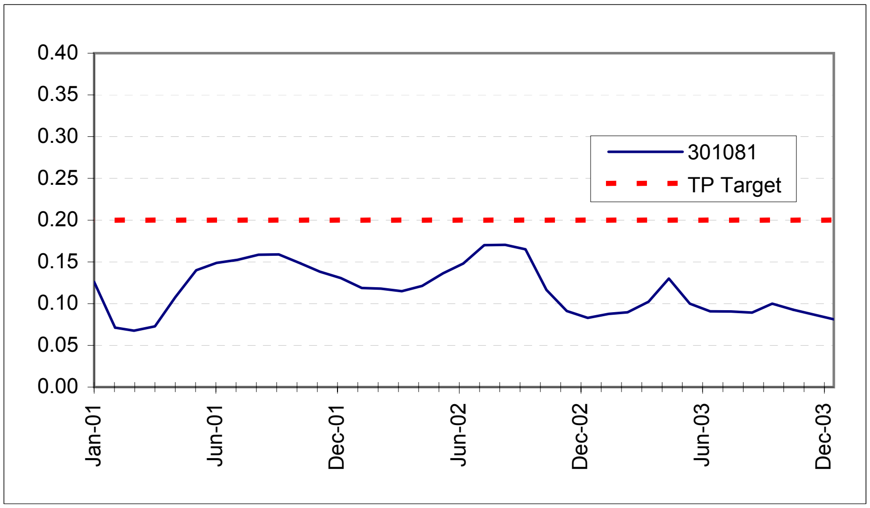
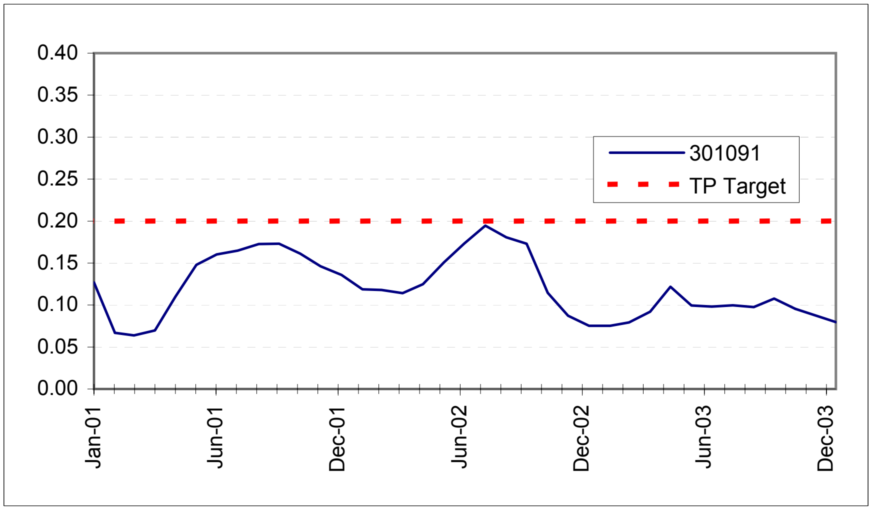
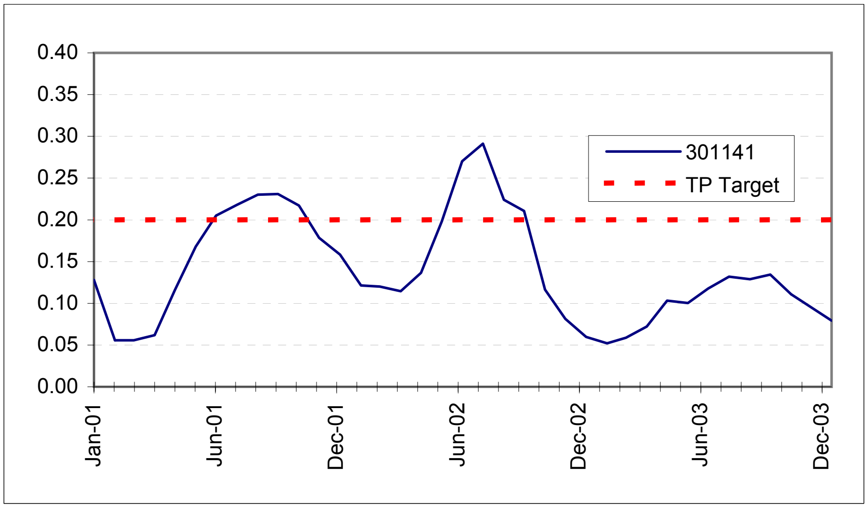
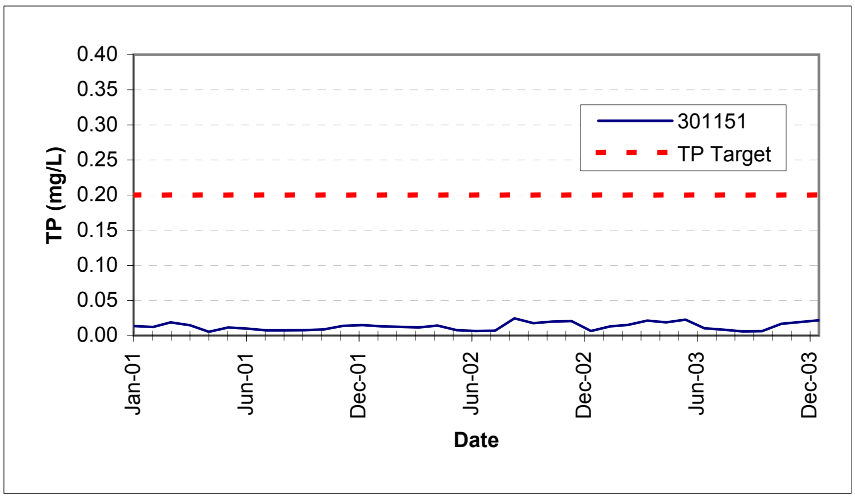


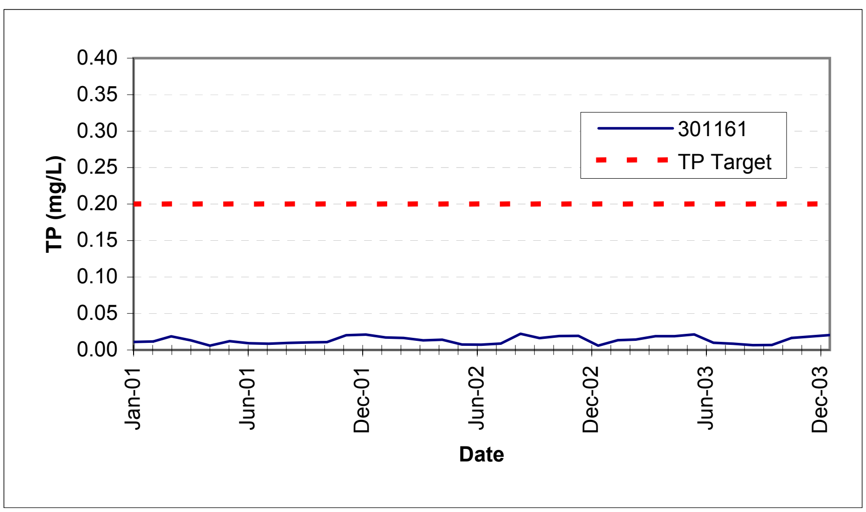




Average Monthly Total Phosphorus (mg/L)

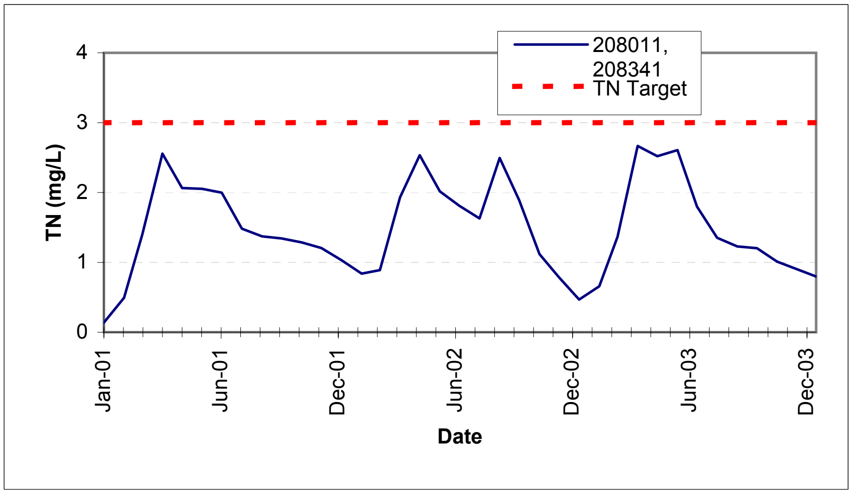


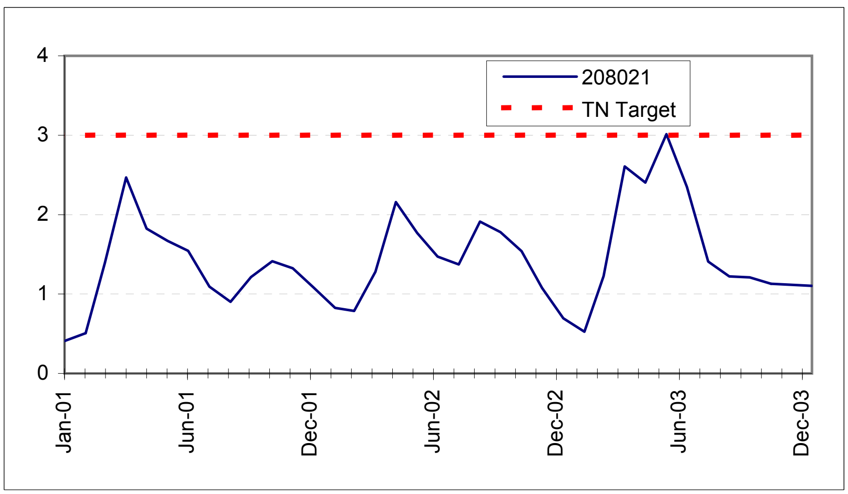


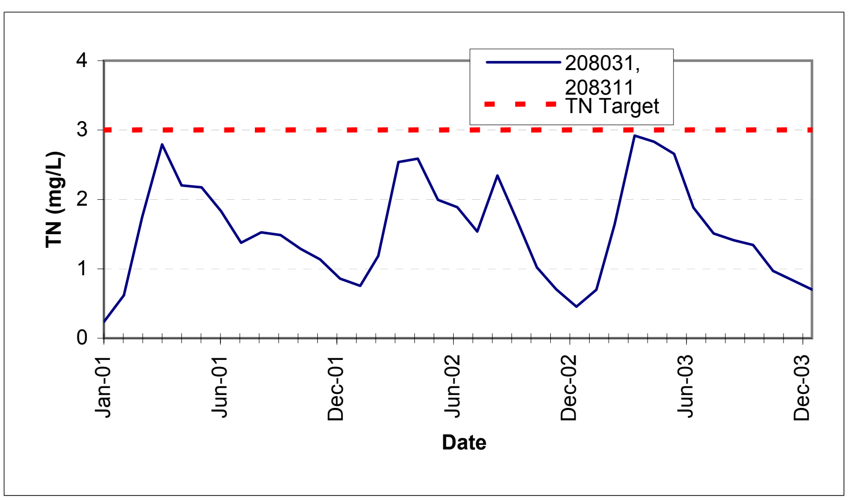


Average Monthly Total Nitrogen (mg/L)

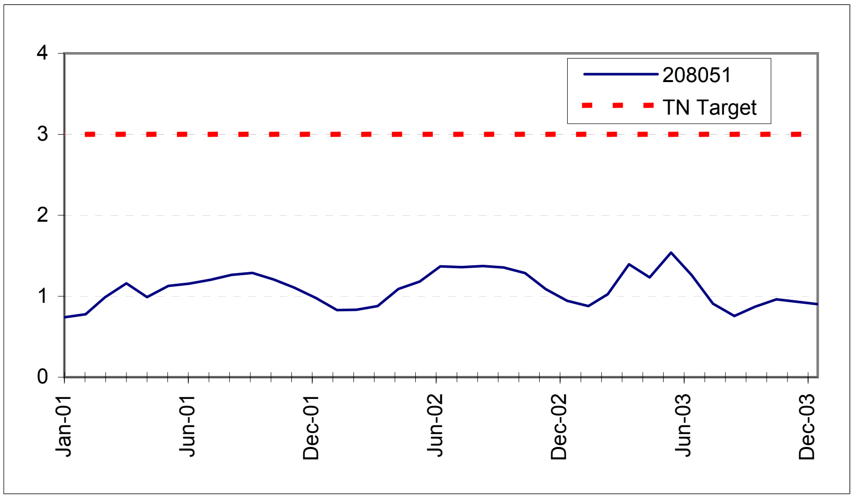
Mispillion River Watershed

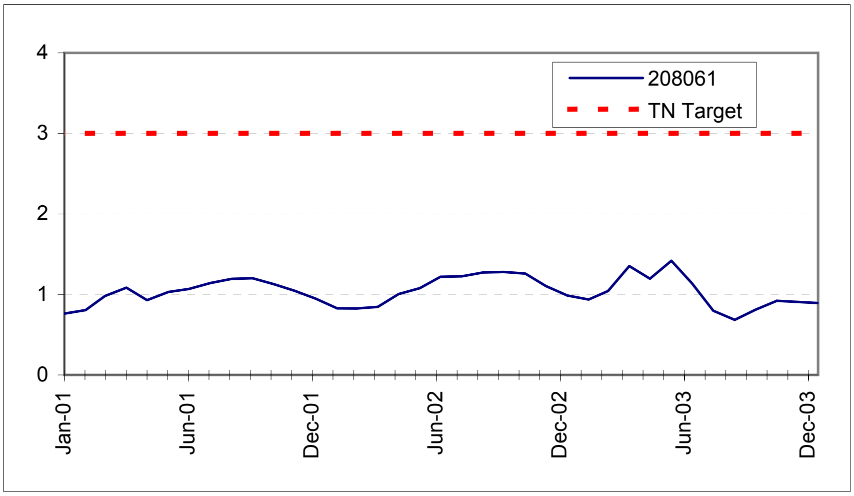


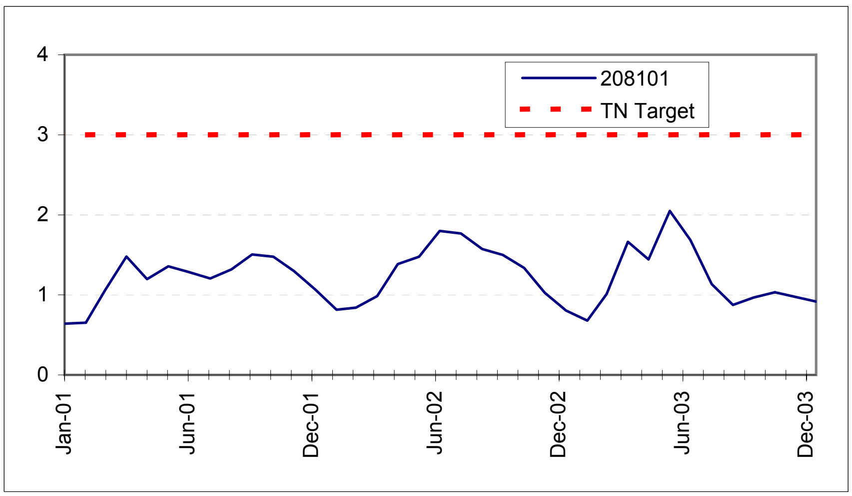




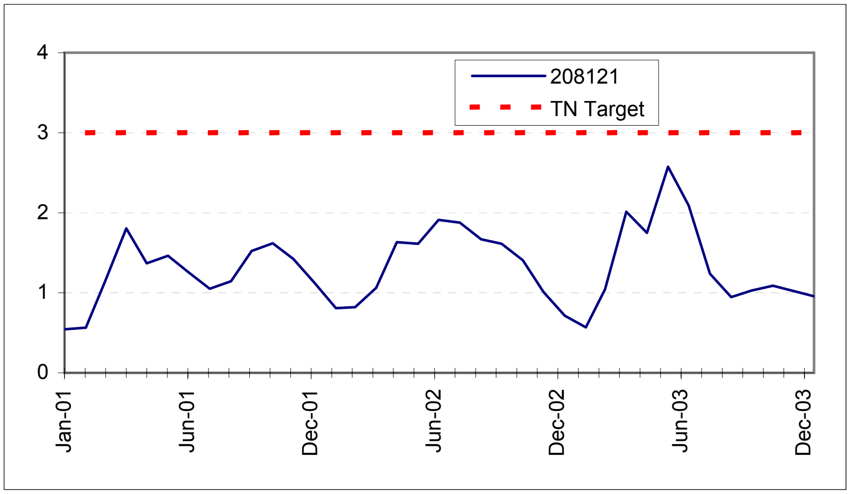
Average Monthly Total Nitrogen (mg/L)

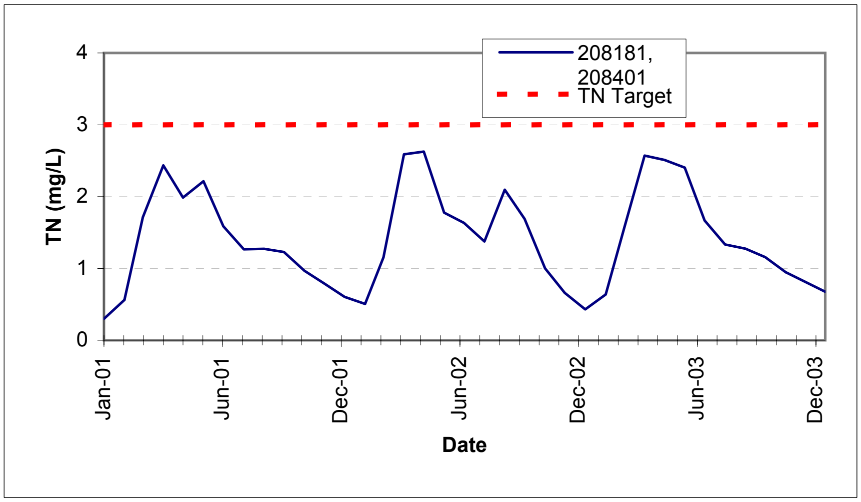


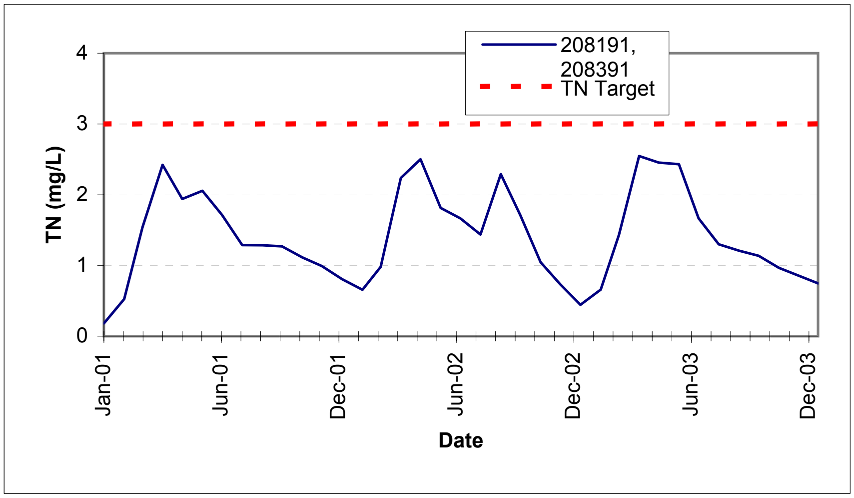




Average Monthly Total Nitrogen (mg/L)







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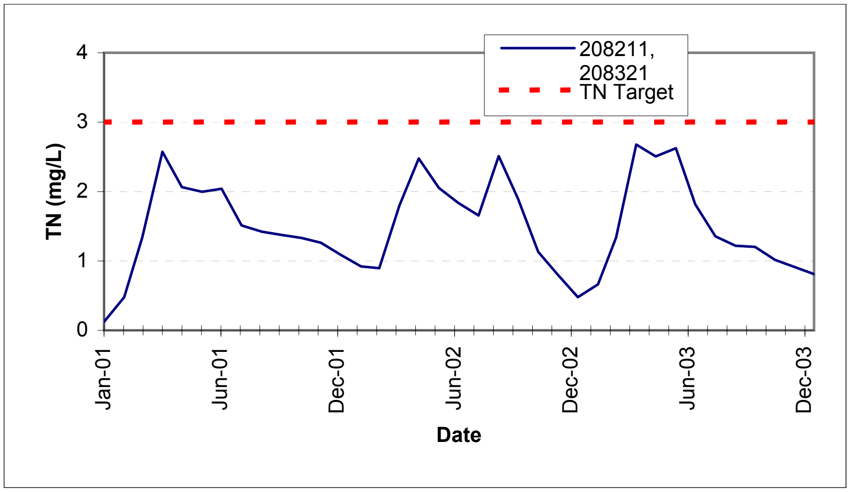
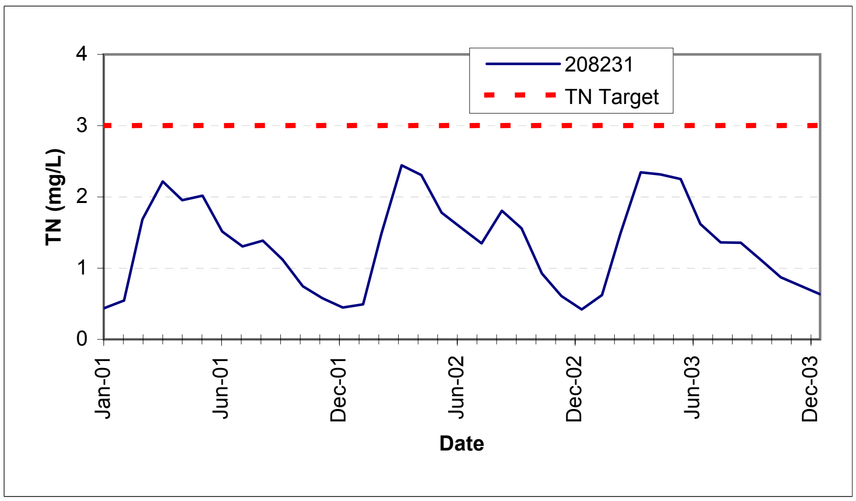
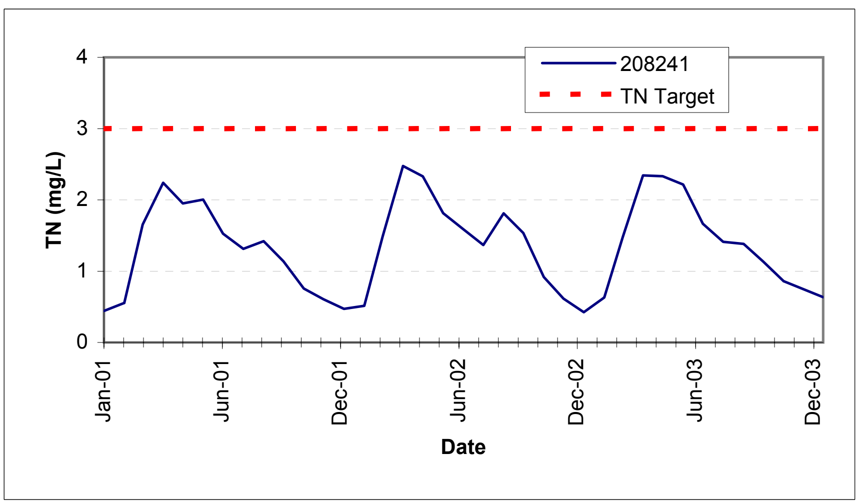
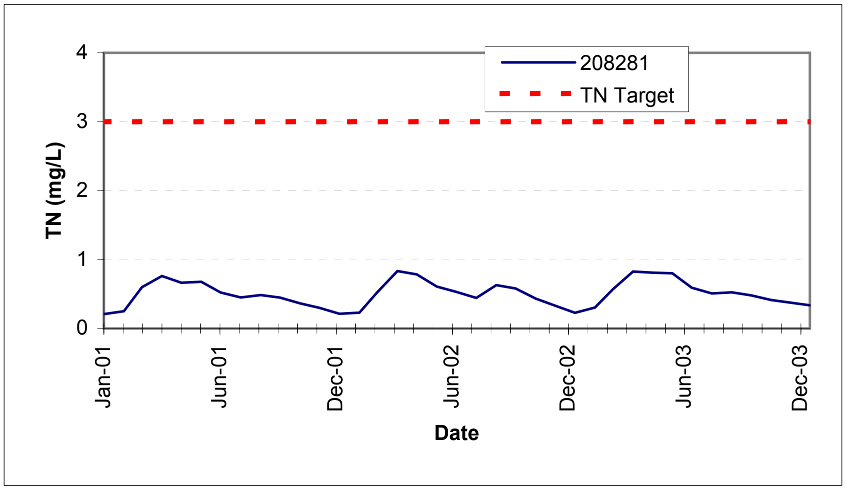
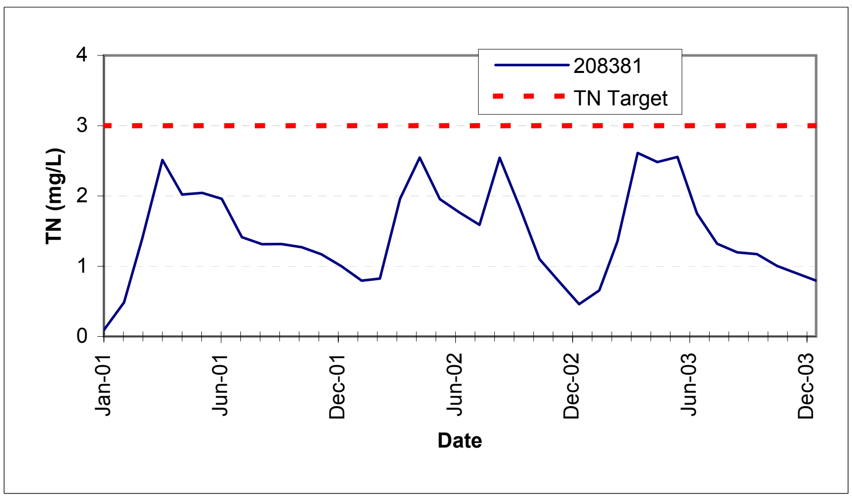






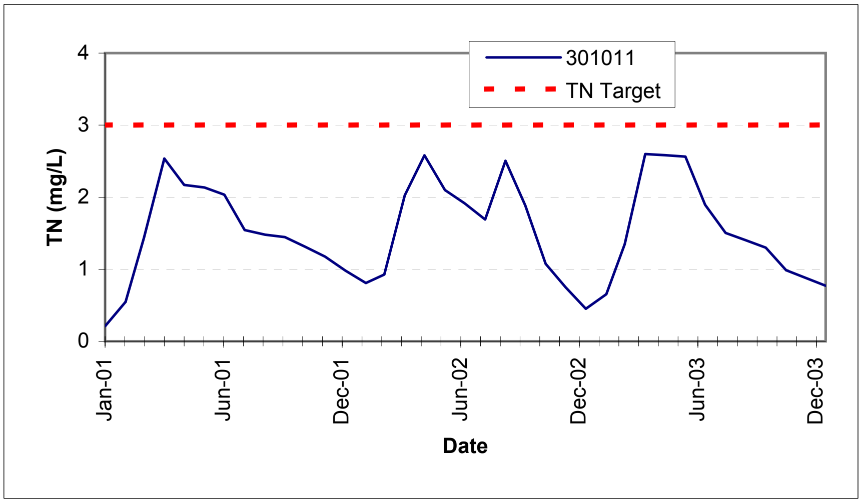
Average Monthly Total Nitrogen (mg/L)

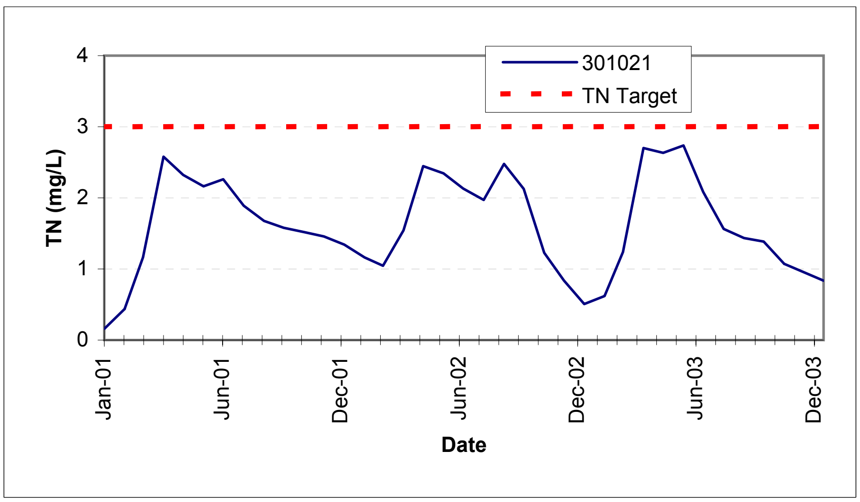


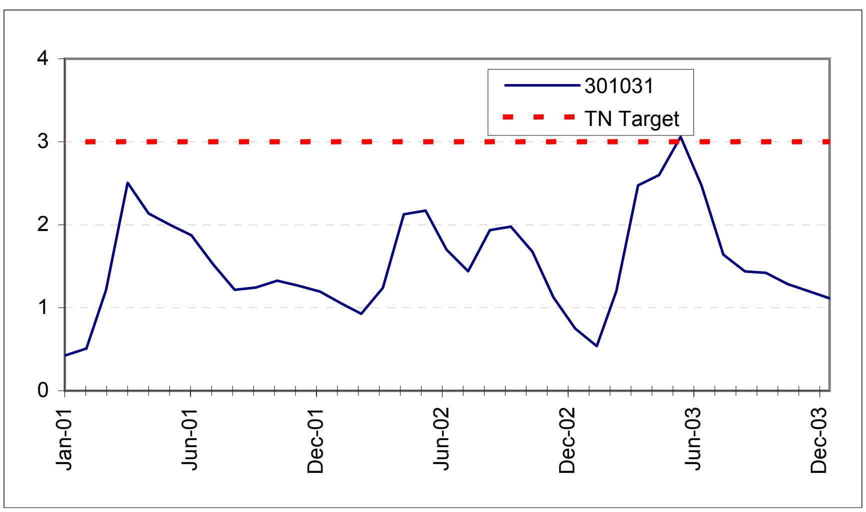


Average Monthly Total Nitrogen (mg/L)

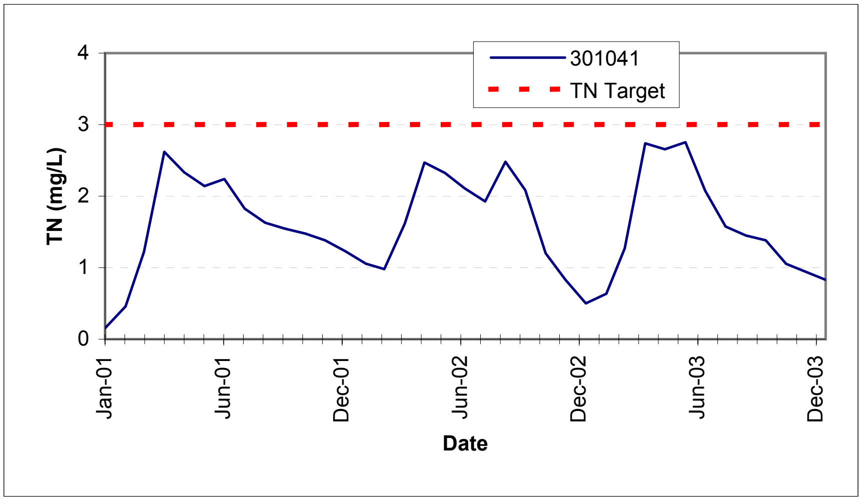
Cedar Creek Watershed

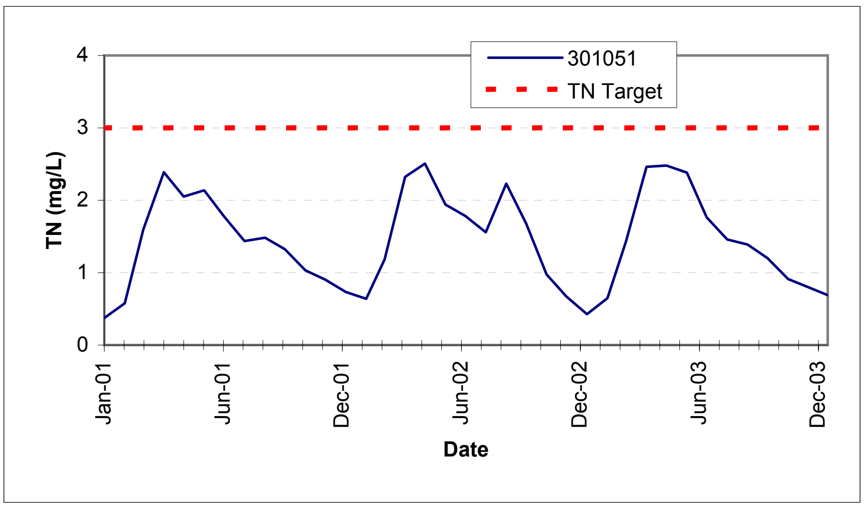


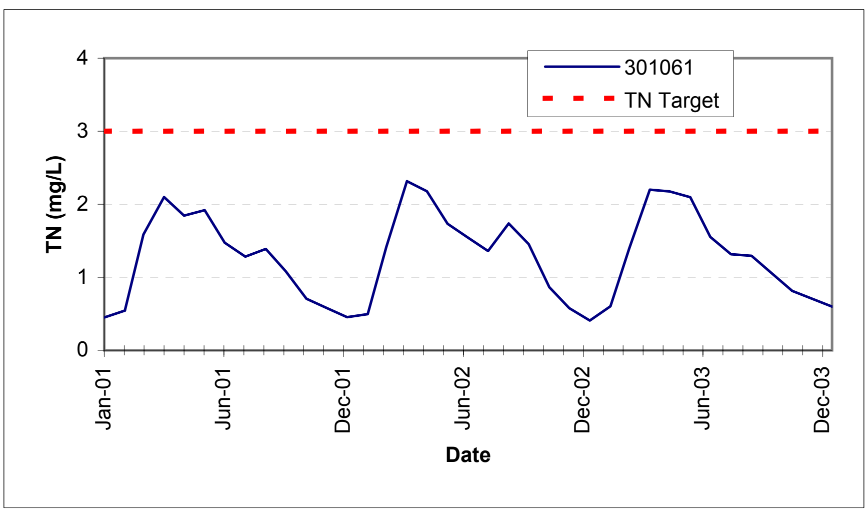




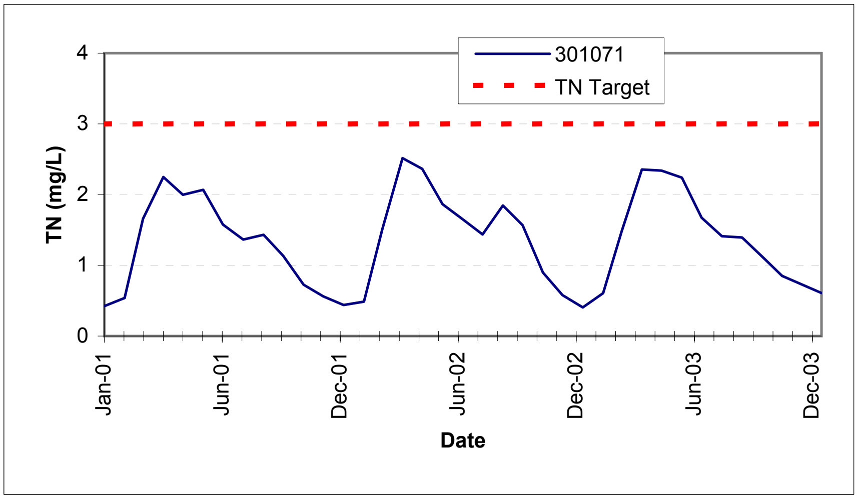
Average Monthly Total Nitrogen (mg/L)

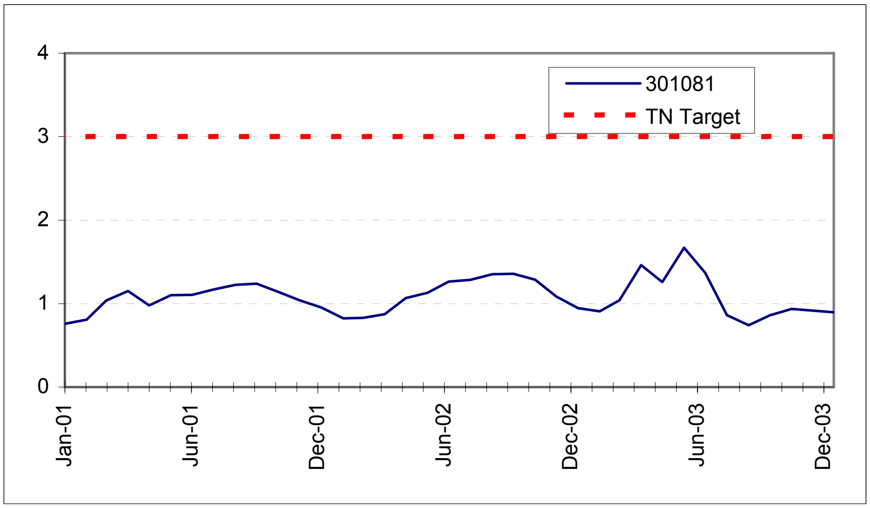


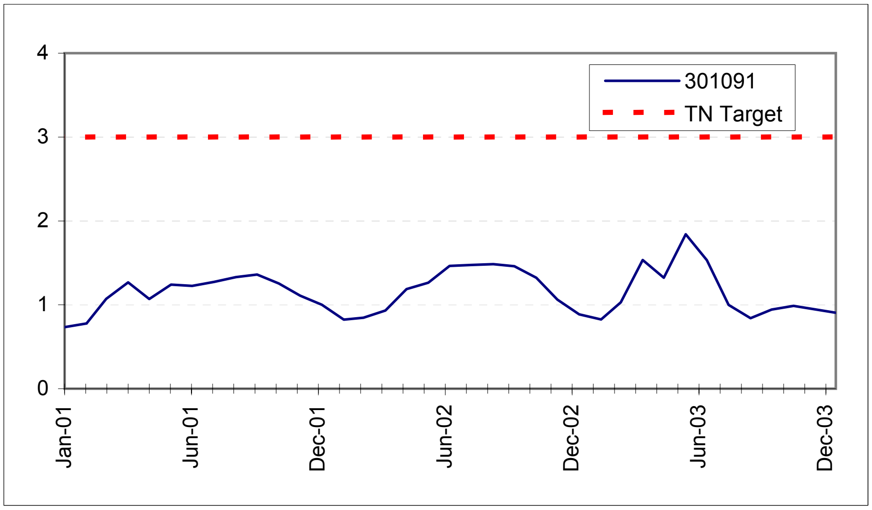




Average Monthly Total Nitrogen (mg/L)







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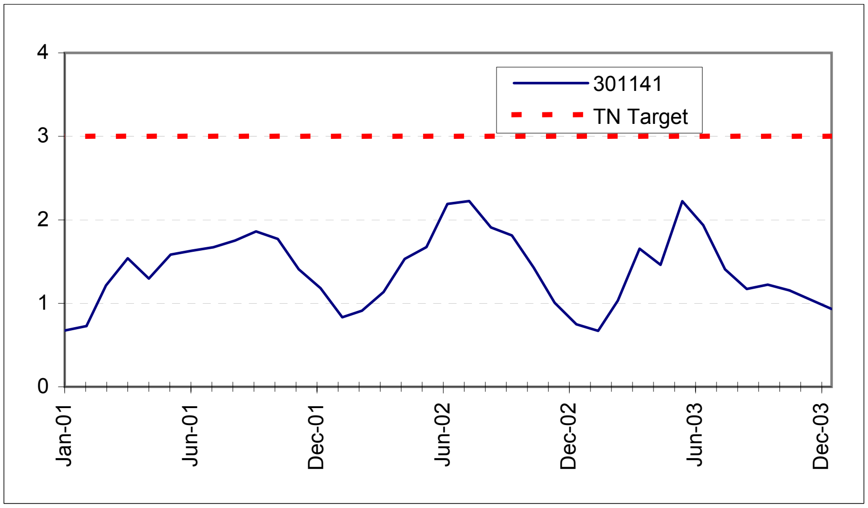
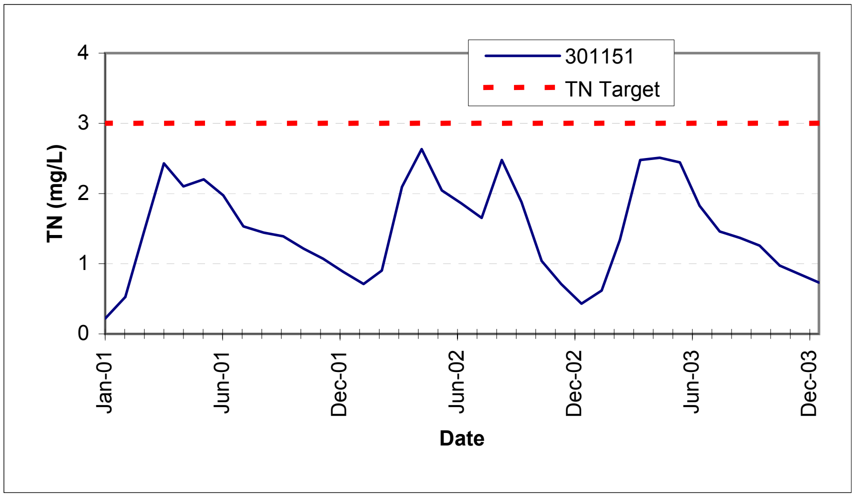
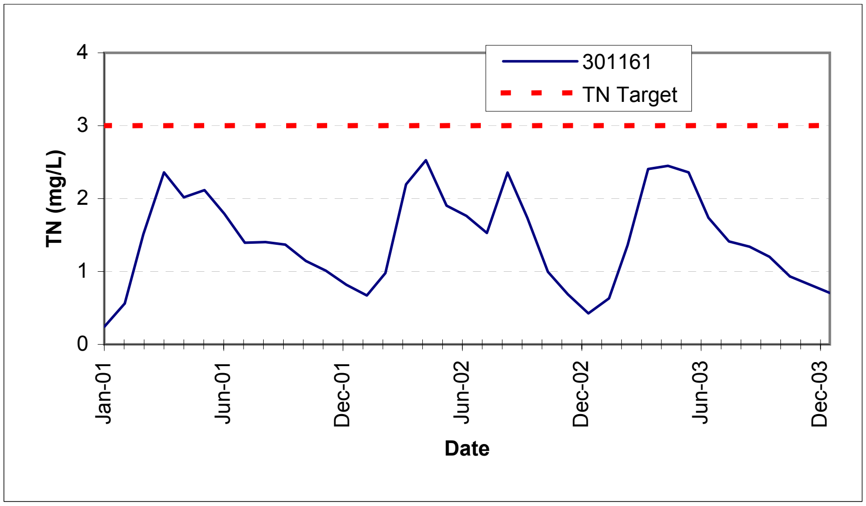
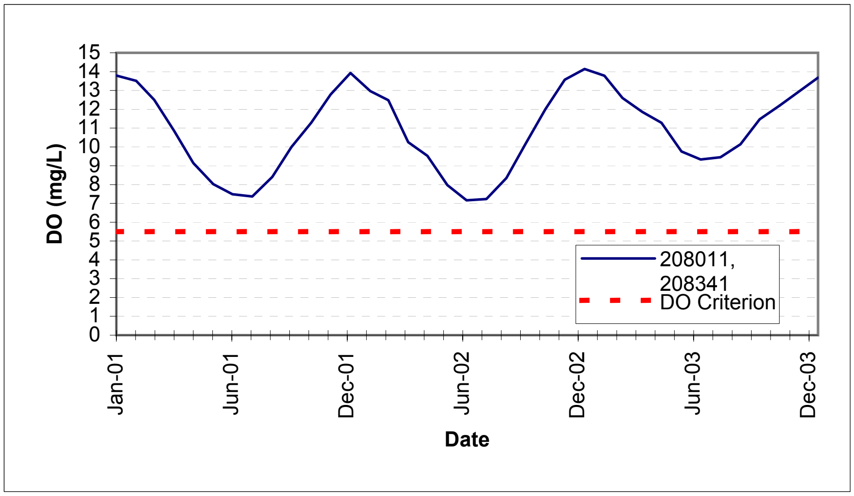


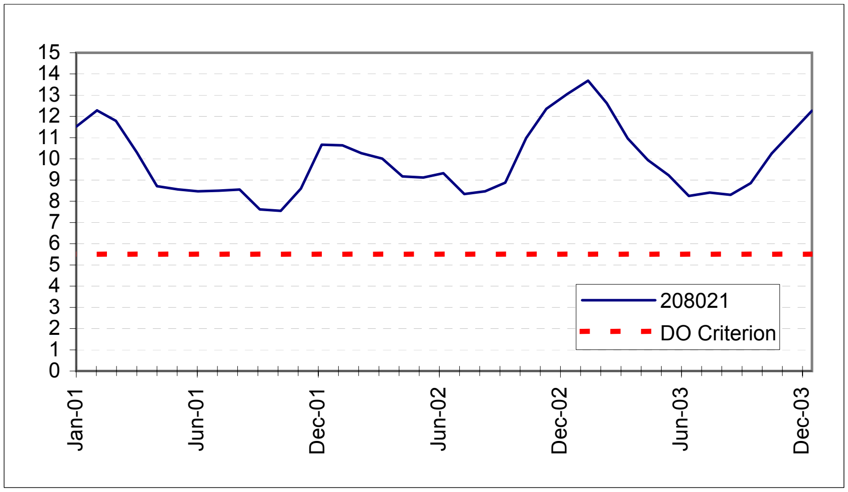


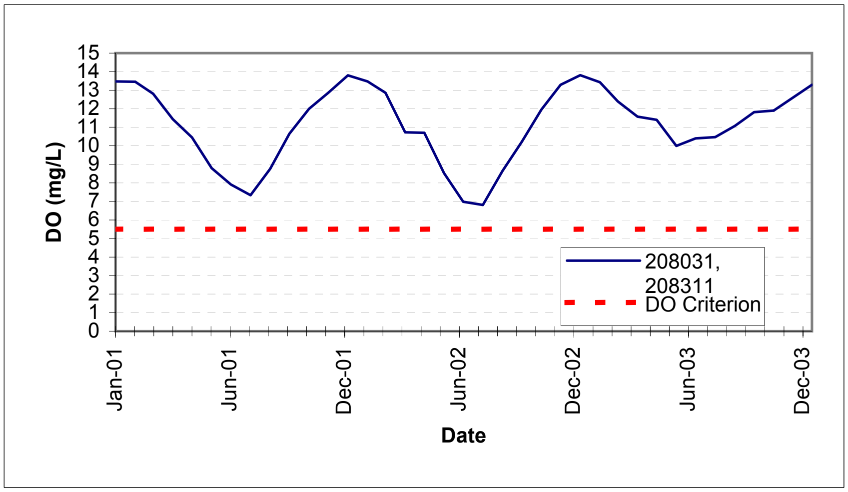


Average Monthly Dissolved Oxygen (mg/L)

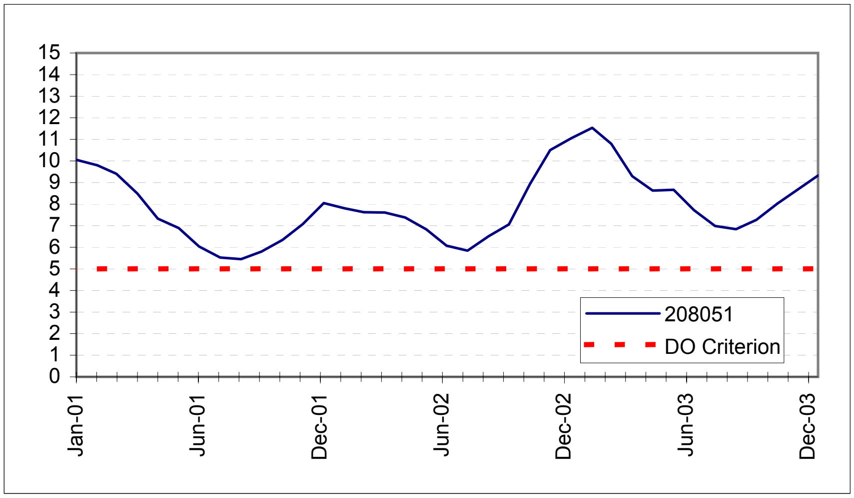
Mispillion River Watershed

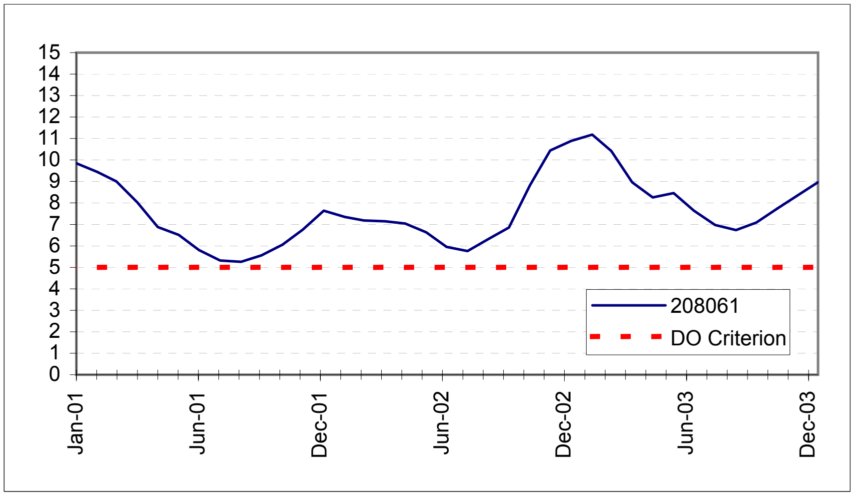


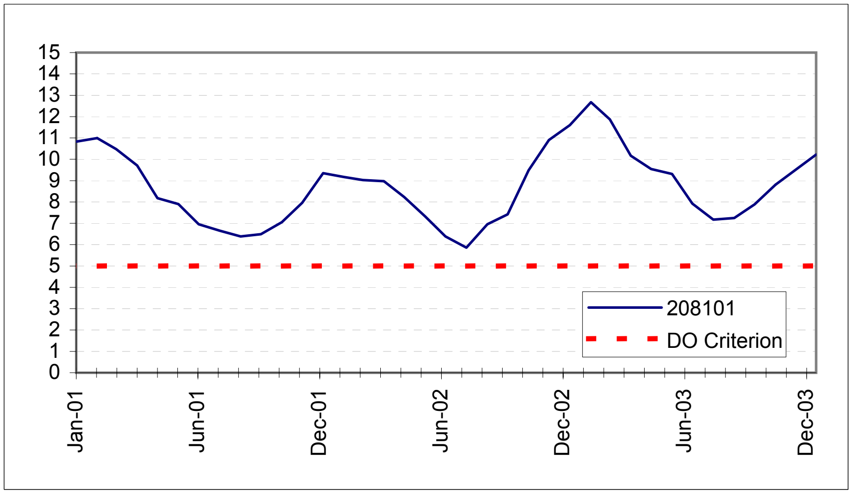




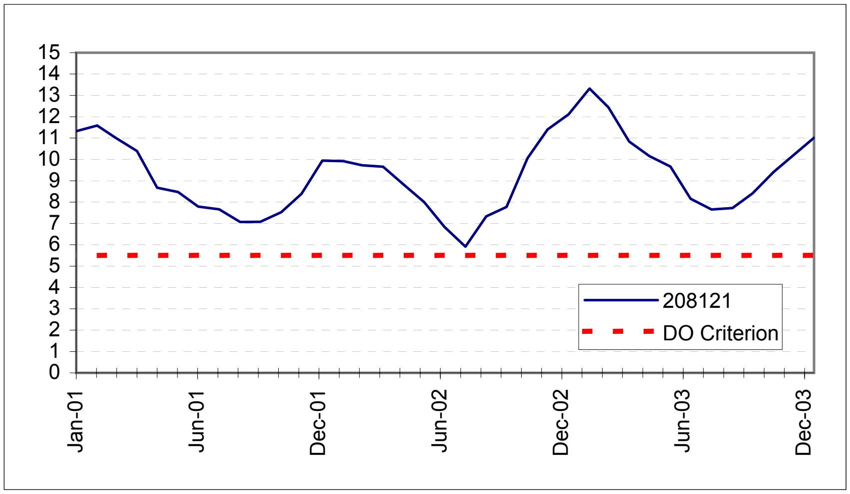
Average Monthly Dissolved Oxygen (mg/L)

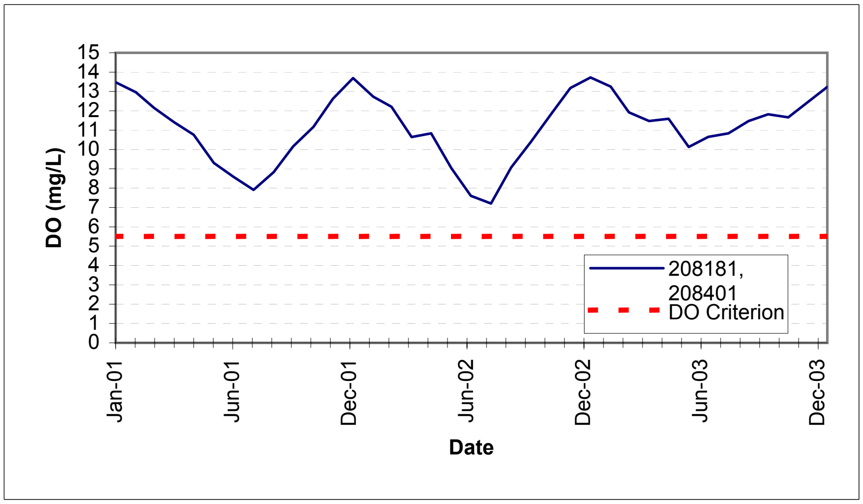


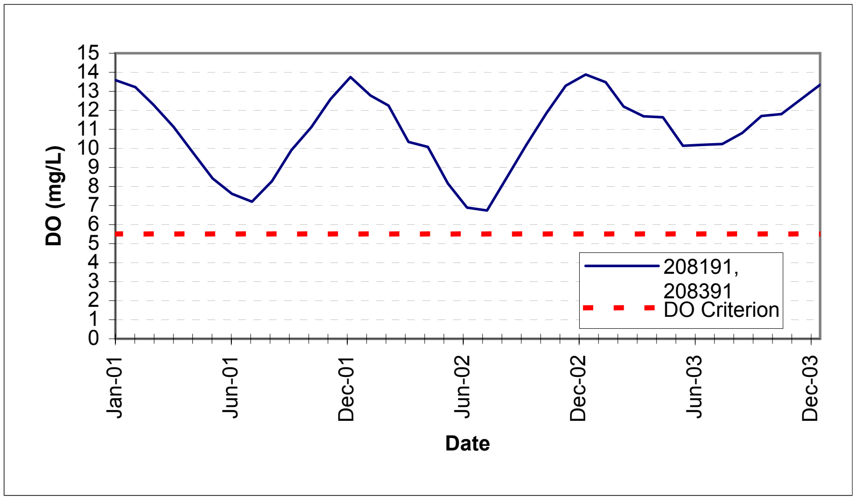




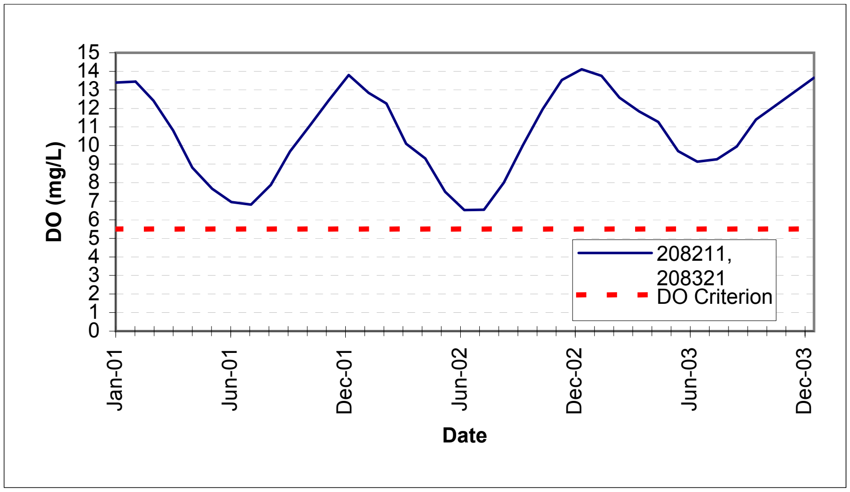
Average Monthly Dissolved Oxygen (mg/L)

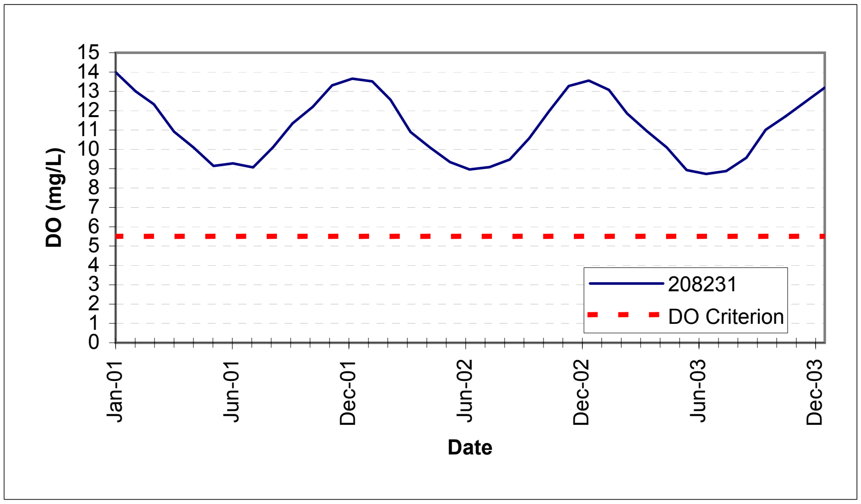


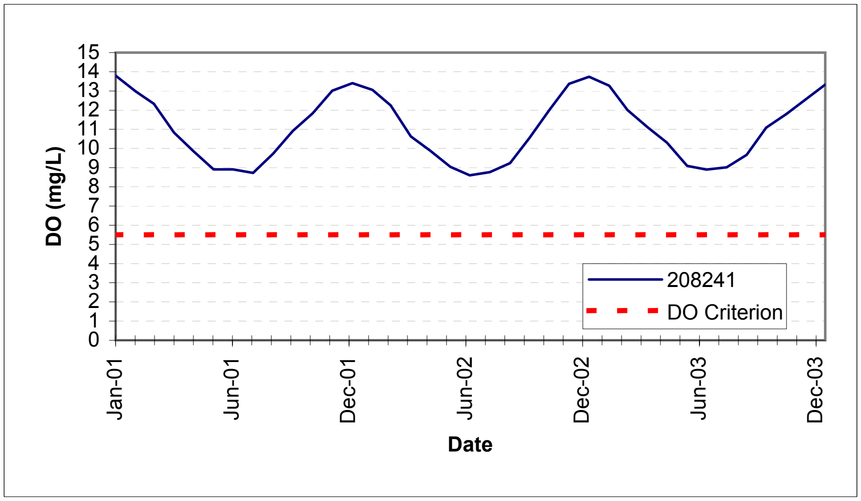




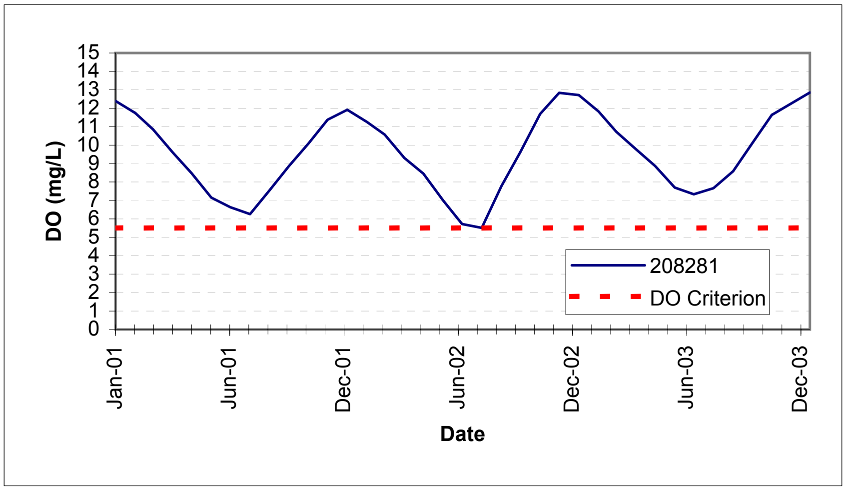
Average Monthly Dissolved Oxygen (mg/L)

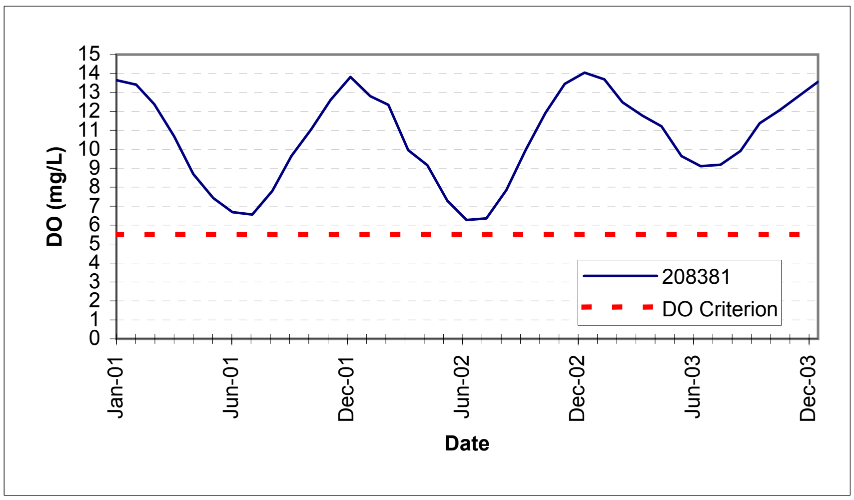






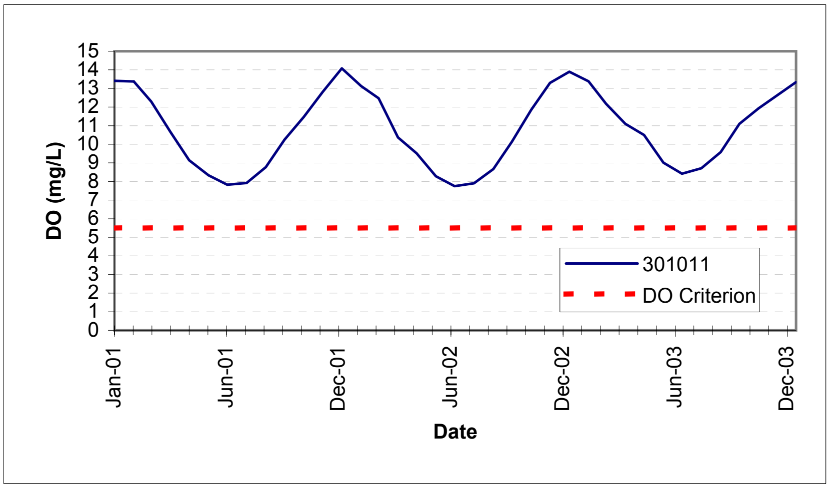
Average Monthly Dissolved Oxygen (mg/L)

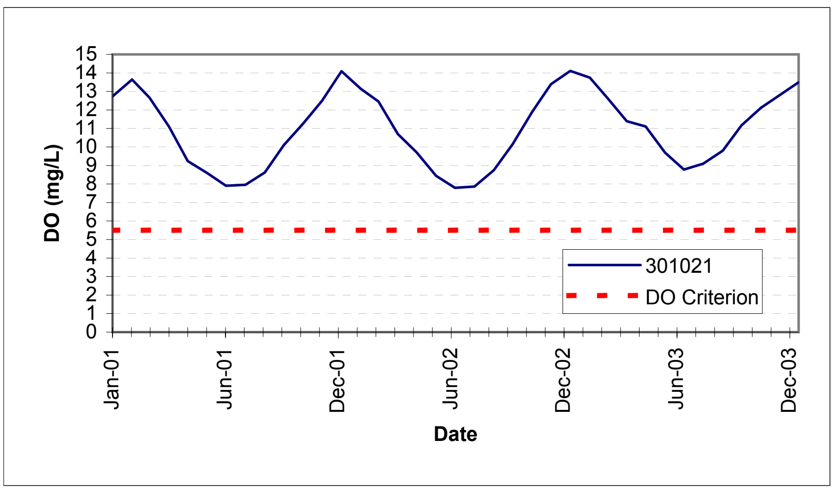


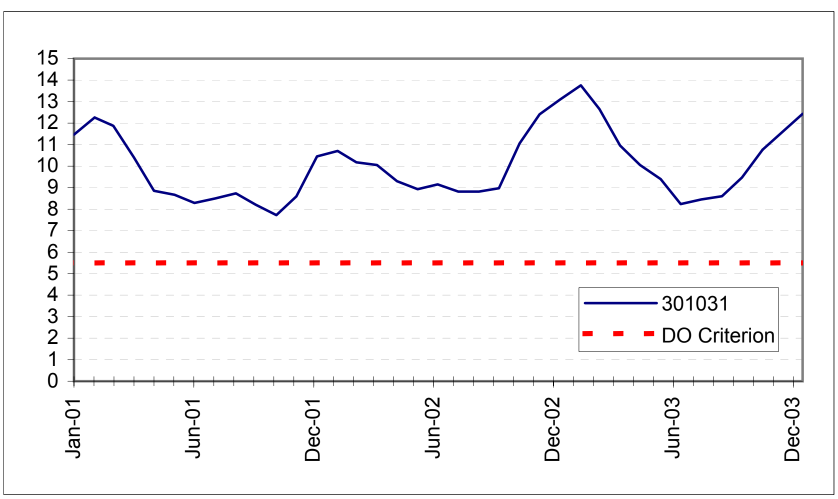


Average Monthly Dissolved Oxygen (mg/L)

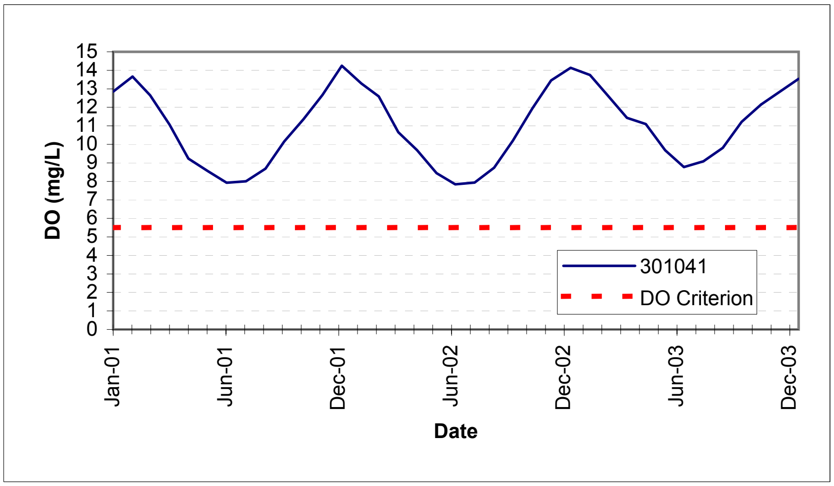
Cedar Creek Watershed

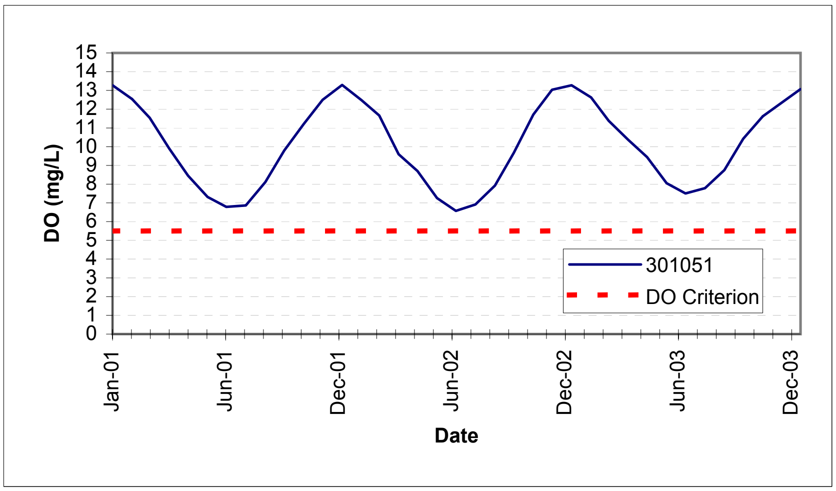


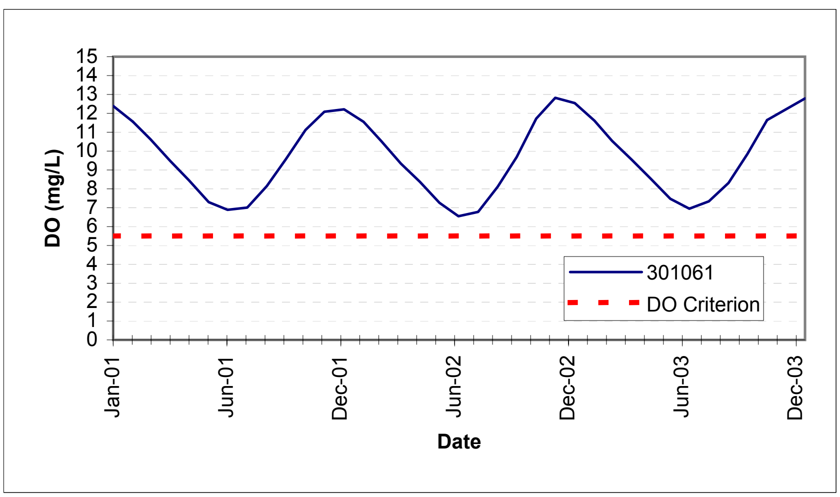




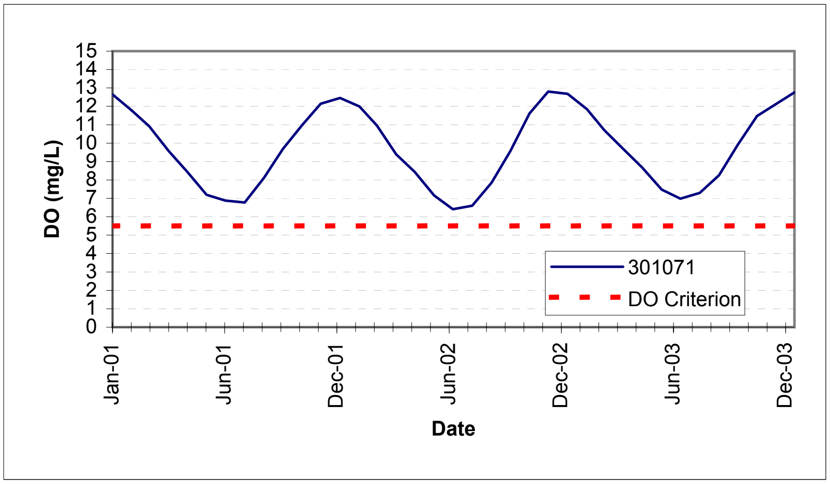
Average Monthly Dissolved Oxygen (mg/L)

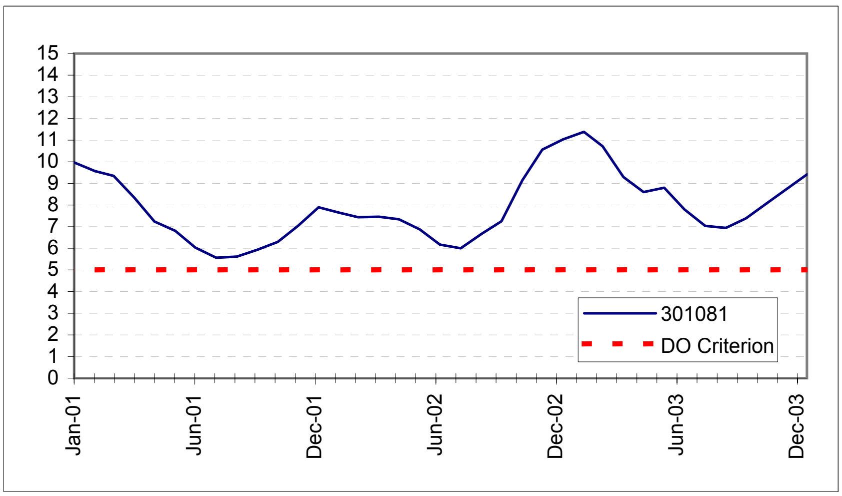


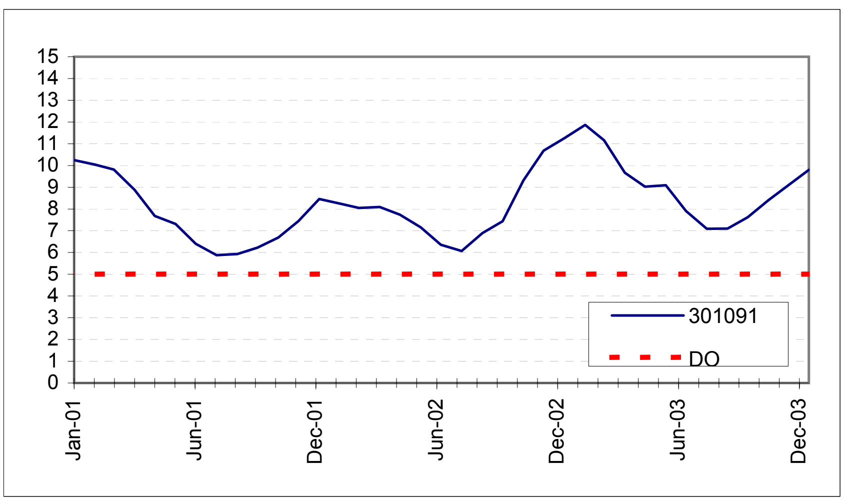




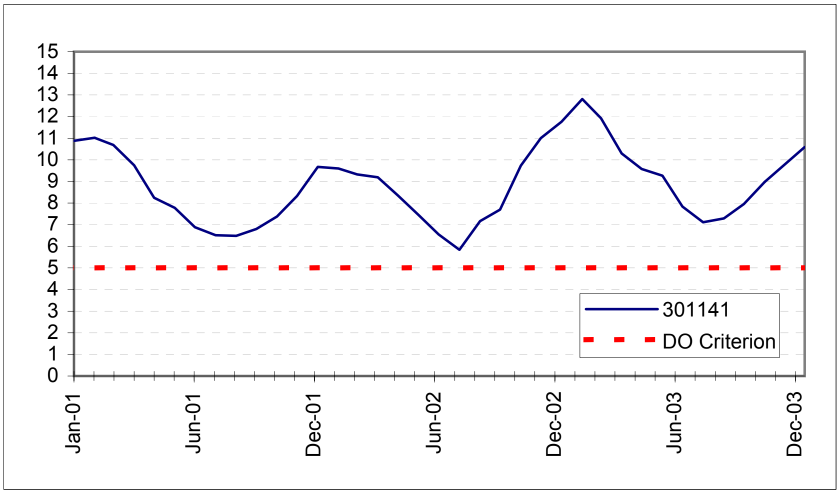
Average Monthly Dissolved Oxygen (mg/L)

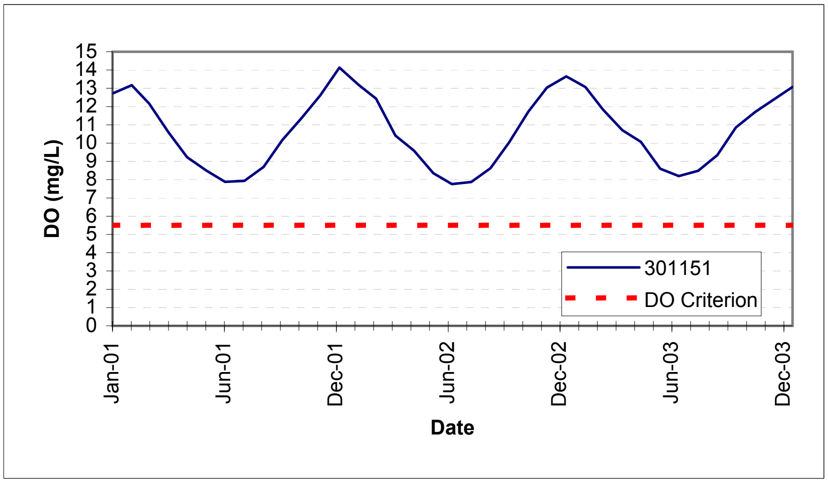


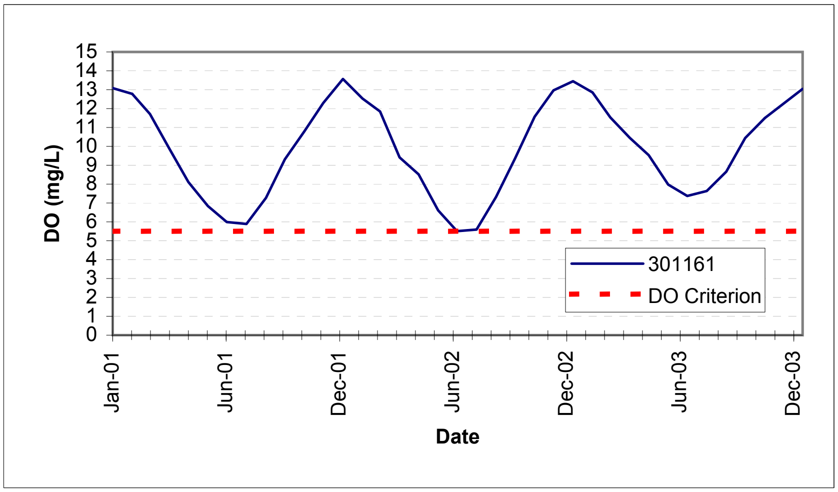




Average Monthly Dissolved Oxygen (mg/L)







Appendix B: Bacteria TMDL Modeling Results

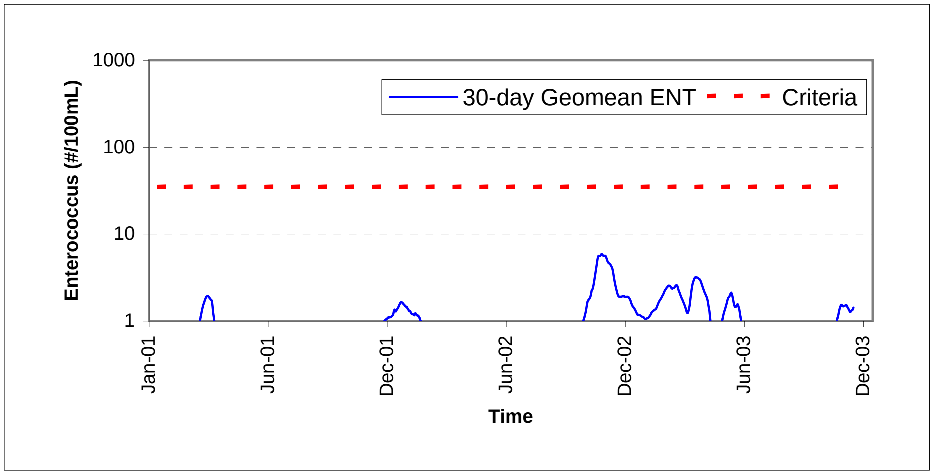
Note that downstream segments that are considered marine waters are compared to a criterion of 35 ppt and fresh water segments are compared to a criterion of 100 ppt.

Bacteria TMDL modeling results are presented for each of the locations represented in the table below.

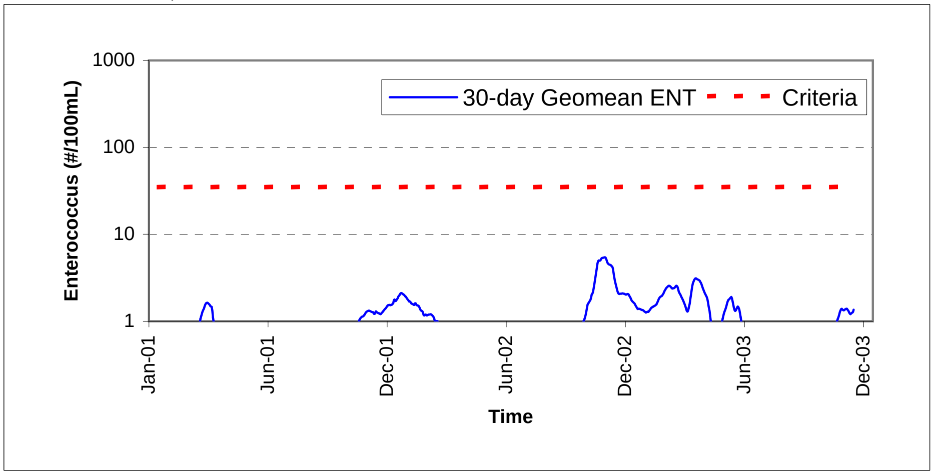
Model	Station	Location	Subwatershed/Reach ID
		Cedar Creek	
LSPC	301011	At Clendaniel Pond Rd (or Rd 38), downstream from Clendaniel Pond outfall	20
	301021	Cedar Creek, Mill Pond at Rd 212	17
	301041	At Cubbage Pond Rd (or Rd 214), downstream from Cubbage Pond outfall	18
	301051	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	21
	301061	Upstream side of Rt. 113 bridge, upstream of Hudson Pond	24
	301071	On Church Branch, at Cubbage Pond Rd (or Rd 214)	16
	301151	Middle of Cedar Creek Mill Pond, at Fleatown Rd (Rd 224)	15
	301161	Middle of Hudson Pond	22
EFDC	301031	Cedar Creek at DE Route 14	13
	301081	Confluence of Cedar Creek with Mispillion River	1
	301091	Cedar Creek at Rt. 36 bridge	1
	301141	On Slaughter Creek, at Slaughter Neck Rd (Rd 224)	3
		Mispillion River	
LSPC	208181	Abbotts Pond at Rd.620	26
	208191	Blairs Pond off Rd 443, at the Boat Ramp	20
	208211	Mispillion River, Silver Lake at DE Route 36, Milford	13
	208231	Blairs Pond; Beaverdam Branch at Rd 384 (USGS 01484100)	23
	208241	Upstream Blairs Pond, on Tantrough Branch, at Abbotts Pond Rd (Rd 442 or Rd 620)	24
	208321	Middle of Silver Lake	13
	208391	Middle of Blairs Pond on Beaverdam Branch, at Williamsville Rd (Rd 443)	20
EFDC	208021	Mispillion River at Delaware Route 14 bridge	7
	208051	At mouth of Mispillion River	1
	208061	Mispillion River 0.43 miles from mouth at lighthouse	1
	208101	Mispillion River, 4.64 miles from mouth	3
	208121	Mispillion River, 7.14 miles from mouth	6

Mispillion River Watershed

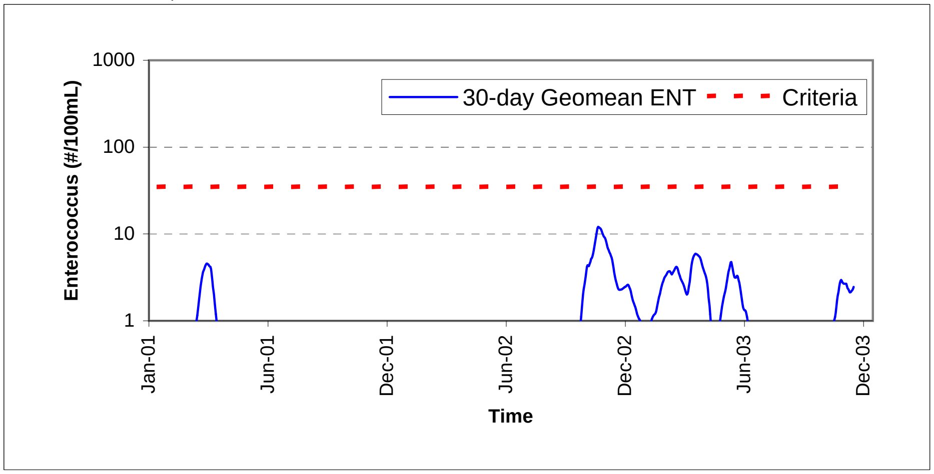
Station 208051, Reach 1



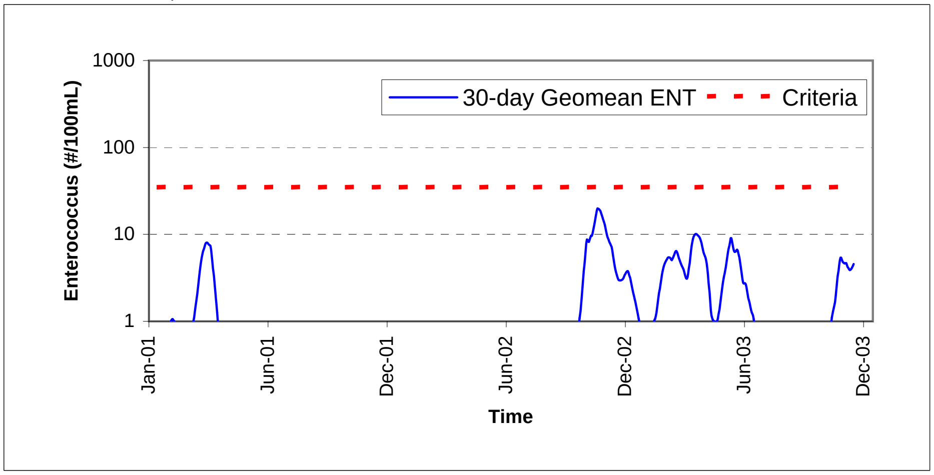
Station 208061, Reach 1



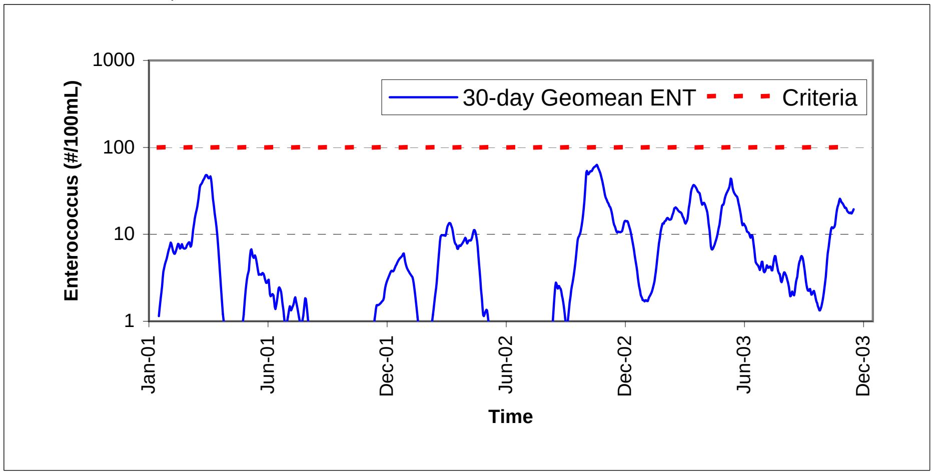
Station 208101, Reach 3



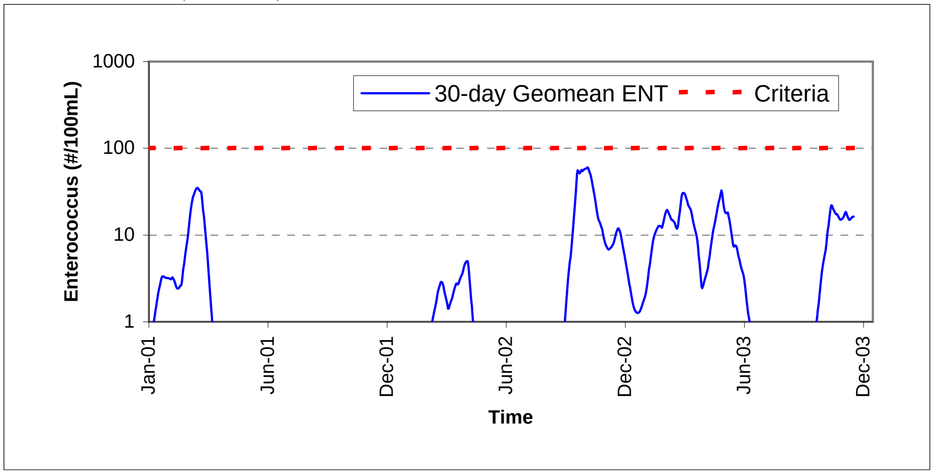
Station 208121, Reach 6



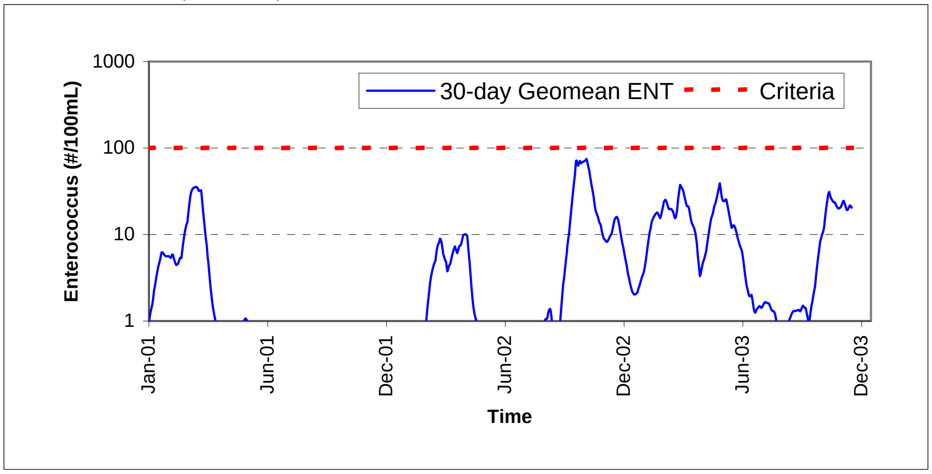
Station 208021, Reach 7



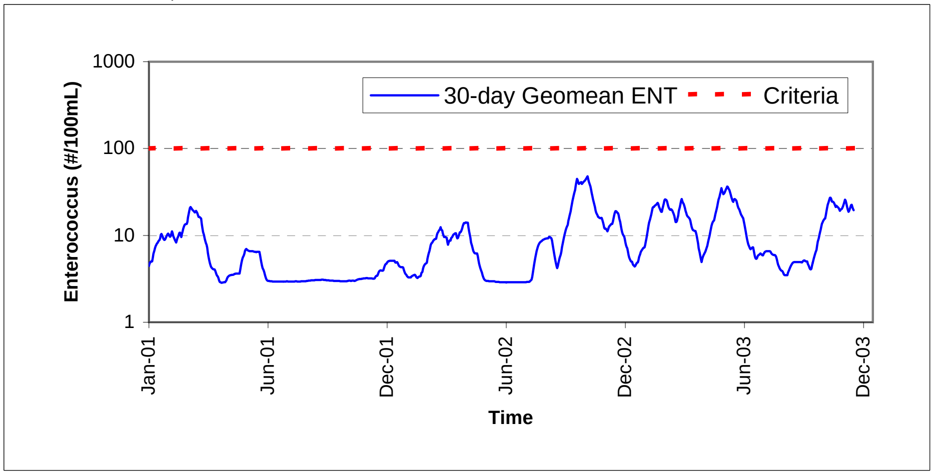
Stations 208211, 208321, Reach 13



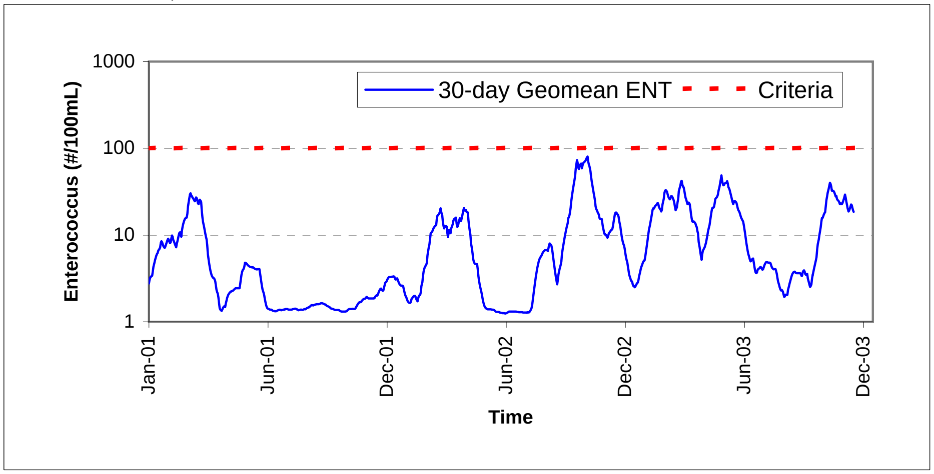
Stations 208191, 208391, Reach 20



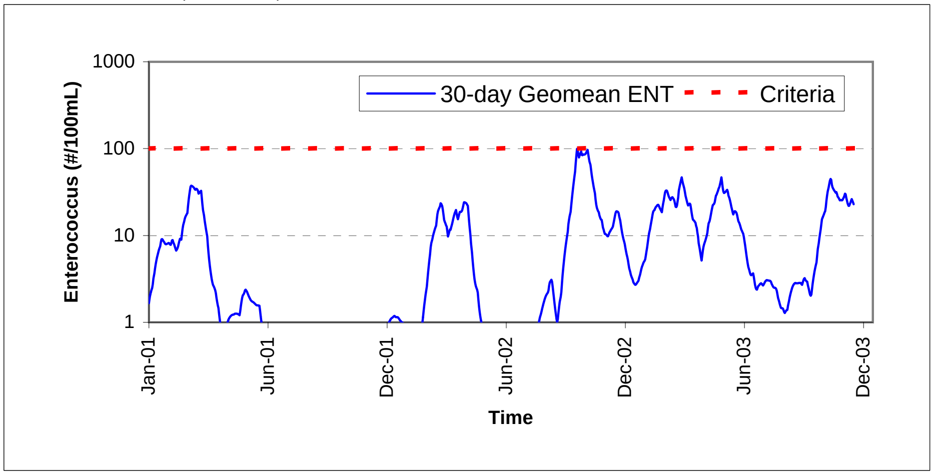
Station 208231, Reach 23



Station 208241, Reach 24

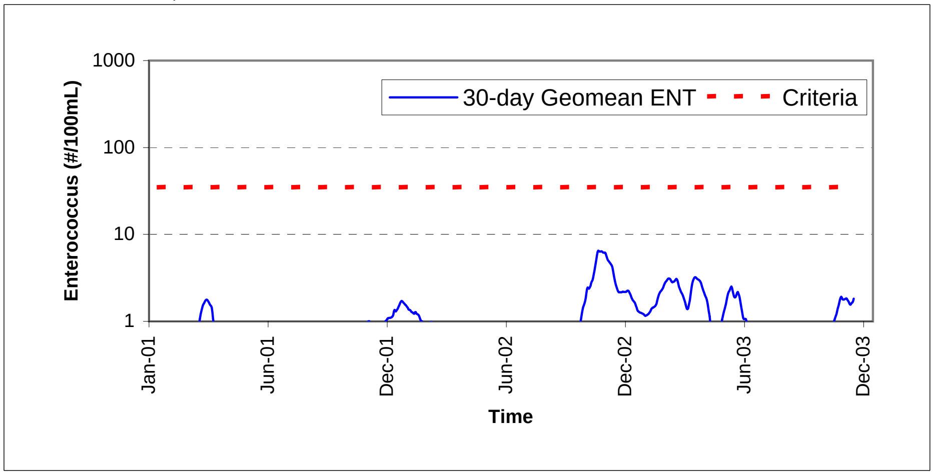


Stations 208181, 208401, Reach 26

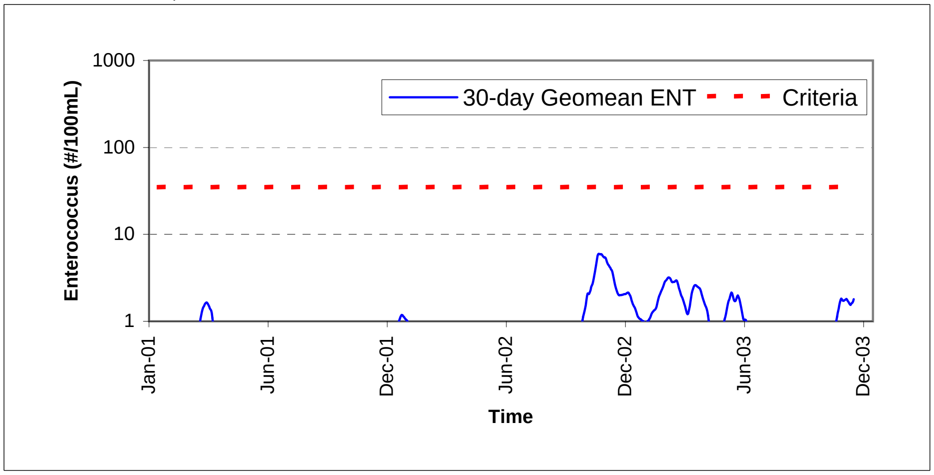


Cedar Creek Watershed

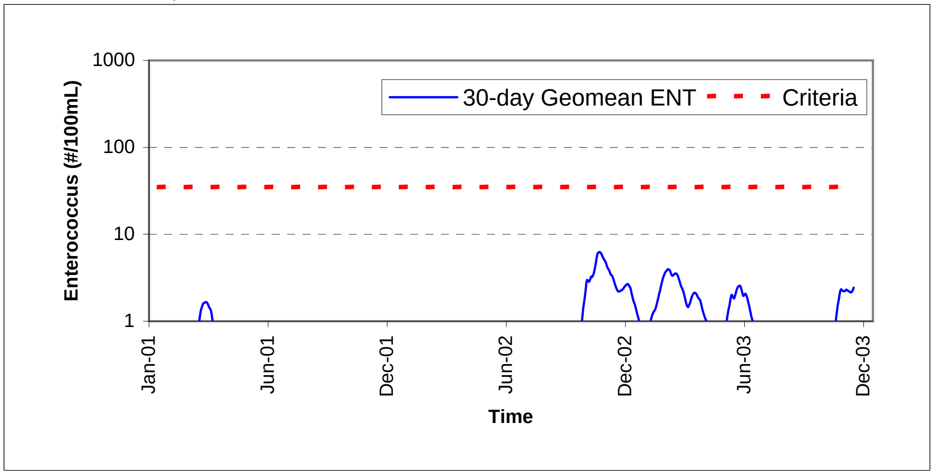
Station 301081, Reach 1



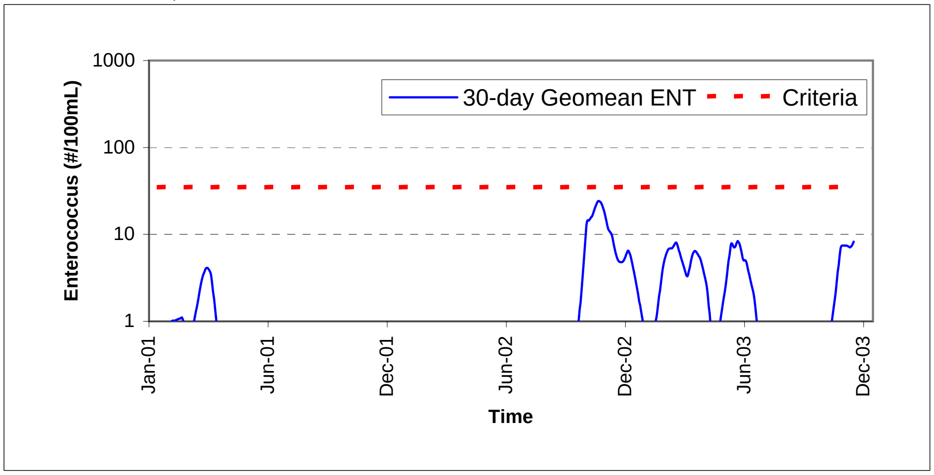
Station 301091, Reach 1



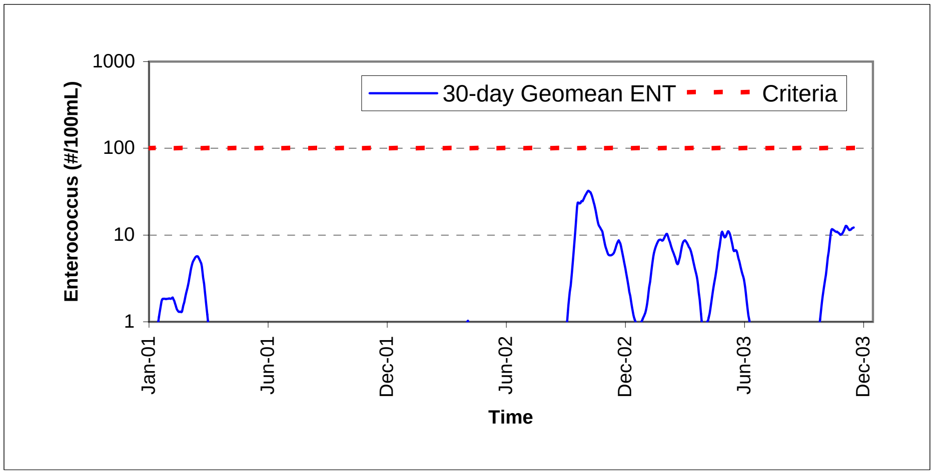
Station 301141, Reach 3



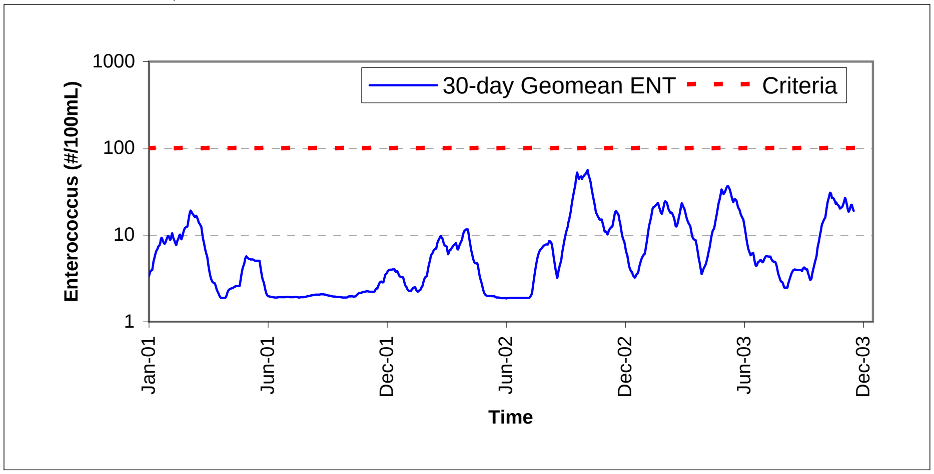
Station 301031, Reach 13



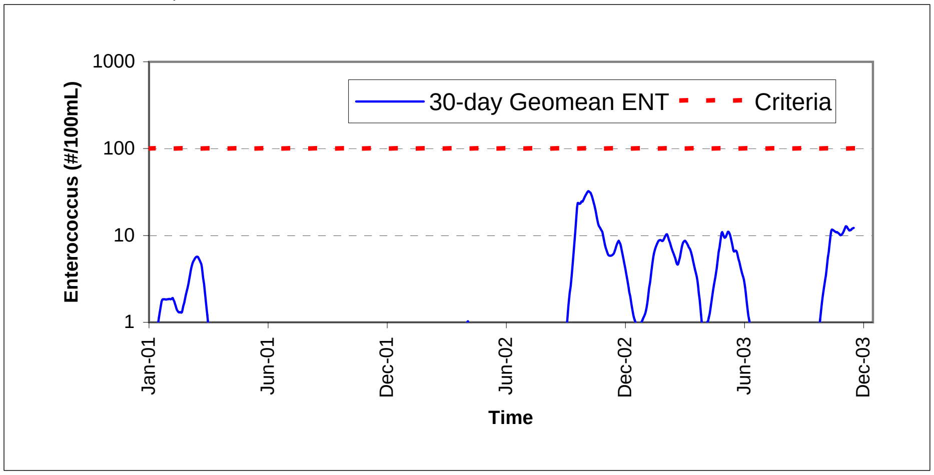
Station 301151, Reach 15



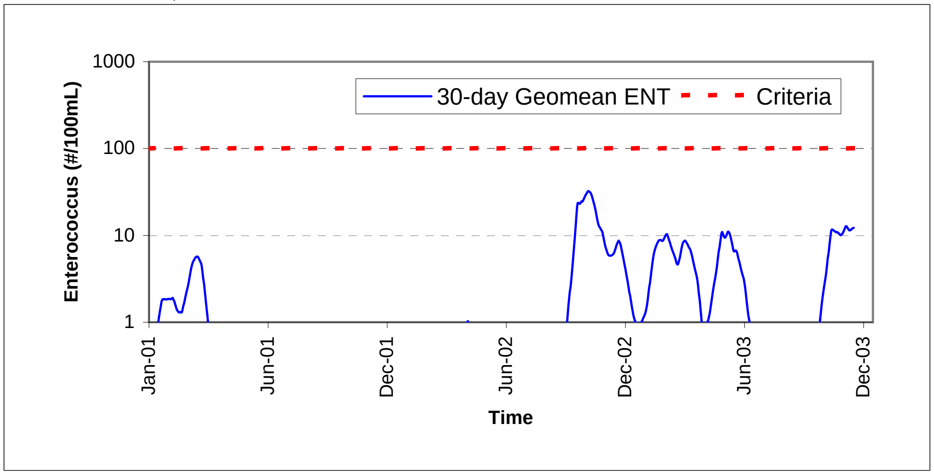
Station 301071, Reach 16



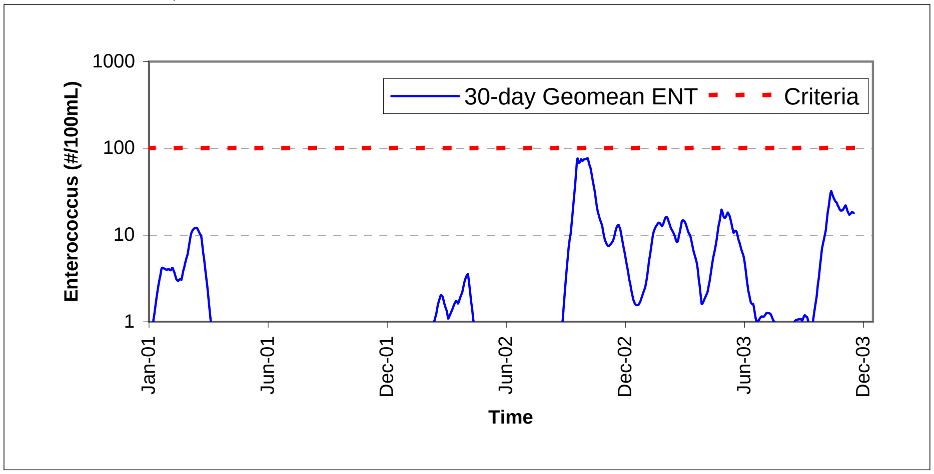
Station 301021, Reach 17



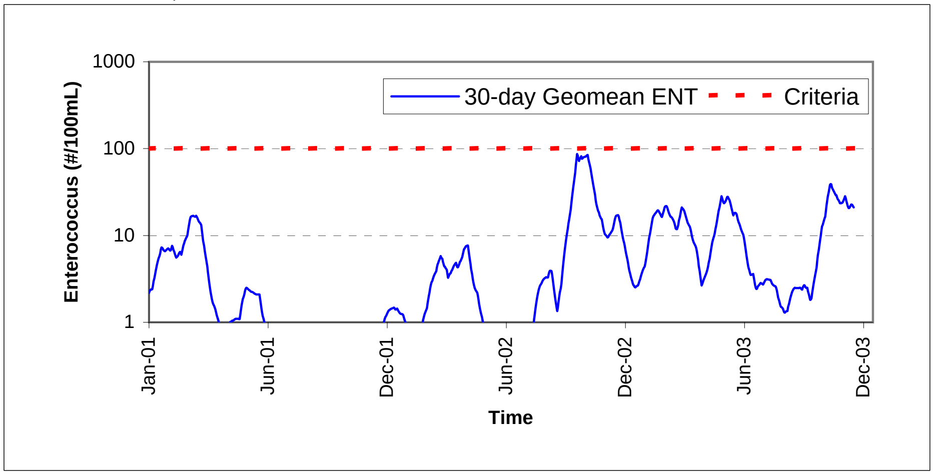
Station 301041, Reach 18



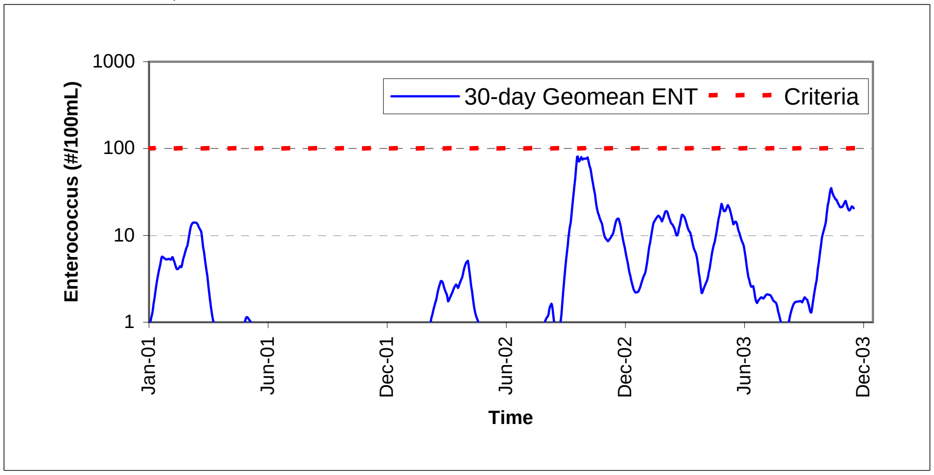
Station 301011, Reach 20



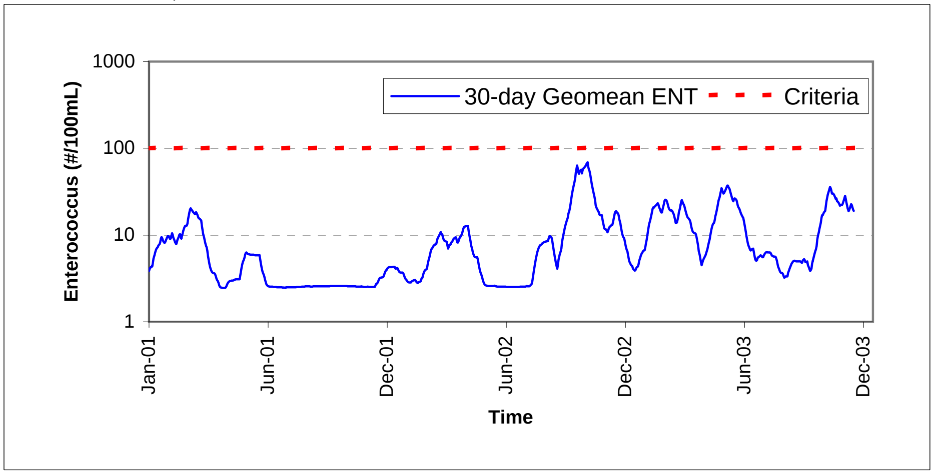
Station 301051, Reach 21



Station 301161, Reach 22



Station 301061, Reach 24



Appendix C: Baseline Accumulation Rates for Nutrients, BOD, and Enterococcus

Mispillion River Watershed

CBOD (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.08	0.08	0.08	0.1225	0.1225	0.1225	0.1225	0.1225	0.1225	0.08	0.08	0.08
Agriculture	0.0875	0.0875	0.0875	0.145	0.145	0.145	0.145	0.145	0.145	0.0875	0.0875	0.0875
Pastures/CAFOs	0.15	0.15	0.15	0.325	0.325	0.175	0.175	0.1	0.1	0.15	0.15	0.15
Brushland/Rangeland	0.045	0.045	0.045	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.045	0.045
Forest	0.045	0.045	0.045	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.045	0.045
Wetland	0.045	0.045	0.045	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.045	0.045
Barren	0.045	0.045	0.045	0.0675	0.0675	0.0675	0.0625	0.0625	0.0625	0.0575	0.045	0.045
Residential	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Commercial	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Industrial	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Institutional/Governmen	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Mixed_Urban/Built-Up	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Other_Urban	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Transportation/Communic	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15
Utilities	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15

NH3 (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Agriculture	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Pastures/CAFOs	0.0001	0.0002	0.0004	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0004	0.0002	0.0001
Brushland/Rangeland	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Forest	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Wetland	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Barren	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Residential	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Commercial	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Industrial	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Institutional/Governmen	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Mixed_Urban/Built-Up	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Other_Urban	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Transportation/Communic	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Utilities	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037

NOX (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Agriculture	0.252	0.288	0.306	0.63	0.63	0.63	0.378	0.378	0.378	0.324	0.288	0.252
Pastures/CAFOs	0.0138	0.0138	0.0138	0.018	0.018	0.018	0.018	0.018	0.018	0.0138	0.0138	0.0138
Brushland/Rangeland	0.0078	0.009	0.0096	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0096	0.009	0.0078
Forest	0.0078	0.009	0.0096	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0096	0.009	0.0078
Wetland	0.0078	0.009	0.0096	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0096	0.009	0.0078
Barren	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Residential	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Commercial	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Industrial	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Institutional/Governmen	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054

Mixed_Urban/Built-Up	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Other_Urban	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Transportation/Communic	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054
Utilities	0.054	0.072	0.09	0.108	0.108	0.108	0.108	0.108	0.108	0.09	0.072	0.054

PO4 (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Commercial	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Industrial	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Institutional/Governmen	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Mixed_Urban/Built-Up	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Other_Urban	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Transportation/Communic	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037
Utilities	0.00037	0.00039	0.00042	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00042	0.00039	0.00037

ORN (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.008	0.008	0.008	0.01225	0.01225	0.01225	0.01225	0.01225	0.01225	0.008	0.008	0.008
Agriculture	0.00875	0.00875	0.00875	0.0145	0.0145	0.0145	0.0145	0.0145	0.0145	0.00875	0.00875	0.00875
Pastures/CAFOs	0.015	0.015	0.015	0.0325	0.0325	0.0175	0.0175	0.01	0.01	0.015	0.015	0.015
Brushland/Rangeland	0.0045	0.0045	0.0045	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.0045	0.0045
Forest	0.0045	0.0045	0.0045	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.0045	0.0045
Wetland	0.0045	0.0045	0.0045	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.0045	0.0045
Barren	0.0045	0.0045	0.0045	0.00675	0.00675	0.00675	0.00625	0.00625	0.00625	0.00575	0.0045	0.0045
Residential	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Commercial	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Industrial	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Institutional/Governmen	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Mixed_Urban/Built-Up	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Other_Urban	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Transportation/Communic	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015
Utilities	0.015	0.015	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.015	0.015

ORP (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.0008	0.0008	0.0008	0.001225	0.001225	0.001225	0.001225	0.001225	0.001225	0.0008	0.0008	0.0008
Agriculture	0.000875	0.000875	0.000875	0.00145	0.00145	0.00145	0.00145	0.00145	0.00145	0.000875	0.000875	0.000875
Pastures/CAFOs	0.0015	0.0015	0.0015	0.00325	0.00325	0.00175	0.00175	0.001	0.001	0.0015	0.0015	0.0015
Brushland/Rangeland	0.00045	0.00045	0.00045	0.0006	0.0006	0.0006	0.0007	0.0007	0.0007	0.0007	0.00045	0.00045
Forest	0.00045	0.00045	0.00045	0.0006	0.0006	0.0006	0.0007	0.0007	0.0007	0.0007	0.00045	0.00045
Wetland	0.00045	0.00045	0.00045	0.0006	0.0006	0.0006	0.0007	0.0007	0.0007	0.0007	0.00045	0.00045
Barren	0.00045	0.00045	0.00045	0.000675	0.000675	0.000675	0.000625	0.000625	0.000625	0.000575	0.00045	0.00045
Residential	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Commercial	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Industrial	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Institutional/Governmen	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Mixed_Urban/Built-Up	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Other_Urban	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Transportation/Communic	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015
Utilities	0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002	0.0015	0.0015	0.0015

Cedar Creek Watershed

CBOD (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.064	0.064	0.064	0.098	0.098	0.098	0.098	0.098	0.098	0.064	0.064	0.064
Agriculture	0.07	0.07	0.07	0.116	0.116	0.116	0.116	0.116	0.116	0.07	0.07	0.07
Pastures/CAFOs	0.12	0.12	0.12	0.26	0.26	0.14	0.14	0.08	0.08	0.12	0.12	0.12
Brushland/Rangeland	0.036	0.036	0.036	0.048	0.048	0.048	0.056	0.056	0.056	0.056	0.036	0.036
Forest	0.036	0.036	0.036	0.048	0.048	0.048	0.056	0.056	0.056	0.056	0.036	0.036
Wetland	0.036	0.036	0.036	0.048	0.048	0.048	0.056	0.056	0.056	0.056	0.036	0.036
Barren	0.036	0.036	0.036	0.054	0.054	0.054	0.05	0.05	0.05	0.046	0.036	0.036
Residential	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Commercial	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Industrial	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Institutional/Governmen	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Mixed_Urban/Built-Up	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Other_Urban	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Transportation/Communic	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12
Utilities	0.12	0.12	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.12	0.12	0.12

NH3 (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Agriculture	0.0003	0.0003	0.0005	0.0013	0.002	0.002	0.0015	0.0014	0.0013	0.001	0.0005	0.0003
Pastures/CAFOs	0.0001	0.0002	0.0004	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0004	0.0002	0.0001
Brushland/Rangeland	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Forest	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Wetland	0.00033	0.0004	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0008	0.0004	0.00033
Barren	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Residential	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Commercial	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Industrial	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Institutional/Governmen	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Mixed_Urban/Built-Up	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Other_Urban	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Transportation/Communic	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037
Utilities	0.0037	0.0039	0.0042	0.005	0.005	0.005	0.005	0.005	0.005	0.0042	0.0039	0.0037

NOX (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Agriculture	0.21	0.24	0.255	0.525	0.525	0.525	0.315	0.315	0.315	0.27	0.24	0.21
Pastures/CAFOs	0.0115	0.0115	0.0115	0.015	0.015	0.015	0.015	0.015	0.015	0.0115	0.0115	0.0115
Brushland/Rangeland	0.0065	0.0075	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.0075	0.0065
Forest	0.0065	0.0075	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.0075	0.0065
Wetland	0.0065	0.0075	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.0075	0.0065
Barren	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Residential	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Commercial	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045

Industrial	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Institutional/Governmen	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Mixed_Urban/Built-Up	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Other_Urban	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Transportation/Communic	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045
Utilities	0.045	0.06	0.075	0.09	0.09	0.09	0.09	0.09	0.09	0.075	0.06	0.045

PO4 (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Commercial	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Industrial	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Institutional/Governmen	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Mixed_Urban/Built-Up	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Other_Urban	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Transportation/Communic	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127
Utilities	0.0127	0.0159	0.0192	0.023	0.023	0.023	0.023	0.023	0.023	0.0192	0.0159	0.0127

ORN (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.0064	0.0064	0.0064	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0064	0.0064	0.0064
Agriculture	0.007	0.007	0.007	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.007	0.007	0.007
Pastures/CAFOs	0.012	0.012	0.012	0.026	0.026	0.014	0.014	0.008	0.008	0.012	0.012	0.012
Brushland/Rangeland	0.0036	0.0036	0.0036	0.0048	0.0048	0.0048	0.0056	0.0056	0.0056	0.0056	0.0036	0.0036
Forest	0.0036	0.0036	0.0036	0.0048	0.0048	0.0048	0.0056	0.0056	0.0056	0.0056	0.0036	0.0036
Wetland	0.0036	0.0036	0.0036	0.0048	0.0048	0.0048	0.0056	0.0056	0.0056	0.0056	0.0036	0.0036
Barren	0.0036	0.0036	0.0036	0.0054	0.0054	0.0054	0.005	0.005	0.005	0.0046	0.0036	0.0036
Residential	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Commercial	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Industrial	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Institutional/Governmen	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Mixed_Urban/Built-Up	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Other_Urban	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Transportation/Communic	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012
Utilities	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.012	0.012	0.012

ORP (lbs/ac-day)

Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	0.00064	0.00064	0.00064	0.00098	0.00098	0.00098	0.00098	0.00098	0.00098	0.00064	0.00064	0.00064
Agriculture	0.0007	0.0007	0.0007	0.00116	0.00116	0.00116	0.00116	0.00116	0.00116	0.0007	0.0007	0.0007
Pastures/CAFOs	0.0012	0.0012	0.0012	0.0026	0.0026	0.0014	0.0014	0.0008	0.0008	0.0012	0.0012	0.0012
Brushland/Rangeland	0.00036	0.00036	0.00036	0.00048	0.00048	0.00048	0.00056	0.00056	0.00056	0.00056	0.00036	0.00036
Forest	0.00036	0.00036	0.00036	0.00048	0.00048	0.00048	0.00056	0.00056	0.00056	0.00056	0.00036	0.00036
Wetland	0.00036	0.00036	0.00036	0.00048	0.00048	0.00048	0.00056	0.00056	0.00056	0.00056	0.00036	0.00036
Barren	0.00036	0.00036	0.00036	0.00054	0.00054	0.00054	0.0005	0.0005	0.0005	0.00046	0.00036	0.00036
Residential	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Commercial	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Industrial	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Institutional/Governmen	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Mixed_Urban/Built-Up	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012

Other_Urban	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Transportation/Communic	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012
Utilities	0.0012	0.0012	0.0012	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0012	0.0012	0.0012

Enterococcus (#/ac-day)

Cedar Creek Watershed													
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A	Recreation	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Agriculture	2.59E+07	2.82E+07	2.59E+07	9.91E+09	9.59E+09	2.66E+07	2.59E+07	2.59E+07	2.66E+07	3.84E+10	3.97E+10	2.59E+07
	Pastures/CAFOs	1.31E+07	8.76E+06	8.07E+06	5.21E+09	5.21E+09	5.21E+09	5.21E+09	5.21E+09	5.21E+09	5.25E+09	5.25E+09	8.07E+06
	Brushland/Rangeland	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Barren	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Residential	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08
	Commercial	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Industrial	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Institutional/Governmen	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Mixed_Urban/Built-Up	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Other_Urban	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Transportation/Communic	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
	Utilities	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
B	Recreation	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Agriculture	6.23E+08	6.89E+08	6.89E+08	8.57E+08	8.29E+08	6.44E+08	6.23E+08	6.23E+08	6.44E+08	4.96E+09	5.12E+09	6.23E+08
	Pastures/CAFOs	1.17E+09	1.23E+09	1.17E+09	9.39E+09	9.36E+09	9.17E+09	9.15E+09	9.15E+09	9.17E+09	1.35E+10	1.37E+10	1.17E+09
	Brushland/Rangeland	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Barren	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Residential	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08
	Commercial	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Industrial	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Institutional/Governmen	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Mixed_Urban/Built-Up	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Other_Urban	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Transportation/Communic	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
	Utilities	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
C	Recreation	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Agriculture	3.91E+06	3.91E+06	3.91E+06	2.53E+09	2.45E+09	3.91E+06	3.91E+06	3.91E+06	3.91E+06	9.78E+09	1.01E+10	3.91E+06
	Pastures/CAFOs	7.32E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05	4.88E+05
	Brushland/Rangeland	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Barren	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Residential	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08	4.30E+08
	Commercial	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Industrial	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Institutional/Governmen	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Mixed_Urban/Built-Up	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Other_Urban	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
	Transportation/Communic	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06

Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Utilities	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06	4.72E+06
						Mispillion River Watershed							
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
D	Recreation	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Agriculture	5.01E+06	5.12E+06	5.01E+06	3.34E+10	3.23E+10	5.04E+06	5.01E+06	5.01E+06	5.04E+06	1.29E+10	1.33E+10	5.01E+06
	Pastures/CAFOs	4.75E+06	4.60E+06	4.75E+06	5.16E+06	5.11E+06	4.78E+06	4.75E+06	4.75E+06	4.78E+06	1.24E+07	1.27E+07	4.75E+06
	Brushland/Rangeland	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Barren	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Residential	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08
	Commercial	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Industrial	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Institutional/Governmen	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Mixed_Urban/Built-Up	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Other_Urban	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Transportation/Communic	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
	Utilities	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06	4.87E+06
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
E	Recreation	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Agriculture	3.61E+08	4.00E+08	3.61E+08	9.30E+09	9.00E+09	3.73E+08	3.61E+08	3.61E+08	3.73E+08	3.69E+10	3.82E+10	3.61E+08
	Pastures/CAFOs	3.61E+08	4.00E+08	3.61E+08	4.96E+08	4.80E+08	3.73E+08	3.61E+08	3.61E+08	3.73E+08	2.86E+09	2.96E+09	3.61E+08
	Brushland/Rangeland	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Barren	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Residential	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08
	Commercial	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Industrial	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Institutional/Governmen	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Mixed_Urban/Built-Up	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Other_Urban	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Transportation/Communic	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
	Utilities	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06	4.47E+06
Group	Land Use ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
F	Recreation	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Agriculture	5.01E+06	5.12E+06	5.01E+06	3.34E+09	3.23E+09	5.04E+06	5.01E+06	5.01E+06	5.04E+06	1.29E+09	1.33E+09	5.01E+06
	Pastures/CAFOs	4.75E+06	4.60E+06	4.75E+06	5.16E+06	5.11E+06	4.78E+06	4.75E+06	4.75E+06	4.78E+06	1.24E+07	1.27E+07	4.75E+06
	Brushland/Rangeland	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Forest	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06	3.91E+06
	Wetland	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Barren	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Residential	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08	1.90E+08
	Commercial	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Industrial	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Institutional/Governmen	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Mixed_Urban/Built-Up	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Other_Urban	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Transportation/Communic	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06
	Utilities	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06	5.07E+06

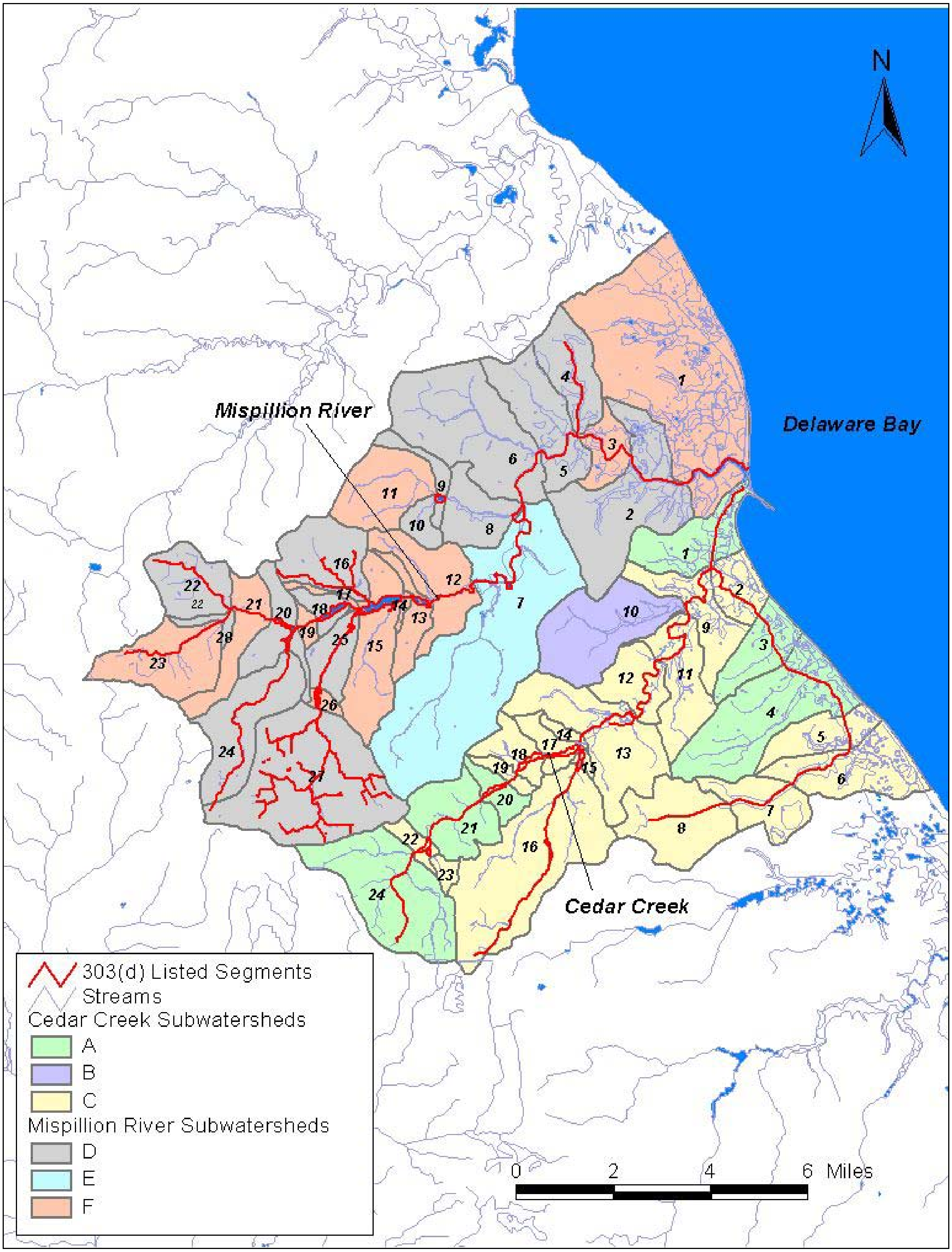


Figure C-1. Groups representing different land use-specific bacteria loading rates.

Appendix D: TMDL Loads and Reductions by Land Use

Mispillion River Watershed

Existing Enterococcus (#/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Recreation	4.25E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E+07	2.32E+06	0.00E+00	0.00E+00	0.00E+00	8.32E+06	0.00E+00	0.00E+00	0.00E+00
Agriculture	2.37E+10	3.39E+09	1.25E+11	2.29E+11	6.99E+11	1.25E+12	1.33E+11	8.00E+10	5.97E+10	3.32E+10	7.64E+09	7.32E+09	3.18E+08	2.67E+10
Pastures/CAFOs	8.38E+06	3.26E+07	3.00E+06	2.69E+07	7.50E+06	2.90E+09	3.23E+06	1.52E+06	2.96E+06	1.81E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Brushland/Rangeland	1.71E+07	0.00E+00	1.17E+07	1.54E+06	4.00E+06	1.20E+07	0.00E+00	1.69E+05	0.00E+00	9.62E+04	5.44E+05	0.00E+00	0.00E+00	1.99E+06
Forest	8.80E+07	2.21E+06	1.72E+07	1.00E+07	3.06E+07	5.89E+07	1.61E+07	5.06E+06	2.39E+06	1.93E+07	5.24E+06	1.72E+06	0.00E+00	1.72E+07
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+05	2.97E+05	5.34E+05	2.92E+05	2.43E+04	6.74E+04	2.75E+05
Barren	2.15E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E+07	2.88E+06	0.00E+00	2.67E+06	0.00E+00	7.28E+06	1.30E+06	0.00E+00	4.13E+06
Residential	6.08E+08	4.20E+07	3.66E+08	1.10E+09	2.83E+09	1.14E+10	1.58E+09	3.53E+08	3.69E+08	1.89E+09	5.73E+09	1.92E+09	3.67E+08	5.76E+09
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.66E+07	1.12E+07	3.50E+06	5.82E+07	8.18E+07	1.40E+06	2.36E+08
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E+07	8.91E+08	4.24E+07	7.54E+07	3.29E+08	1.19E+06	2.18E+09	6.91E+08	4.09E+06	4.54E+08
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.77E+07	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+08	1.88E+08	0.00E+00	4.50E+06	0.00E+00	1.22E+08	8.49E+07	0.00E+00	1.48E+07
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	1.40E+07	5.52E+07	2.99E+07	6.37E+07	3.65E+07	0.00E+00	7.69E+04	0.00E+00	2.93E+08	7.17E+06	2.04E+07	3.77E+07
Transportation/Communications	1.96E+06	0.00E+00	0.00E+00	0.00E+00	1.40E+08	5.41E+08	2.33E+08	2.79E+07	2.71E+07	1.12E+06	4.95E+07	9.65E+07	2.19E+07	8.37E+06
Utilities	0.00E+00	0.00E+00	0.00E+00	7.96E+06	3.90E+07	2.75E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Land Use	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	0.00E+00	0.00E+00	0.00E+00	4.74E+04	0.00E+00	5.37E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	3.02E+11	2.51E+09	5.46E+10	3.23E+09	5.20E+11	1.69E+11	2.01E+10	2.27E+11	3.08E+10	3.37E+11	1.18E+11	1.90E+09	8.92E+11	4.91E+10
Pastures/CAFOs	1.33E+07	0.00E+00	0.00E+00	0.00E+00	5.17E+07	2.37E+06	0.00E+00	5.33E+06	0.00E+00	1.29E+07	7.50E+06	0.00E+00	9.51E+06	5.32E+05
Brushland/Rangeland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E+06	1.54E+07	3.11E+06	5.97E+06	2.10E+06	2.63E+07	0.00E+00
Forest	2.61E+07	1.88E+06	7.62E+06	4.39E+06	2.15E+07	2.12E+07	1.68E+07	2.18E+07	3.28E+07	5.52E+07	1.43E+07	2.41E+06	8.04E+07	1.48E+06
Wetland	1.47E+06	7.57E+04	1.77E+05	9.49E+04	0.00E+00	3.40E+05	4.07E+05	2.31E+06	2.05E+06	1.55E+06	1.30E+06	5.16E+04	9.90E+06	1.60E+05
Barren	1.50E+06	0.00E+00	0.00E+00	0.00E+00	1.20E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.77E+06	0.00E+00	0.00E+00	0.00E+00
Residential	1.23E+09	1.22E+08	5.52E+08	1.30E+08	3.94E+08	1.40E+09	1.31E+09	1.19E+09	9.16E+08	1.62E+09	8.91E+08	2.79E+08	2.87E+09	1.36E+08
Water	2.27E+07	0.00E+00	1.28E+08	2.61E+06	0.00E+00	1.28E+08	4.98E+06	0.00E+00	4.98E+06	1.37E+07	4.33E+07	0.00E+00	1.48E+07	6.19E+06
Commercial	1.32E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E+06	4.07E+07	9.82E+07	0.00E+00	4.24E+07	0.00E+00	0.00E+00	3.19E+06	0.00E+00
Industrial	7.32E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E+07	1.51E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+06	0.00E+00	0.00E+00	0.00E+00	3.88E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	6.58E+06	0.00E+00	0.00E+00	0.00E+00	2.79E+07	0.00E+00	0.00E+00	6.04E+07	3.93E+07	1.93E+07	7.77E+06	0.00E+00	1.42E+07	0.00E+00

Percent Reduction Enterococcus Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	80%	-	-	-	-	80%	80%	-	-	-	80%	-	-	-	-	-	-	80%	-	80%	-	-	-	-	-	-	-	-
Agriculture	87%	87%	87%	88%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%
Pastures/CAFOs	87%	87%	87%	88%	87%	87%	87%	87%	87%	87%	-	-	-	-	87%	-	-	-	87%	87%	-	87%	-	87%	87%	-	87%	87%
Brushland/Rangeland	80%	-	80%	80%	80%	80%	-	80%	-	80%	80%	-	-	80%	-	-	-	-	-	-	-	80%	80%	80%	80%	80%	80%	-
Forest	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	-	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Wetland	-	-	-	-	-	-	-	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	-	80%	80%	80%	80%	80%	80%	80%	80%	80%
Barren	80%	-	-	-	-	80%	80%	-	80%	-	80%	80%	-	80%	80%	-	-	-	80%	-	-	-	-	-	80%	-	-	-
Residential	87%	87%	87%	88%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%
Water	-	-	-	-	-	-	-	80%	80%	80%	80%	80%	80%	80%	80%	-	80%	80%	-	80%	80%	-	80%	80%	80%	-	80%	80%
Commercial	-	-	-	-	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	-	-	-	-	80%	80%	80%	-	80%	-	-	80%	-
Industrial	-	-	-	-	-	-	-	-	-	-	80%	-	-	-	80%	-	-	-	-	-	-	80%	-	-	-	-	-	-
Institutional/Government	-	-	-	-	-	80%	80%	-	80%	-	80%	80%	-	80%	-	-	-	-	-	-	80%	80%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	80%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	80%	80%	80%	80%	80%	-	80%	-	80%	80%	80%	80%	-	-	-	-	-	80%	-	-	-	80%	-	-	-	-
Transportation/Communications	80%	-	-	-	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	-	-	-	80%	80%	80%	-	-	-	-	-	-	-	-	80%	-	-	-	80%	-	-	80%	80%	80%	80%	-	80%	-

TMDL Enterococcus (#/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Recreation	8.50E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.26E+06	4.63E+05	0.00E+00	0.00E+00	0.00E+00	1.66E+06	0.00E+00	0.00E+00	0.00E+00
Agriculture	3.08E+09	4.41E+08	1.63E+10	2.97E+10	9.09E+10	1.62E+11	1.73E+10	1.04E+10	7.76E+09	4.32E+09	9.93E+08	9.52E+08	4.14E+07	3.47E+09
Pastures/CAFOs	1.09E+06	4.24E+06	3.91E+05	3.50E+06	9.75E+05	3.77E+08	4.20E+05	1.98E+05	3.85E+05	2.36E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Brushland/Rangeland	3.42E+06	0.00E+00	2.34E+06	3.09E+05	8.00E+05	2.41E+06	0.00E+00	3.37E+04	0.00E+00	1.92E+04	1.09E+05	0.00E+00	0.00E+00	3.97E+05
Forest	1.76E+07	4.42E+05	3.44E+06	2.01E+06	6.12E+06	1.18E+07	3.23E+06	1.01E+06	4.78E+05	3.85E+06	1.05E+06	3.45E+05	0.00E+00	3.44E+06
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.69E+04	5.95E+04	1.07E+05	5.84E+04	4.85E+03	1.35E+04	5.51E+04
Barren	4.30E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+07	5.76E+05	0.00E+00	5.35E+05	0.00E+00	1.46E+06	2.59E+05	0.00E+00	8.25E+05
Residential	7.90E+07	5.47E+06	4.76E+07	1.42E+08	3.67E+08	1.48E+09	2.06E+08	4.59E+07	4.79E+07	2.46E+08	7.44E+08	2.49E+08	4.77E+07	7.48E+08
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E+06	2.25E+06	7.01E+05	1.16E+07	1.64E+07	2.79E+05	4.73E+07
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E+07	1.78E+08	8.48E+06	1.51E+07	6.58E+07	2.38E+05	4.37E+08	1.38E+08	8.17E+05	9.08E+07
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E+07	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.27E+07	3.75E+07	0.00E+00	9.00E+05	0.00E+00	2.45E+07	1.70E+07	0.00E+00	2.96E+06
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	2.81E+06	1.10E+07	5.98E+06	1.27E+07	7.30E+06	0.00E+00	1.54E+04	0.00E+00	5.86E+07	1.43E+06	4.08E+06	7.54E+06
Transportation/Communications	3.92E+05	0.00E+00	0.00E+00	0.00E+00	2.80E+07	1.08E+08	4.66E+07	5.58E+06	5.42E+06	2.24E+05	9.89E+06	1.93E+07	4.39E+06	1.67E+06
Utilities	0.00E+00	0.00E+00	0.00E+00	1.59E+06	7.80E+06	5.51E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Land Use	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	0.00E+00	0.00E+00	0.00E+00	9.48E+03	0.00E+00	1.07E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	3.93E+10	3.27E+08	7.10E+09	4.20E+08	6.76E+10	2.19E+10	2.61E+09	2.95E+10	4.01E+09	4.38E+10	1.53E+10	2.46E+08	1.16E+11	6.39E+09
Pastures/CAFOs	1.73E+06	0.00E+00	0.00E+00	0.00E+00	6.72E+06	3.08E+05	0.00E+00	6.93E+05	0.00E+00	1.67E+06	9.75E+05	0.00E+00	1.24E+06	6.91E+04
Brushland/Rangeland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.44E+05	3.08E+06	6.22E+05	1.19E+06	4.20E+05	5.26E+06	0.00E+00
Forest	5.22E+06	3.75E+05	1.52E+06	8.77E+05	4.30E+06	4.24E+06	3.36E+06	4.35E+06	6.56E+06	1.10E+07	2.86E+06	4.83E+05	1.61E+07	2.97E+05
Wetland	2.94E+05	1.51E+04	3.54E+04	1.90E+04	0.00E+00	6.80E+04	8.15E+04	4.62E+05	4.10E+05	3.11E+05	2.60E+05	1.03E+04	1.98E+06	3.19E+04
Barren	2.99E+05	0.00E+00	0.00E+00	0.00E+00	2.40E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.54E+05	0.00E+00	0.00E+00	0.00E+00
Residential	1.59E+08	1.58E+07	7.18E+07	1.69E+07	5.12E+07	1.81E+08	1.70E+08	1.55E+08	1.19E+08	2.11E+08	1.16E+08	3.63E+07	3.74E+08	1.77E+07
Water	4.54E+06	0.00E+00	2.56E+07	5.23E+05	0.00E+00	2.57E+07	9.95E+05	0.00E+00	9.95E+05	2.75E+06	8.66E+06	0.00E+00	2.96E+06	1.24E+06
Commercial	2.63E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+06	8.13E+06	1.96E+07	0.00E+00	8.48E+06	0.00E+00	0.00E+00	6.38E+05	0.00E+00
Industrial	1.46E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.05E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.15E+06	3.02E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E+05	0.00E+00	0.00E+00	0.00E+00	7.77E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	1.32E+06	0.00E+00	0.00E+00	0.00E+00	5.58E+06	0.00E+00	0.00E+00	1.21E+07	7.86E+06	3.87E+06	1.55E+06	0.00E+00	2.83E+06	0.00E+00

Existing BOD (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Recreation	5.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.29E+00	3.28E-01	0.00E+00	0.00E+00	0.00E+00	1.00E+00	0.00E+00	0.00E+00
Agriculture	2.97E+01	6.18E+01	4.25E+00	1.49E+01	2.72E+01	8.31E+01	1.47E+02	1.58E+01	9.51E+00	7.10E+00	4.16E+01	9.58E+00	9.18E+00	3.99E-01
Pastures/CAFOs	1.54E+00	1.01E+01	5.98E+00	5.85E-01	5.24E+00	1.46E+00	4.17E+00	6.29E-01	2.96E-01	5.77E-01	3.33E+00	0.00E+00	0.00E+00	0.00E+00
Brushland/Rangeland	1.57E+00	0.00E+00	0.00E+00	1.24E+00	1.64E-01	4.24E-01	1.25E+00	0.00E+00	1.79E-02	0.00E+00	8.83E-03	5.00E-02	0.00E+00	0.00E+00
Forest	1.85E+01	4.53E+00	4.65E-01	3.63E+00	2.12E+00	6.45E+00	1.24E+01	3.40E+00	1.07E+00	5.04E-01	4.06E+00	1.10E+00	3.63E-01	0.00E+00
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.52E-02	1.53E-01	9.17E-01	5.01E-01	4.17E-02	1.16E-01
Barren	1.24E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E+00	2.46E-01	0.00E+00	2.28E-01	0.00E+00	4.21E-01	7.48E-02	0.00E+00
Residential	2.62E+00	1.94E+00	1.81E-01	1.81E+00	5.41E+00	1.40E+01	4.92E+01	7.82E+00	1.74E+00	1.82E+00	8.16E+00	2.47E+01	8.27E+00	1.58E+00
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.12E-01	1.27E-01	4.92E-02	8.16E-01	1.15E+00	1.96E-02
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	2.63E+01	1.48E+00	2.64E+00	1.15E+01	3.09E-02	5.68E+01	1.80E+01	1.06E-01
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.32E+00	6.55E+00	0.00E+00	1.57E-01	0.00E+00	4.11E+00	2.85E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.26E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	4.91E-01	1.93E+00	1.05E+00	2.43E+00	1.28E+00	0.00E+00	2.69E-03	0.00E+00	9.84E+00	2.41E-01	6.84E-01
Transportation/Communications	6.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.90E+00	2.06E+01	8.14E+00	9.76E-01	9.48E-01	3.76E-02	1.66E+00	3.24E+00	7.37E-01
Utilities	0.00E+00	9.76E-01	0.00E+00	0.00E+00	2.78E-01	1.36E+00	1.05E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Land Use	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.72E-03	7.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	3.34E+01	3.59E+01	3.15E+00	6.49E+00	4.05E+00	2.01E+01	2.52E+01	2.70E+01	3.86E+01	4.00E+01	1.40E+01	2.38E+00	1.06E+02	5.84E+00
Pastures/CAFOs	0.00E+00	2.59E+00	0.00E+00	0.00E+00	0.00E+00	4.62E-01	0.00E+00	1.04E+00	0.00E+00	2.51E+00	1.46E+00	0.00E+00	1.85E+00	1.04E-01
Brushland/Rangeland	1.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-01	1.42E+00	3.30E-01	6.33E-01	1.93E-01	2.79E+00	0.00E+00
Forest	3.63E+00	5.50E+00	3.96E-01	1.61E+00	9.24E-01	4.47E+00	3.55E+00	4.59E+00	6.92E+00	1.16E+01	3.02E+00	5.09E-01	1.70E+01	3.13E-01
Wetland	4.73E-01	7.58E-01	1.30E-01	9.14E-02	1.63E-01	1.76E-01	7.00E-01	1.19E+00	3.52E+00	8.02E-01	6.71E-01	8.87E-02	5.11E+00	8.23E-02
Barren	2.38E-01	1.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-01	0.00E+00	0.00E+00	0.00E+00
Residential	2.48E+01	6.05E+00	5.24E-01	2.73E+00	5.62E-01	6.89E+00	5.63E+00	5.88E+00	3.95E+00	8.01E+00	4.40E+00	1.20E+00	1.42E+01	6.72E-01
Water	3.32E+00	2.56E-01	0.00E+00	1.44E+00	3.67E-02	1.45E+00	6.98E-02	0.00E+00	6.98E-02	1.55E-01	4.88E-01	0.00E+00	1.67E-01	6.98E-02
Commercial	1.18E+01	4.60E-01	0.00E+00	0.00E+00	0.00E+00	2.11E-01	1.06E+00	3.43E+00	0.00E+00	1.48E+00	0.00E+00	0.00E+00	1.12E-01	0.00E+00
Industrial	0.00E+00	2.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	4.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.28E-01	5.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	1.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-02	0.00E+00	0.00E+00	0.00E+00	1.36E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	2.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	2.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E+00	1.32E+00	6.76E-01	2.72E-01	0.00E+00	4.95E-01	0.00E+00

Percent Reduction BOD Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	57%	-	-	-	-	-	57%	57%	-	-	-	57%	-	-	-	-	-	-	57%	57%	-	-	-	-	-	-	-	-
Agriculture	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Pastures/CAFOs	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	57%	-	57%	57%	-	57%	57%
Brushland/Rangeland	0%	-	-	0%	0%	0%	0%	-	0%	-	0%	0%	-	-	0%	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	-
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	-	-	-	-	0%	0%	-	0%	-	0%	0%	-	0%	0%	-	-	-	-	-	-	-	-	0%	-	-	-
Residential	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Water	-	-	-	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	-	57%	57%	57%	57%	-	57%	57%	57%	-	57%	57%
Commercial	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	57%	57%	57%	-	57%	-	-	57%	-
Industrial	-	-	-	-	-	-	-	-	-	-	-	57%	-	-	-	57%	-	-	-	-	-	57%	-	-	-	-	-	-
Institutional/Government	-	-	-	-	-	-	57%	57%	-	57%	-	57%	57%	-	57%	-	-	-	-	-	57%	57%	-	-	-	-	-	-

Mixed Urban/Built-Up	-	-	-	-	-	57%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	88%	57%	57%	57%	57%	-	57%	-	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	-	-	-
Transportation/Communications	57%	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	-	57%	-	-	57%	57%	57%	-	-	-	-	-	-	-	-	57%	-	-	-	-	-	57%	57%	57%	57%	-	57%	-

TMDL BOD (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	2.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+00	1.41E-01	0.00E+00	0.00E+00	0.00E+00	4.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.46E-03	3.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	1.28E+01	2.66E+01	1.83E+00	1.86E+00	1.17E+01	3.57E+01	6.33E+01	6.79E+00	4.09E+00	3.05E+00	1.79E+01	4.12E+00	3.95E+00	1.71E-01	1.44E+01	1.55E+01	1.36E+00	2.79E+00	1.74E+00	8.63E+00	1.08E+01	1.16E+01	1.66E+01	1.72E+01	6.03E+00	1.02E+00	4.56E+01	2.51E+00
Pastures/CAFOs	6.62E-01	4.32E+00	2.57E+00	7.31E-02	2.25E+00	6.28E-01	1.79E+00	2.71E-01	1.27E-01	2.48E-01	1.43E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-01	0.00E+00	4.46E-01	0.00E+00	1.08E+00	6.28E-01	0.00E+00	7.96E-01	4.45E-02
Brushland/Rangeland	1.57E+00	0.00E+00	0.00E+00	1.24E+00	1.64E-01	4.24E-01	1.25E+00	0.00E+00	1.79E-02	0.00E+00	8.83E-03	5.00E-02	0.00E+00	0.00E+00	1.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-01	1.42E+00	3.30E-01	6.33E-01	1.93E-01	2.79E+00	0.00E+00
Forest	1.85E+01	4.53E+00	4.65E-01	3.63E+00	2.12E+00	6.45E+00	1.24E+01	3.40E+00	1.07E+00	5.04E-01	4.06E+00	1.10E+00	3.63E-01	0.00E+00	3.63E+00	5.50E+00	3.96E-01	1.61E+00	9.24E-01	4.47E+00	3.55E+00	4.59E+00	6.92E+00	1.16E+01	3.02E+00	5.09E-01	1.70E+01	3.13E-01
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.52E-02	1.53E-01	9.17E-01	5.01E-01	4.17E-02	1.16E-01	4.73E-01	7.58E-01	1.30E-01	9.14E-02	1.63E-01	1.76E-01	7.00E-01	1.19E+00	3.52E+00	8.02E-01	6.71E-01	8.87E-02	5.11E+00	8.23E-02
Barren	1.24E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E+00	2.46E-01	0.00E+00	2.28E-01	0.00E+00	4.21E-01	7.48E-02	0.00E+00	2.38E-01	1.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-01	0.00E+00	0.00E+00	0.00E+00
Residential	1.13E+00	8.36E-01	7.79E-02	2.26E-01	2.33E+00	6.00E+00	2.11E+01	3.36E+00	7.50E-01	7.83E-01	3.51E+00	1.06E+01	3.56E+00	6.81E-01	1.07E+01	2.60E+00	2.25E-01	1.17E+00	2.42E-01	2.96E+00	2.42E+00	2.53E+00	1.70E+00	3.45E+00	1.89E+00	5.17E-01	6.10E+00	2.89E-01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-01	5.45E-02	2.11E-02	3.51E-01	4.94E-01	8.42E-03	1.43E+00	1.10E-01	0.00E+00	6.20E-01	1.58E-02	6.22E-01	3.00E-02	0.00E+00	3.00E-02	6.66E-02	2.10E-01	0.00E+00	7.18E-02	3.00E-02
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E+00	1.13E+01	6.37E-01	1.13E+00	4.94E+00	1.33E-02	2.44E+01	7.72E+00	4.57E-02	5.07E+00	1.98E-01	0.00E+00	0.00E+00	0.00E+00	9.07E-02	4.54E-01	1.48E+00	0.00E+00	6.37E-01	0.00E+00	0.00E+00	4.80E-02	0.00E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.54E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E+00	2.82E+00	0.00E+00	6.76E-02	0.00E+00	1.77E+00	1.23E+00	0.00E+00	2.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.27E-01	2.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	6.13E-02	8.29E-01	4.50E-01	1.04E+00	5.48E-01	0.00E+00	1.16E-03	0.00E+00	4.23E+00	1.03E-01	2.94E-01	5.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	5.84E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	2.83E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E+00	8.86E+00	3.50E+00	4.20E-01	4.07E-01	1.62E-02	7.14E-01	1.39E+00	3.17E-01	1.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	4.20E-01	0.00E+00	0.00E+00	1.20E-01	5.86E-01	4.51E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-01	5.68E-01	2.91E-01	1.17E-01	0.00E+00	2.13E-01	0.00E+00

Existing TN (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	2.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	1.89E-01	0.00E+00	0.00E+00	0.00E+00	5.79E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E-03	4.38E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	5.29E+01	1.10E+02	7.57E+00	2.65E+01	4.84E+01	1.48E+02	2.62E+02	2.81E+01	1.69E+01	1.26E+01	7.41E+01	1.71E+01	1.63E+01	7.10E-01	5.96E+01	6.40E+01	5.61E+00	1.16E+01	7.22E+00	3.58E+01	4.48E+01	4.80E+01	6.88E+01	7.13E+01	2.50E+01	4.23E+00	1.89E+02	1.04E+01
Pastures/CAFOs	3.99E-01	2.61E+00	1.55E+00	1.52E-01	1.36E+00	3.79E-01	1.08E+00	1.63E-01	7.69E-02	1.50E-01	8.63E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.73E-01	0.00E+00	0.00E+00	0.00E+00	1.20E-01	0.00E+00	2.69E-01	0.00E+00	6.50E-01	3.79E-01	0.00E+00	4.80E-01	2.69E-02
Brushland/Rangeland	3.86E-01	0.00E+00	0.00E+00	3.06E-01	4.03E-02	1.04E-01	3.08E-01	0.00E+00	4.40E-03	0.00E+00	2.17E-03	1.23E-02	0.00E+00	0.00E+00	4.49E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-02	3.48E-01	8.11E-02	1.56E-01	4.74E-02	6.85E-01	0.00E+00
Forest	4.92E+00	1.20E+00	1.23E-01	9.62E-01	5.61E-01	1.71E+00	3.29E+00	9.01E-01	2.83E-01	1.34E-01	1.08E+00	2.93E-01	9.63E-02	0.00E+00	9.62E-01	1.46E+00	1.05E-01	4.26E-01	2.45E-01	1.18E+00	9.40E-01	1.22E+00	1.83E+00	3.09E+00	8.00E-01	1.35E-01	4.50E+00	8.30E-02
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-02	5.88E-02	3.52E-01	1.92E-01	1.60E-02	4.44E-02	1.81E-01	2.91E-01	4.98E-02	3.51E-02	6.25E-02	6.73E-02	2.68E-01	4.58E-01	1.35E+00	3.07E-01	2.57E-01	3.40E-02	1.96E+00	3.16E-02
Barren	8.47E-01	6.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E+00	1.68E-01	0.00E+00	1.56E-01	0.00E+00	2.87E-01	5.10E-02	0.00E+00	1.62E-01	8.71E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-01	0.00E+00	0.00E+00	0.00E+00
Residential	1.16E+00	8.63E-01	8.04E-02	8.02E-01	2.40E+00	6.20E+00	2.18E+01	3.47E+00	7.74E-01	8.08E-01	3.62E+00	1.10E+01	3.67E+00	7.02E-01	1.10E+01	2.69E+00	2.33E-01	1.21E+00	2.49E-01	3.06E+00	2.50E+00	2.61E+00	1.75E+00	3.56E+00	1.95E+00	5.34E-01	6.30E+00	2.98E-01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.12E-02	1.27E-02	4.92E-03	8.16E-02	1.15E-01	1.96E-03	3.32E-01	2.56E-02	0.00E+00	1.44E-01	3.67E-03	1.45E-01	6.98E-03	0.00E+00	6.98E-03	1.55E-02	4.88E-02	0.00E+00	1.67E-02	6.98E-03
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+00	1.04E+01	5.85E-01	1.04E+00	4.53E+00	1.22E-02	2.24E+01	7.08E+00	4.19E-02	4.66E+00	1.81E-01	0.00E+00	0.00E+00	0.00E+00	8.32E-02	4.17E-01	1.35E+00	0.00E+00	5.84E-01	0.00E+00	0.00E+00	4.40E-02	0.00E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.17E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+00	2.58E+00	0.00E+00	6.20E-02	0.00E+00	1.62E+00	1.12E+00	0.00E+00	1.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-01	2.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	1.94E-01	7.60E-01	4.12E-01	9.57E-01	5.03E-01	0.00E+00	1.06E-03	0.00E+00	3.88E+00	9.49E-02	2.70E-01	4.99E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-02	0.00E+00	0.00E+00	0.00E+00	5.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	2.60E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E+00	8.12E+00	3.21E+00	3.85E-01	3.74E-01	1.48E-02	6.55E-01	1.28E+00	2.91E-01	1.11E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	3.85E-01	0.00E+00	0.00E+00	1.10E-01	5.38E-01	4.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.07E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.33E-01	5.21E-01	2.67E-01	1.07E-01	0.00E+00	1.95E-01	0.00E+00

Percent Reduction TN Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	57%	-	-	-	-	-	57%	57%	-	-	-	57%	-	-	-	-	-	-	57%	57%	-	-	-	-	-	-	-	-
Agriculture	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Pastures/CAFOs	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	57%	-	57%	57%	-	57%	57%
Brushland/Rangeland	0%	-	-	0%	0%	0%	0%	-	0%	-	0%	0%	-	-	0%	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	-
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	-	-	-	-	0%	0%	-	0%	-	0%	0%	-	0%	0%	-	-	-	-	-	-	-	-	0%	-	-	-
Residential	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Water	-	-	-	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	-	57%	57%	57%	57%	-	57%	57%	57%	-	57%	57%
Commercial	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	57%	57%	57%	-	57%	-	-	57%	-
Industrial	-	-	-	-	-	-	-	-	-	-	-	57%	-	-	-	57%	-	-	-	-	-	57%	-	-	-	-	-	-
Institutional/Government	-	-	-	-	-	-	57%	57%	-	57%	-	57%	57%	-	57%	-	-	-	-	-	57%	57%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	57%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	88%	57%	57%	57%	57%	-	57%	-	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	-	-	-
Transportation/Communications	57%	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	-	57%	-	-	57%	57%	57%	-	-	-	-	-	-	-	-	57%	-	-	-	-	-	57%	57%	57%	57%	-	57%	-

TMDL TN (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	1.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+00	8.14E-02	0.00E+00	0.00E+00	0.00E+00	2.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-03	1.89E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	2.27E+01	4.73E+01	3.26E+00	3.31E+00	2.08E+01	6.37E+01	1.13E+02	1.21E+01	7.28E+00	5.44E+00	3.19E+01	7.34E+00	7.03E+00	3.05E-01	2.56E+01	2.75E+01	2.41E+00	4.97E+00	3.10E+00	1.54E+01	1.93E+01	2.06E+01	2.96E+01	3.07E+01	1.07E+01	1.82E+00	8.12E+01	4.47E+00
Pastures/CAFOs	1.72E-01	1.12E+00	6.67E-01	1.90E-02	5.84E-01	1.63E-01	4.65E-01	7.02E-02	3.31E-02	6.43E-02	3.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E-01	0.00E+00	0.00E+00	0.00E+00	5.15E-02	0.00E+00	1.16E-01	0.00E+00	2.80E-01	1.63E-01	0.00E+00	2.06E-01	1.15E-02
Brushland/Rangeland	3.86E-01	0.00E+00	0.00E+00	3.06E-01	4.03E-02	1.04E-01	3.08E-01	0.00E+00	4.40E-03	0.00E+00	2.17E-03	1.23E-02	0.00E+00	0.00E+00	4.49E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-02	3.48E-01	8.11E-02	1.56E-01	4.74E-02	6.85E-01	0.00E+00
Forest	4.92E+00	1.20E+00	1.23E-01	9.62E-01	5.61E-01	1.71E+00	3.29E+00	9.01E-01	2.83E-01	1.34E-01	1.08E+00	2.93E-01	9.63E-02	0.00E+00	9.62E-01	1.46E+00	1.05E-01	4.26E-01	2.45E-01	1.18E+00	9.40E-01	1.22E+00	1.83E+00	3.09E+00	8.00E-01	1.35E-01	4.50E+00	8.30E-02
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-02	5.88E-02	3.52E-01	1.92E-01	1.60E-02	4.44E-02	1.81E-01	2.91E-01	4.98E-02	3.51E-02	6.25E-02	6.73E-02	2.68E-01	4.58E-01	1.35E+00	3.07E-01	2.57E-01	3.40E-02	1.96E+00	3.16E-02
Barren	8.47E-01	6.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E+00	1.68E-01	0.00E+00	1.56E-01	0.00E+00	2.87E-01	5.10E-02	0.00E+00	1.62E-01	8.71E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-01	0.00E+00	0.00E+00	0.00E+00
Residential	5.00E-01	3.71E-01	3.46E-02	1.00E-01	1.03E+00	2.66E+00	9.38E+00	1.49E+00	3.33E-01	3.47E-01	1.56E+00	4.71E+00	1.58E+00	3.02E-01	4.73E+00	1.15E+00	1.00E-01	5.20E-01	1.07E-01	1.32E+00	1.07E+00	1.12E+00	7.53E-01	1.53E+00	8.39E-01	2.29E-01	2.71E+00	1.28E-01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-02	5.45E-03	2.11E-03	3.51E-02	4.94E-02	8.42E-04	1.43E-01	1.10E-02	0.00E+00	6.20E-02	1.58E-03	6.22E-02	3.00E-03	0.00E+00	3.00E-03	6.66E-03	2.10E-02	0.00E+00	7.18E-03	3.00E-03
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-01	4.46E+00	2.51E-01	4.47E-01	1.95E+00	5.24E-03	9.63E+00	3.05E+00	1.80E-02	2.00E+00	7.80E-02	0.00E+00	0.00E+00	0.00E+00	3.58E-02	1.79E-01	5.82E-01	0.00E+00	2.51E-01	0.00E+00	0.00E+00	1.89E-02	0.00E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.56E-01	0.00E+00	0.00E+00	0.00E+00	4.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.79E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.32E-01	1.11E+00	0.00E+00	2.67E-02	0.00E+00	6.97E-01	4.84E-01	0.00E+00	8.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.96E-02	8.96E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	2.42E-02	3.27E-01	1.77E-01	4.12E-01	2.16E-01	0.00E+00	4.56E-04	0.00E+00	1.67E+00	4.08E-02	1.16E-01	2.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.16E-03	0.00E+00	0.00E+00	0.00E+00	2.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	1.12E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.31E-01	3.49E+00	1.38E+00	1.66E-01	1.61E-01	6.38E-03	2.82E-01	5.49E-01	1.25E-01	4.76E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	1.66E-01	0.00E+00	0.00E+00	4.72E-02	2.31E-01	1.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-01	2.24E-01	1.15E-01	4.61E-02	0.00E+00	8.39E-02	0.00E+00

Existing TP (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	1.23E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-01	7.86E-03	0.00E+00	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-04	1.82E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	6.35E-01	1.32E+00	9.10E-02	3.18E-01	5.82E-01	1.78E+00	3.15E+00	3.38E-01	2.04E-01	1.52E-01	8.91E-01	2.05E-01	1.96E-01	8.54E-03	7.16E-01	7.69E-01	6.75E-02	1.39E-01	8.67E-02	4.30E-01	5.39E-01	5.77E-01	8.27E-01	8.57E-01	3.00E-01	5.08E-02	2.27E+00	1.25E-01
Pastures/CAFOs	2.38E-02	1.56E-01	9.25E-02	9.04E-03	8.10E-02	2.26E-02	6.44E-02	9.73E-03	4.58E-03	8.92E-03	5.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-02	0.00E+00	0.00E+00	0.00E+00	7.14E-03	0.00E+00	1.60E-02	0.00E+00	3.88E-02	2.26E-02	0.00E+00	2.86E-02	1.60E-03
Brushland/Rangeland	2.10E-02	0.00E+00	0.00E+00	1.66E-02	2.19E-03	5.68E-03	1.68E-02	0.00E+00	2.40E-04	0.00E+00	1.18E-04	6.69E-04	0.00E+00	0.00E+00	2.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-03	1.90E-02	4.42E-03	8.48E-03	2.58E-03	3.73E-02	0.00E+00
Forest	2.73E-01	6.67E-02	6.85E-03	5.34E-02	3.11E-02	9.50E-02	1.83E-01	5.01E-02	1.57E-02	7.41E-03	5.98E-02	1.63E-02	5.35E-03	0.00E+00	5.34E-02	8.10E-02	5.82E-03	2.36E-02	1.36E-02	6.58E-02	5.22E-02	6.76E-02	1.02E-01	1.71E-01	4.44E-02	7.49E-03	2.50E-01	4.61E-03
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-03	3.40E-03	2.03E-02	1.11E-02	9.23E-04	2.56E-03	1.05E-02	1.68E-02	2.88E-03	2.02E-03	3.61E-03	3.89E-03	1.55E-02	2.64E-02	7.79E-02	1.78E-02	1.48E-02	1.96E-03	1.13E-01	1.82E-03
Barren	3.13E-02	2.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.66E-02	6.21E-03	0.00E+00	5.76E-03	0.00E+00	1.06E-02	1.89E-03	0.00E+00	6.01E-03	3.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.12E-03	0.00E+00	0.00E+00	0.00E+00
Residential	5.10E-02	3.78E-02	3.53E-03	3.52E-02	1.05E-01	2.72E-01	9.56E-01	1.52E-01	3.39E-02	3.54E-02	1.59E-01	4.80E-01	1.61E-01	3.08E-02	4.83E-01	1.18E-01	1.02E-02	5.30E-02	1.09E-02	1.34E-01	1.09E-01	1.14E-01	7.68E-02	1.56E-01	8.56E-02	2.34E-02	2.76E-01	1.31E-02
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.12E-03	1.27E-03	4.92E-04	8.16E-03	1.15E-02	1.96E-04	3.32E-02	2.56E-03	0.00E+00	1.44E-02	3.67E-04	1.45E-02	6.98E-04	0.00E+00	6.98E-04	1.55E-03	4.88E-03	0.00E+00	1.67E-03	6.98E-04

Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.84E-02	2.82E-01	1.59E-02	2.83E-02	1.23E-01	3.32E-04	6.09E-01	1.93E-01	1.14E-03	1.27E-01	4.94E-03	0.00E+00	0.00E+00	0.00E+00	2.27E-03	1.13E-02	3.69E-02	0.00E+00	1.59E-02	0.00E+00	0.00E+00	1.20E-03	0.00E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.52E-02	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.63E-02	7.03E-02	0.00E+00	1.69E-03	0.00E+00	4.41E-02	3.06E-02	0.00E+00	5.32E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.67E-03	5.67E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	5.27E-03	2.07E-02	1.12E-02	2.60E-02	1.37E-02	0.00E+00	2.89E-05	0.00E+00	1.06E-01	2.58E-03	7.35E-03	1.36E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E-04	0.00E+00	0.00E+00	0.00E+00	1.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	7.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-02	2.21E-01	8.74E-02	1.05E-02	1.02E-02	4.04E-04	1.78E-02	3.48E-02	7.91E-03	3.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	1.05E-02	0.00E+00	0.00E+00	2.99E-03	1.46E-02	1.13E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.27E-02	1.42E-02	7.26E-03	2.91E-03	0.00E+00	5.31E-03	0.00E+00

Percent Reduction TP Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	57%	-	-	-	-	-	57%	57%	-	-	-	57%	-	-	-	-	-	-	57%	57%	-	-	-	-	-	-	-	-
Agriculture	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Pastures/CAFOs	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	57%	-	57%	57%	-	57%	57%
Brushland/Rangeland	0%	-	-	0%	0%	0%	0%	-	0%	-	0%	0%	-	-	0%	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	-
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	-	-	-	-	0%	0%	-	0%	-	0%	0%	-	0%	0%	-	-	-	-	-	-	-	-	0%	-	-	-
Residential	57%	57%	57%	88%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
Water	-	-	-	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	-	57%	57%	57%	57%	-	57%	57%	57%	-	57%	57%
Commercial	-	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	57%	57%	57%	-	57%	-	-	57%	-
Industrial	-	-	-	-	-	-	-	-	-	-	-	57%	-	-	-	57%	-	-	-	-	-	57%	-	-	-	-	-	-
Institutional/Government	-	-	-	-	-	-	57%	57%	-	57%	-	57%	57%	-	57%	-	-	-	-	-	57%	57%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	57%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	88%	57%	57%	57%	57%	-	57%	-	57%	57%	57%	57%	-	-	-	-	57%	-	-	-	57%	-	-	-	-
Transportation/Communications	57%	-	-	-	-	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	-	57%	-	-	57%	57%	57%	-	-	-	-	-	-	-	-	57%	-	-	-	-	-	57%	57%	57%	57%	-	57%	-

TMDL TP (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Recreation	5.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-02	3.38E-03	0.00E+00	0.00E+00	0.00E+00	1.03E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.89E-05	7.84E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	2.73E-01	5.69E-01	3.91E-02	3.97E-02	2.50E-01	7.65E-01	1.35E+00	1.45E-01	8.76E-02	6.53E-02	3.83E-01	8.82E-02	8.45E-02	3.67E-03	3.08E-01	3.31E-01	2.90E-02	5.98E-02	3.73E-02	1.85E-01	2.32E-01	2.48E-01	3.56E-01	3.69E-01	1.29E-01	2.19E-02	9.76E-01	5.38E-02
Pastures/CAFOs	1.02E-02	6.70E-02	3.98E-02	1.14E-03	3.49E-02	9.72E-03	2.77E-02	4.19E-03	1.97E-03	3.84E-03	2.22E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-02	0.00E+00	0.00E+00	0.00E+00	3.08E-03	0.00E+00	6.91E-03	0.00E+00	1.67E-02	9.72E-03	0.00E+00	1.23E-02	6.90E-04
Brushland/Rangeland	2.10E-02	0.00E+00	0.00E+00	1.66E-02	2.19E-03	5.68E-03	1.68E-02	0.00E+00	2.40E-04	0.00E+00	1.18E-04	6.69E-04	0.00E+00	0.00E+00	2.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-03	1.90E-02	4.42E-03	8.48E-03	2.58E-03	3.73E-02	0.00E+00
Forest	2.73E-01	6.67E-02	6.85E-03	5.34E-02	3.11E-02	9.50E-02	1.83E-01	5.01E-02	1.57E-02	7.41E-03	5.98E-02	1.63E-02	5.35E-03	0.00E+00	5.34E-02	8.10E-02	5.82E-03	2.36E-02	1.36E-02	6.58E-02	5.22E-02	6.76E-02	1.02E-01	1.71E-01	4.44E-02	7.49E-03	2.50E-01	4.61E-03
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-03	3.40E-03	2.03E-02	1.11E-02	9.23E-04	2.56E-03	1.05E-02	1.68E-02	2.88E-03	2.02E-03	3.61E-03	3.89E-03	1.55E-02	2.64E-02	7.79E-02	1.78E-02	1.48E-02	1.96E-03	1.13E-01	1.82E-03
Barren	3.13E-02	2.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.66E-02	6.21E-03	0.00E+00	5.76E-03	0.00E+00	1.06E-02	1.89E-03	0.00E+00	6.01E-03	3.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.12E-03	0.00E+00	0.00E+00	0.00E+00
Residential	2.19E-02	1.63E-02	1.52E-03	4.39E-03	4.53E-02	1.17E-01	4.11E-01	6.54E-02	1.46E-02	1.52E-02	6.83E-02	2.07E-01	6.92E-02	1.32E-02	2.08E-01	5.06E-02	4.39E-03	2.28E-02	4.70E-03	5.77E-02	4.71E-02	4.92E-02	3.30E-02	6.71E-02	3.68E-02	1.01E-02	1.19E-01	5.62E-03
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-03	5.45E-04	2.11E-04	3.51E-03	4.94E-03	8.42E-05	1.43E-02	1.10E-03	0.00E+00	6.20E-03	1.58E-04	6.22E-03	3.00E-04	0.00E+00	3.00E-04	6.66E-04	2.10E-03	0.00E+00	7.18E-04	3.00E-04
Commercial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-02	1.21E-01	6.85E-03	1.22E-02	5.31E-02	1.43E-04	2.62E-01	8.30E-02	4.91E-04	5.45E-02	2.12E-03	0.00E+00	0.00E+00	0.00E+00	9.75E-04	4.88E-03	1.59E-02	0.00E+00	6.84E-03	0.00E+00	0.00E+00	5.15E-04	0.00E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-02	0.00E+00	0.00E+00	0.00E+00	1.18E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.88E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-02	3.03E-02	0.00E+00	7.26E-04	0.00E+00	1.90E-02	1.32E-02	0.00E+00	2.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-03	2.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	6.59E-04	8.90E-03	4.83E-03	1.12E-02	5.89E-03	0.00E+00	1.24E-05	0.00E+00	4.55E-02	1.11E-03	3.16E-03	5.85E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-04	0.00E+00	0.00E+00	0.00E+00	6.27E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	3.04E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-02	9.51E-02	3.76E-02	4.51E-03	4.38E-03	1.74E-04	7.67E-03	1.50E-02	3.40E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Utilities	0.00E+00	4.51E-03	0.00E+00	0.00E+00	1.29E-03	6.30E-03	4.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.75E-03	6.10E-03	3.12E-03	1.25E-03	0.00E+00	2.28E-03	0.00E+00

Cedar Creek Watershed

Existing Enterococcus (#/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	1.71E+11	5.68E+09	1.41E+11	5.85E+11	4.80E+10	4.56E+10	7.18E+10	1.16E+11	6.09E+10	7.75E+07	3.31E+11	5.11E+10	1.34E+11	1.16E+10	2.19E+09	1.95E+11	2.41E+10	3.36E+10	1.23E+10	9.89E+10	2.74E+11	3.01E+09	1.52E+10	4.87E+11
Pastures/CAFOs	2.37E+09	0.00E+00	4.84E+08	1.28E+10	2.09E+04	0.00E+00	2.30E+05	0.00E+00	0.00E+00	6.66E+09	0.00E+00	1.38E+05	5.32E+05	0.00E+00	0.00E+00	1.19E+05	0.00E+00	1.02E+05	2.01E+05	4.22E+07	1.37E+10	9.29E+02	0.00E+00	9.44E+08
Brushland/Rangeland	3.21E+05	1.68E+05	2.03E+06	7.23E+06	4.33E+06	0.00E+00	4.10E+05	1.11E+07	4.25E+04	2.74E+06	0.00E+00	9.54E+05	2.24E+06	0.00E+00	5.52E+04	1.01E+08	0.00E+00	0.00E+00	0.00E+00	5.00E+06	1.41E+07	0.00E+00	0.00E+00	3.19E+07
Forest	5.16E+06	2.31E+06	6.57E+06	1.31E+07	5.60E+05	6.54E+06	6.18E+06	3.48E+07	1.03E+07	1.79E+07	9.54E+06	1.01E+07	2.92E+07	2.19E+05	1.48E+06	8.97E+07	3.57E+06	6.64E+06	1.99E+06	6.28E+06	2.28E+07	4.69E+05	1.19E+06	6.13E+07
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+07	5.35E+06	1.65E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.01E+06	2.63E+05	4.70E+04	7.45E+06	3.20E+05	4.01E+05	2.35E+05	1.33E+05	1.60E+06	4.13E+04	1.48E+04	7.95E+06
Barren	3.27E+06	3.67E+06	3.64E+06	1.38E+07	3.75E+06	7.04E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E+06	0.00E+00	0.00E+00	1.55E+06	0.00E+00	0.00E+00	0.00E+00	7.75E+05	2.33E+06	0.00E+00	0.00E+00	0.00E+00
Residential	1.60E+09	1.30E+09	8.31E+08	5.70E+08	4.17E+07	1.27E+09	1.47E+08	1.66E+09	3.60E+08	4.65E+09	1.91E+09	8.19E+07	9.28E+09	1.53E+08	7.24E+08	7.12E+09	2.63E+09	3.78E+09	1.11E+09	1.68E+09	4.02E+09	8.08E+08	9.48E+07	8.23E+09
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E+08	4.87E+06	5.14E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E+08	1.87E+06	5.87E+07	2.39E+07	1.23E+08	1.25E+08	2.14E+06	7.20E+07	9.58E+06	1.73E+07	0.00E+00	3.36E+06
Commercial	7.17E+07	0.00E+00	0.00E+00	6.44E+06	0.00E+00	0.00E+00	6.31E+07	2.09E+06	0.00E+00	0.00E+00	0.00E+00	6.19E+06	9.17E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E+08	0.00E+00	0.00E+00	9.60E+07
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	8.02E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+07	0.00E+00	1.74E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	4.53E+07	0.00E+00	0.00E+00	5.62E+07	6.67E+06	0.00E+00	2.16E+07	7.18E+07	0.00E+00	5.78E+07	2.78E+07	1.42E+07	1.77E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.75E+06	5.47E+07	8.76E+06	0.00E+00	1.19E+08
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.12E+06	0.00E+00	2.65E+07	0.00E+00	0.00E+00	8.46E+07	0.00E+00	0.00E+00	7.12E+07	0.00E+00	1.90E+07	3.50E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Percent Reduction Enterococcus Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agriculture	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Pastures/CAFOs	96%	-	96%	96%	96%	-	96%	-	-	96%	-	96%	96%	-	-	96%	-	96%	96%	96%	96%	96%	-	96%
Brushland/Rangeland	90%	90%	90%	90%	90%	-	90%	90%	90%	90%	-	90%	90%	-	90%	90%	-	-	-	90%	90%	-	-	90%
Forest	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Wetland	-	-	-	-	-	90%	90%	90%	-	-	-	-	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Barren	90%	90%	90%	90%	90%	90%	-	-	-	-	-	-	90%	-	-	90%	-	-	-	90%	90%	-	-	-
Residential	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Water	-	-	-	-	-	90%	90%	90%	-	-	-	-	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	-	90%
Commercial	90%	-	-	90%	-	-	90%	90%	-	-	-	90%	90%	-	-	-	-	-	-	-	90%	-	-	90%
Industrial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Institutional/Government	90%	-	-	-	-	-	-	90%	-	-	-	-	-	-	-	90%	-	90%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportation/Communications	90%	-	-	90%	90%	-	90%	90%	-	90%	90%	90%	90%	-	-	-	-	-	-	90%	90%	90%	-	90%
Utilities	-	-	-	-	-	-	-	90%	-	90%	-	-	90%	-	-	90%	-	90%	90%	-	-	-	-	-

TMDL Enterococcus (#/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	6.83E+09	2.27E+08	5.62E+09	2.34E+10	1.92E+09	1.82E+09	2.87E+09	4.63E+09	2.44E+09	3.10E+06	1.33E+10	2.04E+09	5.34E+09	4.64E+08	8.76E+07	7.82E+09	9.66E+08	1.34E+09	4.92E+08	3.95E+09	1.09E+10	1.20E+08	6.09E+08	1.95E+10
Pastures/CAFOs	9.48E+07	0.00E+00	1.94E+07	5.14E+08	8.36E+02	0.00E+00	9.21E+03	0.00E+00	0.00E+00	2.66E+08	0.00E+00	5.53E+03	2.13E+04	0.00E+00	0.00E+00	4.77E+03	0.00E+00	4.07E+03	8.05E+03	1.69E+06	5.47E+08	3.72E+01	0.00E+00	3.77E+07
Brushland/Rangeland	3.21E+04	1.68E+04	2.03E+05	7.23E+05	4.33E+05	0.00E+00	4.10E+04	1.11E+06	4.25E+03	2.74E+05	0.00E+00	9.54E+04	2.24E+05	0.00E+00	5.52E+03	1.01E+07	0.00E+00	0.00E+00	0.00E+00	5.00E+05	1.41E+06	0.00E+00	0.00E+00	3.19E+06
Forest	5.16E+05	2.31E+05	6.57E+05	1.31E+06	5.60E+04	6.54E+05	6.18E+05	3.48E+06	1.03E+06	1.79E+06	9.54E+05	1.01E+06	2.92E+06	2.19E+04	1.48E+05	8.97E+06	3.57E+05	6.64E+05	1.99E+05	6.28E+05	2.28E+06	4.69E+04	1.19E+05	6.13E+06
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+06	5.35E+05	1.65E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.01E+05	2.63E+04	4.70E+03	7.45E+05	3.20E+04	4.01E+04	2.35E+04	1.33E+04	1.60E+05	4.13E+03	1.48E+03	7.95E+05
Barren	3.27E+05	3.67E+05	3.64E+05	1.38E+06	3.75E+05	7.04E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E+05	0.00E+00	0.00E+00	1.55E+05	0.00E+00	0.00E+00	0.00E+00	7.75E+04	2.33E+05	0.00E+00	0.00E+00	0.00E+00
Residential	6.42E+07	5.19E+07	3.32E+07	2.28E+07	1.67E+06	5.08E+07	5.88E+06	6.65E+07	1.44E+07	1.86E+08	7.64E+07	3.28E+06	3.71E+08	6.11E+06	2.90E+07	2.85E+08	1.05E+08	1.51E+08	4.45E+07	6.73E+07	1.61E+08	3.23E+07	3.79E+06	3.29E+08
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E+07	4.87E+05	5.14E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E+07	1.87E+05	5.87E+06	2.39E+06	1.23E+07	1.25E+07	2.14E+05	7.20E+06	9.58E+05	1.73E+06	0.00E+00	3.36E+05
Commercial	7.17E+06	0.00E+00	0.00E+00	6.44E+05	0.00E+00	0.00E+00	6.31E+06	2.09E+05	0.00E+00	0.00E+00	0.00E+00	6.19E+05	9.17E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E+07	0.00E+00	0.00E+00	9.60E+06
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	8.02E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+06	0.00E+00	1.74E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	4.53E+06	0.00E+00	0.00E+00	5.62E+06	6.67E+05	0.00E+00	2.16E+06	7.18E+06	0.00E+00	5.78E+06	2.78E+06	1.42E+06	1.77E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.75E+05	5.47E+06	8.76E+05	0.00E+00	1.19E+07
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.12E+05	0.00E+00	2.65E+06	0.00E+00	0.00E+00	8.46E+06	0.00E+00	0.00E+00	7.12E+06	0.00E+00	1.90E+06	3.50E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Existing BOD (lbs/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	1.50E+01	1.96E+00	1.23E+01	5.12E+01	1.65E+01	1.57E+01	2.47E+01	3.98E+01	2.10E+01	5.05E+01	2.90E+01	1.76E+01	4.60E+01	3.99E+00	7.53E-01	6.73E+01	8.31E+00	1.16E+01	4.24E+00	8.65E+00	2.39E+01	1.04E+00	5.24E+00	4.26E+01
Pastures/CAFOs	6.89E-01	0.00E+00	1.41E-01	3.73E+00	3.80E-02	0.00E+00	4.19E-01	0.00E+00	0.00E+00	9.17E-01	0.00E+00	2.51E-01	9.69E-01	0.00E+00	0.00E+00	2.17E-01	0.00E+00	1.85E-01	3.66E-01	1.23E-02	3.97E+00	1.69E-03	0.00E+00	2.74E-01
Brushland/Rangeland	2.85E-02	1.47E-02	1.80E-01	6.41E-01	3.79E-01	0.00E+00	3.59E-02	9.73E-01	3.72E-03	2.27E-01	0.00E+00	8.35E-02	1.96E-01	0.00E+00	4.84E-03	8.80E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-01	1.25E+00	0.00E+00	0.00E+00	2.83E+00
Forest	8.69E-01	3.89E-01	1.11E+00	2.20E+00	9.44E-02	1.10E+00	1.04E+00	5.87E+00	1.74E+00	3.01E+00	1.61E+00	1.70E+00	4.93E+00	3.70E-02	2.50E-01	1.51E+01	6.02E-01	1.12E+00	3.36E-01	1.06E+00	3.85E+00	7.92E-02	2.01E-01	1.03E+01
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.03E+00	2.28E+00	7.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E+00	1.12E-01	2.00E-02	3.17E+00	1.36E-01	1.71E-01	1.00E-01	5.75E-02	6.91E-01	1.76E-02	6.28E-03	3.43E+00
Barren	2.34E-01	2.59E-01	2.60E-01	9.85E-01	2.65E-01	4.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-01	0.00E+00	0.00E+00	1.09E-01	0.00E+00	0.00E+00	0.00E+00	5.54E-02	1.66E-01	0.00E+00	0.00E+00	0.00E+00
Residential	2.25E+00	1.82E+00	1.17E+00	8.00E-01	5.85E-02	1.78E+00	2.06E-01	2.33E+00	5.05E-01	6.53E+00	2.68E+00	1.15E-01	1.30E+01	2.14E-01	1.02E+00	9.99E+00	3.69E+00	5.30E+00	1.56E+00	2.36E+00	5.64E+00	1.13E+00	1.33E-01	1.15E+01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.61E+00	5.41E-02	5.72E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E+00	2.08E-02	6.53E-01	2.66E-01	1.37E+00	1.39E+00	2.38E-02	8.11E-01	1.08E-01	1.93E-01	0.00E+00	3.78E-02
Commercial	2.10E+00	0.00E+00	0.00E+00	1.88E-01	0.00E+00	0.00E+00	1.82E+00	6.02E-02	0.00E+00	0.00E+00	0.00E+00	1.78E-01	2.65E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.50E+00	0.00E+00	0.00E+00	2.80E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	2.29E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.75E-01	0.00E+00	5.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	1.32E+00	0.00E+00	0.00E+00	1.64E+00	1.92E-01	0.00E+00	6.24E-01	2.07E+00	0.00E+00	1.58E+00	8.13E-01	4.10E-01	5.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-01	1.60E+00	2.53E-01	0.00E+00	3.49E+00
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-01	0.00E+00	7.26E-01	0.00E+00	0.00E+00	2.44E+00	0.00E+00	0.00E+00	2.05E+00	0.00E+00	5.48E-01	1.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Percent Reduction BOD Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agriculture	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Pastures/CAFOs	45%	-	45%	45%	45%	-	45%	-	-	45%	-	45%	45%	-	-	45%	-	45%	45%	45%	45%	45%	-	45%
Brushland/Rangeland	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	-	0%	0%	-	0%	0%	-	-	-	0%	0%	-	-	0%
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	0%	0%	0%	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	0%	0%	0%	0%	-	-	-	-	-	-	0%	-	-	0%	-	-	-	0%	0%	-	-	-
Residential	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Water	-	-	-	-	-	45%	45%	45%	-	-	-	-	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	-	45%
Commercial	45%	-	-	45%	-	-	45%	45%	-	-	-	45%	45%	-	-	-	-	-	-	-	45%	-	-	45%
Industrial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Institutional/Government	45%	-	-	-	-	-	-	45%	-	-	-	-	-	-	-	45%	-	45%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportation/Communications	45%	-	-	45%	45%	-	45%	45%	-	45%	45%	45%	45%	-	-	-	-	-	-	45%	45%	45%	-	45%
Utilities	-	-	-	-	-	-	-	45%	-	45%	-	-	45%	-	-	45%	-	45%	45%	-	-	-	-	-

TMDL BOD (lbs/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	8.22E+00	1.08E+00	6.77E+00	2.82E+01	9.08E+00	8.62E+00	1.36E+01	2.19E+01	1.15E+01	2.78E+01	1.60E+01	9.68E+00	2.53E+01	2.19E+00	4.14E-01	3.70E+01	4.57E+00	6.36E+00	2.33E+00	4.76E+00	1.32E+01	5.69E-01	2.88E+00	2.34E+01
Pastures/CAFOs	3.79E-01	0.00E+00	7.74E-02	2.05E+00	2.09E-02	0.00E+00	2.30E-01	0.00E+00	0.00E+00	5.04E-01	0.00E+00	1.38E-01	5.33E-01	0.00E+00	0.00E+00	1.19E-01	0.00E+00	1.02E-01	2.01E-01	6.74E-03	2.19E+00	9.30E-04	0.00E+00	1.51E-01
Brushland/Rangeland	2.85E-02	1.47E-02	1.80E-01	6.41E-01	3.79E-01	0.00E+00	3.59E-02	9.73E-01	3.72E-03	2.27E-01	0.00E+00	8.35E-02	1.96E-01	0.00E+00	4.84E-03	8.80E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-01	1.25E+00	0.00E+00	0.00E+00	2.83E+00
Forest	8.69E-01	3.89E-01	1.11E+00	2.20E+00	9.44E-02	1.10E+00	1.04E+00	5.87E+00	1.74E+00	3.01E+00	1.61E+00	1.70E+00	4.93E+00	3.70E-02	2.50E-01	1.51E+01	6.02E-01	1.12E+00	3.36E-01	1.06E+00	3.85E+00	7.92E-02	2.01E-01	1.03E+01
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.03E+00	2.28E+00	7.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E+00	1.12E-01	2.00E-02	3.17E+00	1.36E-01	1.71E-01	1.00E-01	5.75E-02	6.91E-01	1.76E-02	6.28E-03	3.43E+00
Barren	2.34E-01	2.59E-01	2.60E-01	9.85E-01	2.65E-01	4.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-01	0.00E+00	0.00E+00	1.09E-01	0.00E+00	0.00E+00	0.00E+00	5.54E-02	1.66E-01	0.00E+00	0.00E+00	0.00E+00
Residential	1.24E+00	1.00E+00	6.41E-01	4.40E-01	3.22E-02	9.80E-01	1.13E-01	1.28E+00	2.78E-01	3.59E+00	1.47E+00	6.32E-02	7.17E+00	1.18E-01	5.59E-01	5.50E+00	2.03E+00	2.92E+00	8.60E-01	1.30E+00	3.10E+00	6.24E-01	7.32E-02	6.35E+00
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E+00	2.98E-02	3.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-01	1.14E-02	3.59E-01	1.46E-01	7.52E-01	7.65E-01	1.31E-02	4.46E-01	5.94E-02	1.06E-01	0.00E+00	2.08E-02
Commercial	1.15E+00	0.00E+00	0.00E+00	1.03E-01	0.00E+00	0.00E+00	1.00E+00	3.31E-02	0.00E+00	0.00E+00	0.00E+00	9.82E-02	1.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+00	0.00E+00	0.00E+00	1.54E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	1.26E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E-01	0.00E+00	2.76E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	7.29E-01	0.00E+00	0.00E+00	9.04E-01	1.06E-01	0.00E+00	3.43E-01	1.14E+00	0.00E+00	8.70E-01	4.47E-01	2.25E-01	2.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-02	8.79E-01	1.39E-01	0.00E+00	1.92E+00
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-01	0.00E+00	3.99E-01	0.00E+00	0.00E+00	1.34E+00	0.00E+00	0.00E+00	1.13E+00	0.00E+00	3.02E-01	5.56E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Existing TP (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	9.77E-01	1.28E-01	8.04E-01	3.35E+00	1.08E+00	1.02E+00	1.61E+00	2.60E+00	1.37E+00	3.30E+00	1.90E+00	1.15E+00	3.00E+00	2.61E-01	4.92E-02	4.40E+00	5.43E-01	7.56E-01	2.77E-01	5.65E-01	1.56E+00	6.77E-02	3.43E-01	2.78E+00
Pastures/CAFOs	9.12E-03	0.00E+00	1.86E-03	4.94E-02	5.04E-04	0.00E+00	5.55E-03	0.00E+00	0.00E+00	1.21E-02	0.00E+00	3.33E-03	1.28E-02	0.00E+00	0.00E+00	2.87E-03	0.00E+00	2.45E-03	4.85E-03	1.62E-04	5.26E-02	2.24E-05	0.00E+00	3.63E-03
Brushland/Rangeland	4.42E-04	2.28E-04	2.80E-03	9.95E-03	5.88E-03	0.00E+00	5.57E-04	1.51E-02	5.77E-05	3.53E-03	0.00E+00	1.30E-03	3.04E-03	0.00E+00	7.50E-05	1.37E-01	0.00E+00	0.00E+00	0.00E+00	6.88E-03	1.95E-02	0.00E+00	0.00E+00	4.39E-02
Forest	1.19E-02	5.33E-03	1.52E-02	3.02E-02	1.29E-03	1.51E-02	1.43E-02	8.04E-02	2.38E-02	4.13E-02	2.21E-02	2.32E-02	6.76E-02	5.06E-04	3.42E-03	2.07E-01	8.25E-03	1.53E-02	4.60E-03	1.45E-02	5.27E-02	1.08E-03	2.76E-03	1.42E-01
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.14E-02	2.59E-02	8.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.43E-02	1.28E-03	2.28E-04	3.61E-02	1.55E-03	1.94E-03	1.14E-03	6.54E-04	7.87E-03	2.00E-04	7.16E-05	3.91E-02
Barren	1.05E-02	1.17E-02	1.17E-02	4.44E-02	1.19E-02	2.24E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-02	0.00E+00	0.00E+00	4.92E-03	0.00E+00	0.00E+00	0.00E+00	2.49E-03	7.49E-03	0.00E+00	0.00E+00	0.00E+00
Residential	6.37E-02	5.15E-02	3.30E-02	2.27E-02	1.66E-03	5.05E-02	5.84E-03	6.61E-02	1.43E-02	1.85E-01	7.59E-02	3.25E-03	3.69E-01	6.07E-03	2.88E-02	2.83E-01	1.04E-01	1.50E-01	4.42E-02	6.68E-02	1.60E-01	3.21E-02	3.77E-03	3.27E-01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.61E-02	5.41E-04	5.72E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-02	2.08E-04	6.53E-03	2.66E-03	1.37E-02	1.39E-02	2.38E-04	8.11E-03	1.08E-03	1.93E-03	0.00E+00	3.78E-04
Commercial	1.70E-01	0.00E+00	0.00E+00	1.52E-02	0.00E+00	0.00E+00	1.48E-01	4.88E-03	0.00E+00	0.00E+00	0.00E+00	1.45E-02	2.14E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-01	0.00E+00	0.00E+00	2.27E-01
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	1.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-02	0.00E+00	4.07E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	1.07E-01	0.00E+00	0.00E+00	1.33E-01	1.56E-02	0.00E+00	5.05E-02	1.68E-01	0.00E+00	1.28E-01	6.58E-02	3.32E-02	4.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.88E-03	1.30E-01	2.05E-02	0.00E+00	2.82E-01
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-02	0.00E+00	5.88E-02	0.00E+00	0.00E+00	1.98E-01	0.00E+00	0.00E+00	1.66E-01	0.00E+00	4.44E-02	8.19E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Percent Reduction TP Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agriculture	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Pastures/CAFOs	45%	-	45%	45%	45%	-	45%	-	-	45%	-	45%	45%	-	-	45%	-	45%	45%	45%	45%	45%	-	45%
Brushland/Rangeland	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	-	0%	0%	-	0%	0%	-	-	-	0%	0%	-	-	0%
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	0%	0%	0%	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	0%	0%	0%	0%	-	-	-	-	-	-	0%	-	-	0%	-	-	-	0%	0%	-	-	-
Residential	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Water	-	-	-	-	-	45%	45%	45%	-	-	-	-	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	-	45%
Commercial	45%	-	-	45%	-	-	45%	45%	-	-	-	45%	45%	-	-	-	-	-	-	-	45%	-	-	45%
Industrial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Institutional/Government	45%	-	-	-	-	-	-	45%	-	-	-	-	-	-	-	45%	-	45%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportation/Communications	45%	-	-	45%	45%	-	45%	45%	-	45%	45%	45%	45%	-	-	-	-	-	-	45%	45%	45%	-	45%
Utilities	-	-	-	-	-	-	-	45%	-	45%	-	-	45%	-	-	45%	-	45%	45%	-	-	-	-	-

TMDL TP (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	5.37E-01	7.03E-02	4.42E-01	1.84E+00	5.93E-01	5.64E-01	8.88E-01	1.43E+00	7.53E-01	1.82E+00	1.04E+00	6.32E-01	1.65E+00	1.43E-01	2.71E-02	2.42E+00	2.99E-01	4.16E-01	1.52E-01	3.11E-01	8.60E-01	3.72E-02	1.88E-01	1.53E+00

Pastures/CAFOs	5.02E-03	0.00E+00	1.03E-03	2.72E-02	2.77E-04	0.00E+00	3.05E-03	0.00E+00	0.00E+00	6.68E-03	0.00E+00	1.83E-03	7.06E-03	0.00E+00	0.00E+00	1.58E-03	0.00E+00	1.35E-03	2.67E-03	8.93E-05	2.89E-02	1.23E-05	0.00E+00	2.00E-03
Brushland/Rangeland	4.42E-04	2.28E-04	2.80E-03	9.95E-03	5.88E-03	0.00E+00	5.57E-04	1.51E-02	5.77E-05	3.53E-03	0.00E+00	1.30E-03	3.04E-03	0.00E+00	7.50E-05	1.37E-01	0.00E+00	0.00E+00	0.00E+00	6.88E-03	1.95E-02	0.00E+00	0.00E+00	4.39E-02
Forest	1.19E-02	5.33E-03	1.52E-02	3.02E-02	1.29E-03	1.51E-02	1.43E-02	8.04E-02	2.38E-02	4.13E-02	2.21E-02	2.32E-02	6.76E-02	5.06E-04	3.42E-03	2.07E-01	8.25E-03	1.53E-02	4.60E-03	1.45E-02	5.27E-02	1.08E-03	2.76E-03	1.42E-01
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.14E-02	2.59E-02	8.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.43E-02	1.28E-03	2.28E-04	3.61E-02	1.55E-03	1.94E-03	1.14E-03	6.54E-04	7.87E-03	2.00E-04	7.16E-05	3.91E-02
Barren	1.05E-02	1.17E-02	1.17E-02	4.44E-02	1.19E-02	2.24E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-02	0.00E+00	0.00E+00	4.92E-03	0.00E+00	0.00E+00	0.00E+00	2.49E-03	7.49E-03	0.00E+00	0.00E+00	0.00E+00
Residential	3.51E-02	2.84E-02	1.82E-02	1.25E-02	9.11E-04	2.77E-02	3.21E-03	3.63E-02	7.87E-03	1.02E-01	4.17E-02	1.79E-03	2.03E-01	3.34E-03	1.58E-02	1.56E-01	5.75E-02	8.26E-02	2.43E-02	3.67E-02	8.79E-02	1.77E-02	2.07E-03	1.80E-01
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-02	2.98E-04	3.15E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-03	1.14E-04	3.59E-03	1.46E-03	7.52E-03	7.65E-03	1.31E-04	4.46E-03	5.94E-04	1.06E-03	0.00E+00	2.08E-04
Commercial	9.34E-02	0.00E+00	0.00E+00	8.38E-03	0.00E+00	0.00E+00	8.12E-02	2.68E-03	0.00E+00	0.00E+00	0.00E+00	7.95E-03	1.18E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-01	0.00E+00	0.00E+00	1.25E-01
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00	2.24E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	5.90E-02	0.00E+00	0.00E+00	7.32E-02	8.58E-03	0.00E+00	2.78E-02	9.22E-02	0.00E+00	7.05E-02	3.62E-02	1.83E-02	2.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.89E-03	7.12E-02	1.13E-02	0.00E+00	1.55E-01
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.15E-03	0.00E+00	3.23E-02	0.00E+00	0.00E+00	1.09E-01	0.00E+00	0.00E+00	9.15E-02	0.00E+00	2.44E-02	4.50E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Existing TN (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	2.75E+01	3.60E+00	2.26E+01	9.42E+01	3.04E+01	2.89E+01	4.55E+01	7.33E+01	3.86E+01	9.30E+01	5.34E+01	3.24E+01	8.46E+01	7.34E+00	1.39E+00	1.24E+02	1.53E+01	2.13E+01	7.80E+00	1.59E+01	4.41E+01	1.91E+00	9.65E+00	7.84E+01
Pastures/CAFOs	1.85E-01	0.00E+00	3.78E-02	1.00E+00	1.02E-02	0.00E+00	1.12E-01	0.00E+00	0.00E+00	2.46E-01	0.00E+00	6.75E-02	2.60E-01	0.00E+00	0.00E+00	5.82E-02	0.00E+00	4.97E-02	9.82E-02	3.29E-03	1.07E+00	4.54E-04	0.00E+00	7.36E-02
Brushland/Rangeland	7.28E-03	3.76E-03	4.61E-02	1.64E-01	9.70E-02	0.00E+00	9.18E-03	2.49E-01	9.51E-04	5.81E-02	0.00E+00	2.14E-02	5.01E-02	0.00E+00	1.24E-03	2.25E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-01	3.21E-01	0.00E+00	0.00E+00	7.24E-01
Forest	2.41E-01	1.08E-01	3.07E-01	6.11E-01	2.62E-02	3.06E-01	2.89E-01	1.63E+00	4.82E-01	8.36E-01	4.46E-01	4.71E-01	1.37E+00	1.02E-02	6.93E-02	4.19E+00	1.67E-01	3.11E-01	9.32E-02	2.94E-01	1.07E+00	2.20E-02	5.58E-02	2.87E+00
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E+00	9.29E-01	2.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-01	4.57E-02	8.17E-03	1.29E+00	5.57E-02	6.96E-02	4.09E-02	2.35E-02	2.82E-01	7.18E-03	2.56E-03	1.40E+00
Barren	1.67E-01	1.85E-01	1.86E-01	7.05E-01	1.89E-01	3.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E-01	0.00E+00	0.00E+00	7.82E-02	0.00E+00	0.00E+00	0.00E+00	3.96E-02	1.19E-01	0.00E+00	0.00E+00	0.00E+00
Residential	1.04E+00	8.45E-01	5.41E-01	3.71E-01	2.71E-02	8.27E-01	9.57E-02	1.08E+00	2.34E-01	3.03E+00	1.24E+00	5.33E-02	6.05E+00	9.95E-02	4.72E-01	4.64E+00	1.71E+00	2.46E+00	7.25E-01	1.10E+00	2.62E+00	5.26E-01	6.17E-02	5.36E+00
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.61E-01	5.41E-03	5.72E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-01	2.08E-03	6.53E-02	2.66E-02	1.37E-01	1.39E-01	2.38E-03	8.11E-02	1.08E-02	1.93E-02	0.00E+00	3.78E-03
Commercial	8.56E-01	0.00E+00	0.00E+00	7.68E-02	0.00E+00	0.00E+00	7.44E-01	2.46E-02	0.00E+00	0.00E+00	0.00E+00	7.29E-02	1.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+00	0.00E+00	0.00E+00	1.14E+00
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	9.36E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E-01	0.00E+00	2.05E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	5.41E-01	0.00E+00	0.00E+00	6.71E-01	7.86E-02	0.00E+00	2.55E-01	8.45E-01	0.00E+00	6.46E-01	3.32E-01	1.67E-01	2.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.48E-02	6.53E-01	1.03E-01	0.00E+00	1.42E+00
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.38E-02	0.00E+00	2.96E-01	0.00E+00	0.00E+00	9.96E-01	0.00E+00	0.00E+00	8.38E-01	0.00E+00	2.24E-01	4.13E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Percent Reduction TN Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agriculture	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Pastures/CAFOs	45%	-	45%	45%	45%	-	45%	-	-	45%	-	45%	45%	-	-	45%	-	45%	45%	45%	45%	45%	-	45%
Brushland/Rangeland	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	-	0%	0%	-	0%	0%	-	-	-	0%	0%	-	-	0%
Forest	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wetland	-	-	-	-	-	0%	0%	0%	-	-	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barren	0%	0%	0%	0%	0%	0%	-	-	-	-	-	-	0%	-	-	0%	-	-	-	0%	0%	-	-	-
Residential	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Water	-	-	-	-	-	45%	45%	45%	-	-	-	-	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	-	45%
Commercial	45%	-	-	45%	-	-	45%	45%	-	-	-	45%	45%	-	-	-	-	-	-	-	45%	-	-	45%
Industrial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Institutional/Government	45%	-	-	-	-	-	-	45%	-	-	-	-	-	-	-	45%	-	45%	-	-	-	-	-	-
Mixed Urban/Built-Up	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Urban	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportation/Communications	45%	-	-	45%	45%	-	45%	45%	-	45%	45%	45%	45%	-	-	-	-	-	-	45%	45%	45%	-	45%
Utilities	-	-	-	-	-	-	-	45%	-	45%	-	-	45%	-	-	45%	-	45%	45%	-	-	-	-	-

TMDL TN (lb/day) Subwatershed

Land Use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Recreation	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Agriculture	1.51E+01	1.98E+00	1.24E+01	5.18E+01	1.67E+01	1.59E+01	2.50E+01	4.03E+01	2.12E+01	5.12E+01	2.94E+01	1.78E+01	4.65E+01	4.04E+00	7.63E-01	6.81E+01	8.41E+00	1.17E+01	4.29E+00	8.76E+00	2.42E+01	1.05E+00	5.31E+00	4.31E+01
Pastures/CAFOs	1.02E-01	0.00E+00	2.08E-02	5.51E-01	5.62E-03	0.00E+00	6.18E-02	0.00E+00	0.00E+00	1.35E-01	0.00E+00	3.71E-02	1.43E-01	0.00E+00	0.00E+00	3.20E-02	0.00E+00	2.73E-02	5.40E-02	1.81E-03	5.87E-01	2.50E-04	0.00E+00	4.05E-02
Brushland/Rangeland	7.28E-03	3.76E-03	4.61E-02	1.64E-01	9.70E-02	0.00E+00	9.18E-03	2.49E-01	9.51E-04	5.81E-02	0.00E+00	2.14E-02	5.01E-02	0.00E+00	1.24E-03	2.25E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-01	3.21E-01	0.00E+00	0.00E+00	7.24E-01
Forest	2.41E-01	1.08E-01	3.07E-01	6.11E-01	2.62E-02	3.06E-01	2.89E-01	1.63E+00	4.82E-01	8.36E-01	4.46E-01	4.71E-01	1.37E+00	1.02E-02	6.93E-02	4.19E+00	1.67E-01	3.11E-01	9.32E-02	2.94E-01	1.07E+00	2.20E-02	5.58E-02	2.87E+00
Wetland	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E+00	9.29E-01	2.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-01	4.57E-02	8.17E-03	1.29E+00	5.57E-02	6.96E-02	4.09E-02	2.35E-02	2.82E-01	7.18E-03	2.56E-03	1.40E+00
Barren	1.67E-01	1.85E-01	1.86E-01	7.05E-01	1.89E-01	3.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E-01	0.00E+00	0.00E+00	7.82E-02	0.00E+00	0.00E+00	0.00E+00	3.96E-02	1.19E-01	0.00E+00	0.00E+00	0.00E+00
Residential	5.75E-01	4.65E-01	2.98E-01	2.04E-01	1.49E-02	4.55E-01	5.26E-02	5.96E-01	1.29E-01	1.67E+00	6.84E-01	2.93E-02	3.33E+00	5.47E-02	2.59E-01	2.55E+00	9.42E-01	1.35E+00	3.99E-01	6.02E-01	1.44E+00	2.89E-01	3.40E-02	2.95E+00
Water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-01	2.98E-03	3.15E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-02	1.14E-03	3.59E-02	1.46E-02	7.52E-02	7.65E-02	1.31E-03	4.46E-02	5.94E-03	1.06E-02	0.00E+00	2.08E-03
Commercial	4.71E-01	0.00E+00	0.00E+00	4.23E-02	0.00E+00	0.00E+00	4.09E-01	1.35E-02	0.00E+00	0.00E+00	0.00E+00	4.01E-02	5.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+00	0.00E+00	0.00E+00	6.30E-01
Industrial	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Institutional/Government	5.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.55E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-01	0.00E+00	1.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mixed Urban/Built-Up	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Other Urban	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Transportation/Communications	2.97E-01	0.00E+00	0.00E+00	3.69E-01	4.32E-02	0.00E+00	1.40E-01	4.65E-01	0.00E+00	3.55E-01	1.83E-01	9.20E-02	1.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.46E-02	3.59E-01	5.67E-02	0.00E+00	7.83E-01
Utilities	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.61E-02	0.00E+00	1.63E-01	0.00E+00	0.00E+00	5.48E-01	0.00E+00	0.00E+00	4.61E-01	0.00E+00	1.23E-01	2.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00