Amendment to the Lower Delaware, Monmouth County and Tri-County Water Quality Management Plans

Total Maximum Daily Loads for Phosphorus to Address 5 Stream Segments in the Lower Delaware Water Region

WMA 17, WMA 18 and WMA 20
(Cohansey River, Big Timber Creek, Oldmans Creek,
and Blacks CreekWatersheds)

Proposed: July 5, 2005
Established: August 31, 2005
Approved: September 30, 2005
Adopted:

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1.0 Executive Summary

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (Department) developed the *2004 Integrated List of Waterbodies* addressing the overall water quality of the State's waters and, in Sublist 5, identifying the list of impaired waterbodies. On October 4, 2004, the Department adopted the *2004 Integrated List of Waterbodies* as an amendment to the Statewide Water Quality Management Plan, pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). In the Lower Delaware Water Region, the *2004 Integrated List of Waterbodies* Sublist 5 identifies the waterbodies identified in Table 1 as impaired with respect to phosphorus, as indicated by the presence of phosphorus concentrations in excess of standards. A TMDL is required to be developed for each impairment listed on Sublist 5. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. TMDLs are established to address the phosphorus impairment in the waterbodies identified in Table 1.

Table 1 Impaired stream segments identified on the *2004 Integrated List of Waterbodies* to be addressed in this TMDL report.

TMDL Number	WMA	Station Name/Waterbody	Site ID	Sublist	Proposed Action
1	17	Barrett Run at Bridgeton	01413013	5	Establish TMDL
2	17	Cohansey River at Seeley	01412800	5	Establish TMDL
3	18	Big Timber Creek S Br at Blackwood Terrace	01467329	5	Establish TMDL
4	18	Oldmans Creek at Porches Mill	01477510	5	Establish TMDL
5	20	Blacks Creek at Chesterfield - Georgetown Rd	01464527	5	Establish TMDL

This TMDL report includes implementation strategies to achieve SWQS for phosphorus, including an additional measure, which will be included in the municipal stormwater permits for municipalities within the affected watersheds, to adopt a low phosphorus fertilizer ordinance. The TMDLs in this report have been proposed and will be adopted by the Department as amendments to the appropriate area-wide water quality management plans in accordance with N.J.A.C. 7:15-3.4(g). This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA's) May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs.

2.0 Introduction

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The *Integrated List of Waterbodies* combines these two assessments and assigns waterbodies to one of five sublists. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that loading capacity to known point and nonpoint sources in the form of Waste Load Allocations (WLAs) for point sources, Load Allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

This report establishes 5 TMDLs that address phosphorus impairment in 87.0 river miles with respect to the waterbodies identified in Table 2. These TMDLs include management approaches to reduce loadings of phosphorus from various sources in order to attain applicable surface water quality standards for phosphorus. With respect to the phosphorus impairment, the waterbodies will be moved to Sublist 4 following approval of the TMDLs by EPA. Blacks Creek at Chesterfield (Site ID # 01464527, AN0132), Barrett Run in Bridgeton (Site ID # 01413013, AN0714) and the Cohansey River (Site ID # 01412800, AN0712) stream segments also appears on Sublist 5 as being impaired for benthic macroinvertabrates and the Cohansey River at Seeley stream segment (Site ID# 01412800) also appears on Sublist 5 as being impaired for both lead and pH. These impairments will be addressed in future TMDL documents.

Recent EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that the TMDLs in this report address the following items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.

4. Load allocations.
5. Waste load allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.

3.0 Pollutant of Concern and Area of Interest

Pollutant of Concern

The pollutant of concern for these TMDLs is phosphorus. For the segments in the Lower Delaware Water Region identified in Table 2, phosphorus concentrations were found to exceed New Jersey's SWQS, found at N.J.A.C. 7-9B. These waterbodies were given a "medium" priority ranking in the 2004 Integrated Water Quality Monitoring and Assessment Report.

Table 2 Waterbodies listed for phosphorus impairment in the Lower Delaware Water Region for which TMDLs are being Established

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	17	Barrett Run at Bridgeton	01413013	Cumberland	8.5
2	17	Cohansey River at Seeley	01412800	Cumberland, Salem	31.9
3	18	Big Timber Creek S Br at Blackwood Terrace	01467329	Gloucester, Camden	9.4
4	18	Oldmans Creek at Porches Mill	01477510	Gloucester, Salem	16.4
5	20	Blacks Creek at Chesterfield	01464527	Burlington, Monmouth	20.8
Total River Miles:					**87.0**

Applicable Water Quality Standards

As stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters, the standards for phosphorus are as follows:

Phosphorus, Total (mg/l):

i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.

ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where site-specific criteria are developed pursuant to N.J.A.C. 7:9B1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Also as stated in N.J.A.C. 7:9B-1.5(g)2:

Nutrient policies are as follows:

Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

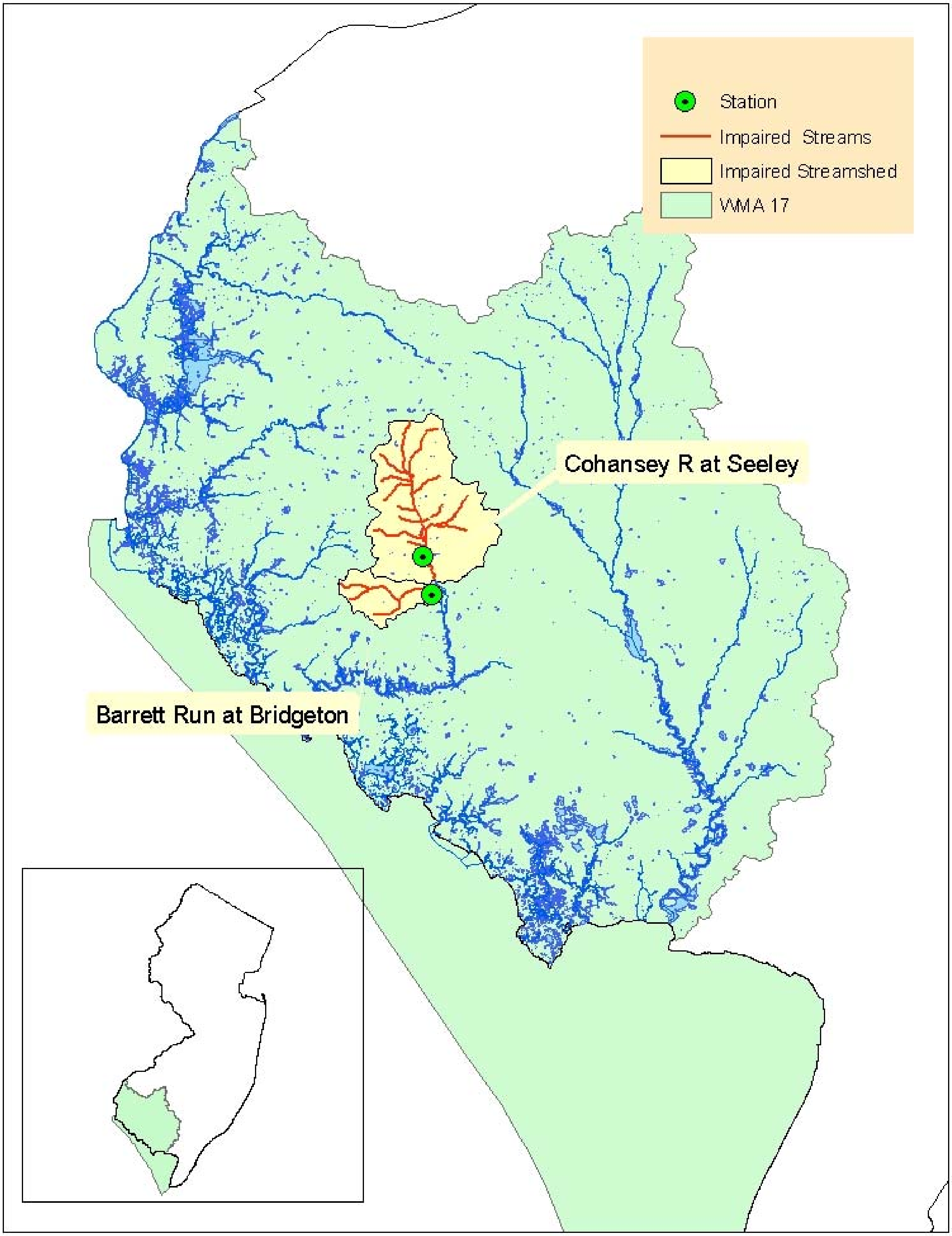
In all FW2 waters, the designated uses are (NJAC 7:9B-1.12):

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;
3 Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

Area of Interest

These TMDLs address 87.0 impaired river miles within the Lower Delaware Water Region. Based on the detailed county hydrography stream coverage, 128.3 overall stream miles are affected by the TMDLs due to the fact that the implementation plans cover entire watersheds, not just impaired waterbody segments. The spatial extent of the impaired segments and the affected drainage areas are depicted in Figures 1-7.

Figure 1   Spatial extent of impaired segments and affected drainage area: WMA 17



WMA 17:

Watershed Management Area 17 includes the Cohansey River, Maurice River, Salem River and Alloway, Dividing, Manantico, Manumuskin, Miles, Mill, Stow and Whooping Creeks. This area includes portions of Atlantic, Cumberland, Gloucester, and Salem counties, over 39 municipalities and encompasses 885 square miles.

The Cohansey River, which includes the impaired segments, is nearly 30 miles long, draining 105 square miles of eastern Salem County to the Delaware Bay. This is an area of very low relief, which results in numerous small tributaries. Sunset Lake and Mary Elmer Lake are among 20 major impoundments in this drainage basin. Agriculture and forest are the main land uses of the overall watershed; agriculture is predominant in the impaired watersheds. Land use in the affected drainage area is presented in Table 3 and depicted in Figures 2 and 3.

Table 3 River miles, Watershed size, and Area by Anderson Land Use Classification

	Barrett Run at Bridgeton Site ID 01413013	Cohansey River at Seeley Site ID 01412800
River miles and drainage area		
Sublist 5 impaired river miles	8.5	31.9
Total river miles within watershed and included in the implementation plan	15.8	61.8
Watershed size (acres)	4945	23941
Landuse/Landcover (acres)		
Agriculture	3663.9	16626.2
medium / high density residential	261.7	164.5
low density / rural residential	442.2	1602.8
commercial	60.7	128.8
industrial	1.5	64.2
mixed urban / other urban	99.1	516.5
barren	10.8	70.8
forest	233.2	2948.5
wetlands	149.3	1707.8
water	22.4	110.9
Total	**4945**	**23941**

Figure 2 Land Use of Barrett Run at Bridgeton (Site ID# 01413013)

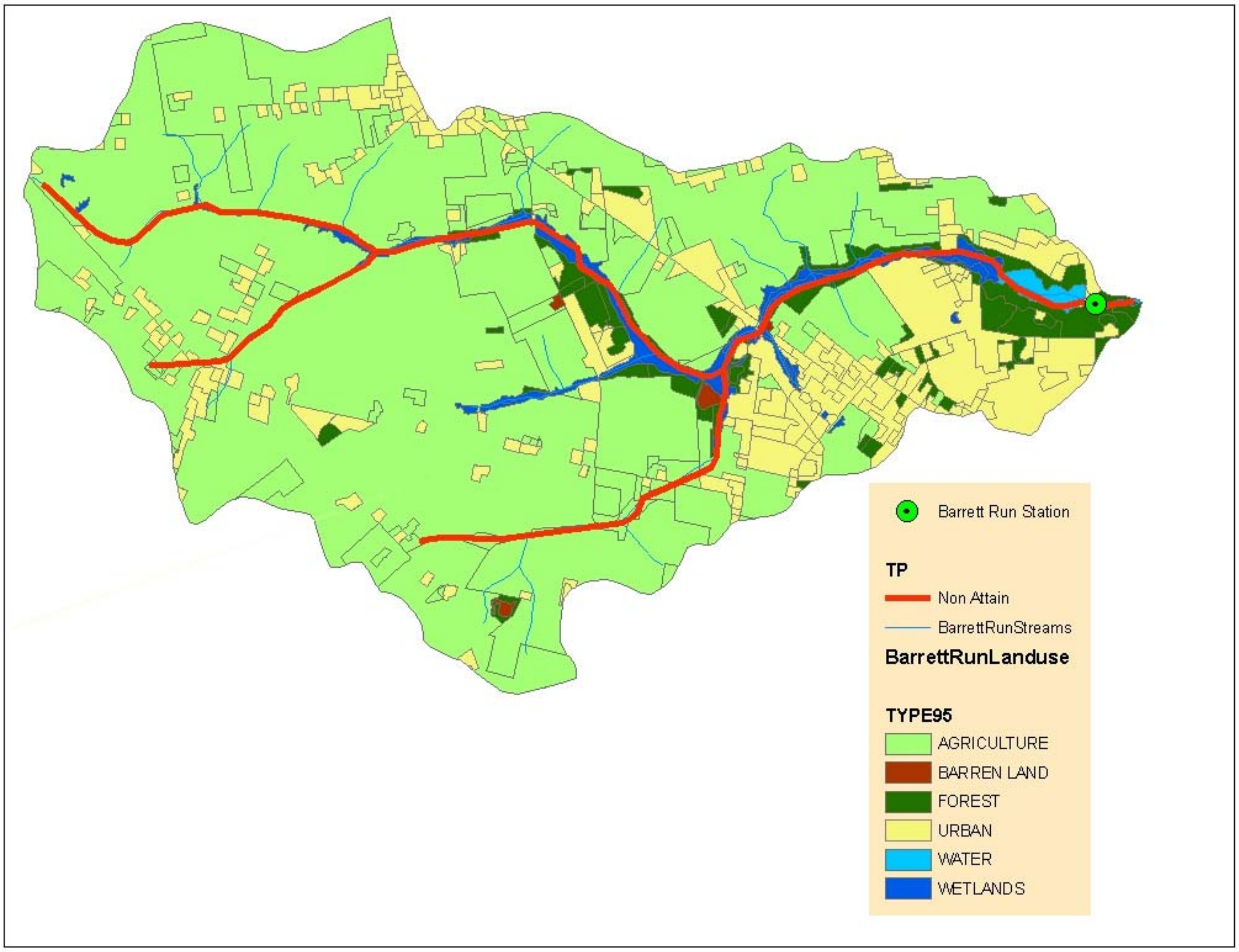

Barrett Run Station
TP
Non Attain
BarrettRunStreams
BarrettRunLanduse
TYPE95
AGRICULTURE
BARREN LAND
FOREST
URBAN
WATER
WETLANDS

Figure 3 Land Use of Cohansey River at Seeley (Site ID 01412800)

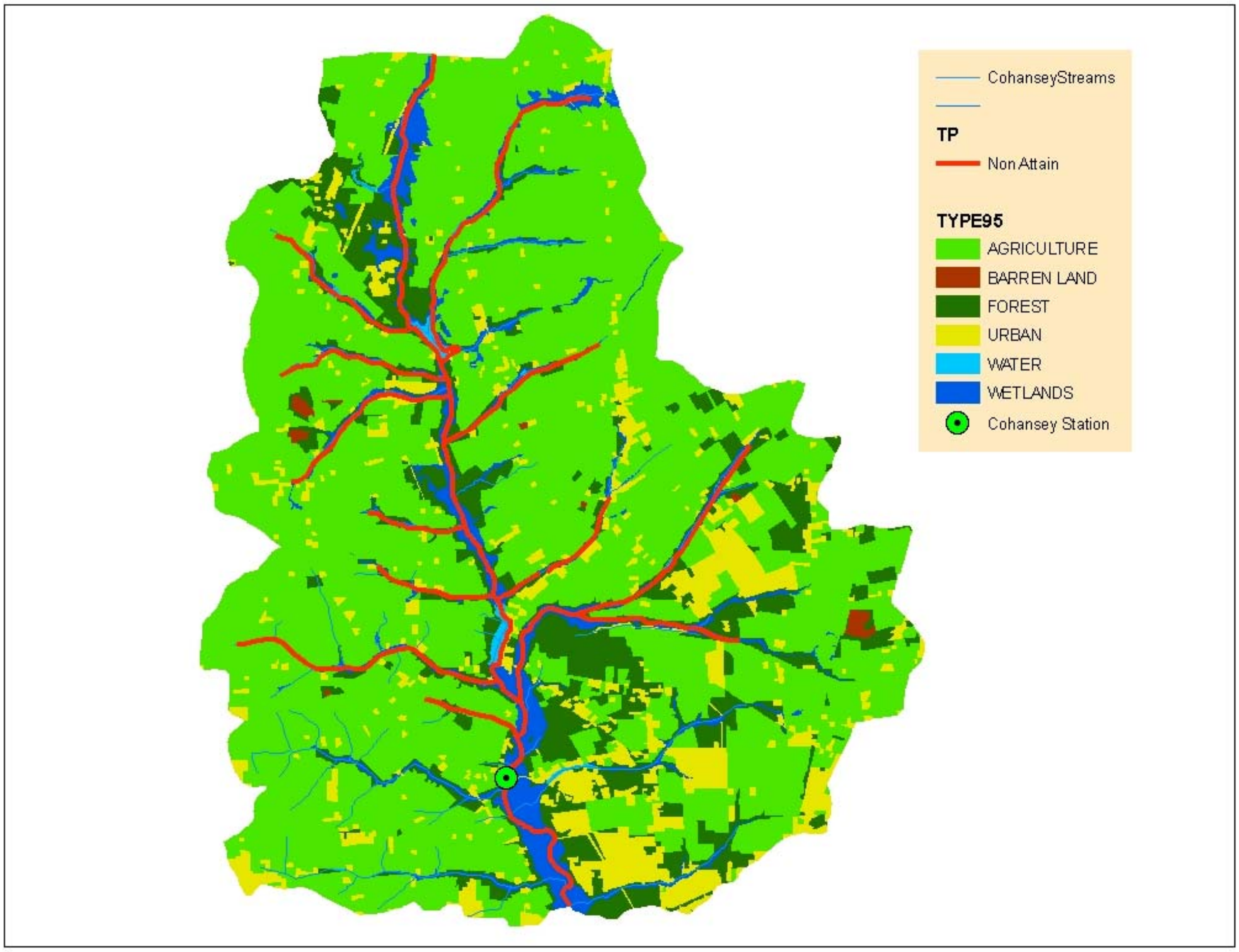
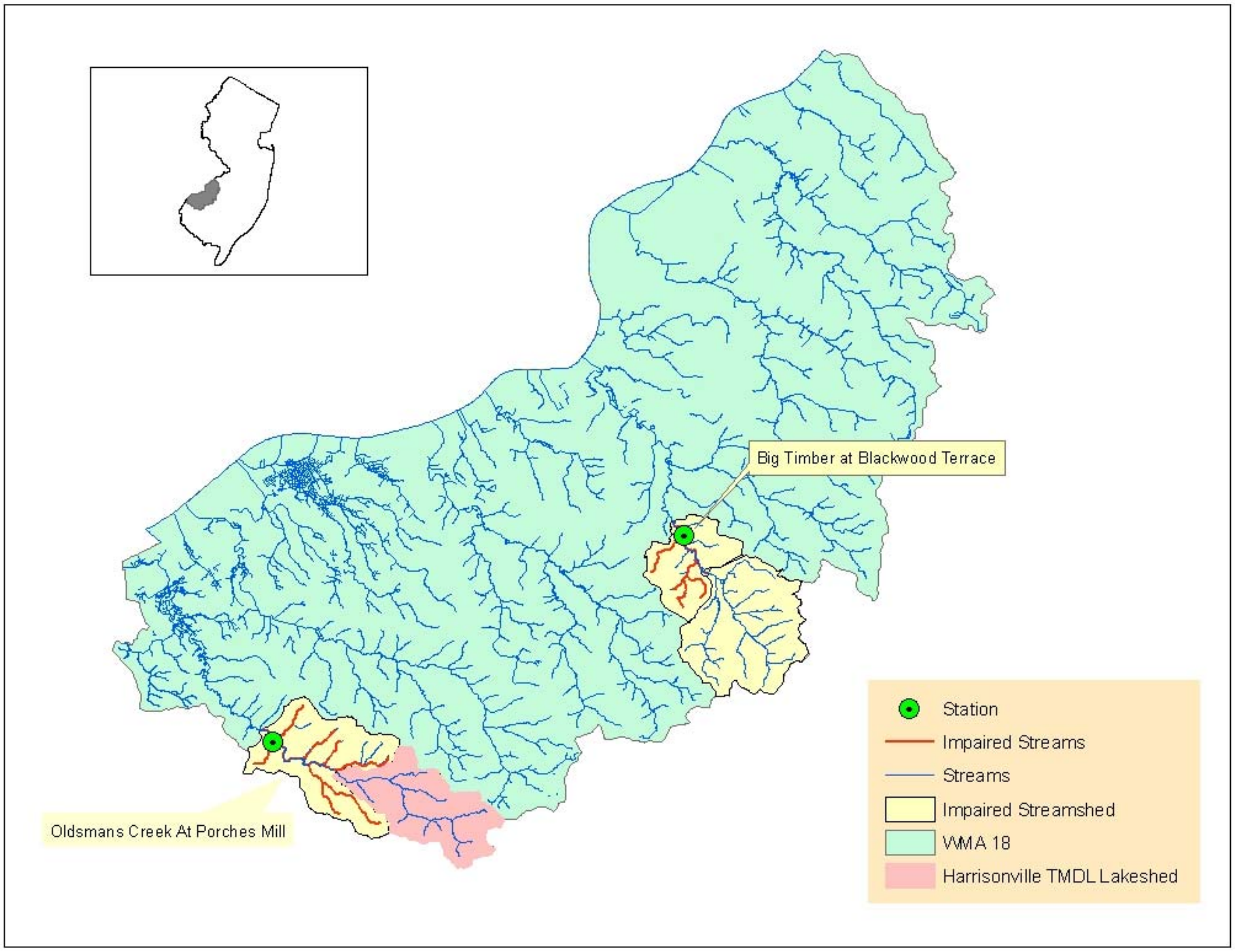


Figure 4 Spatial extent of impaired segments and affected drainage areas: WMA 18



WMA 18:

Watershed Management Area 18 includes Cooper River, Big Timber, Mantua, Newton, Oldmans, Pennsauken, Pompeston, Raccoon, Repaupo, and Woodbury Creeks, as well as Baldwin Run, Swede Run and Maple Swamp. This management area covers all or parts of Burlington, Camden and Gloucester counties, including 68 municipalities encompassing 391 square miles.

Big Timber Creek drains an area of 63 miles. The mainstem and most of the south branch divide Gloucester and Camden Counties before flowing into the Delaware River near Brooklawn, south of Camden. Major tributaries include Otter Creek, Beaver Brook, and Almonesson Creek. Major impoundments are Blackwood Lake, Grenloch Lake, Hirsch Pond, and Nash's Lake. This watershed is primarily urban/suburban with forests at the headwaters and cities at the mouth of Big Timber Creek.

Oldmans Creek drains an area of 44 square miles and flows on the Coastal Plain to the Delaware River. This Creek, 20 miles long, marks the boundary between Gloucester and Salem Counties. Tidal marshes exist at the mouth of this creek, while the western third of the creek is tidal. Major tributaries include Kettle Run and Beaver Creek. For the most part the watershed is agricultural and forested, with some residential and industrial development.

Land use in the affected drainage areas are presented in Table 4 and depicted in Figures 5 and 6.

Table 4 River miles, Watershed size, and Area by Anderson Land Use Classification

	Big Timber Creek Site ID 01467329	Oldmans Creek Site ID 01477510
River miles and drainage area		
Sublist 5 impaired river miles	9.4	16.3
Total river miles within watershed and included in the implementation plan	12.7	20.5
Watershed size (acres)	13451	7471
Landuse/Landcover (acres)		
agriculture	885.8	4343.58
medium / high density residential	3695.5	15.2
low density / rural residential	1224.4	894.3
commercial	778.9	18.4
industrial	161.7	9.3
mixed urban / other urban	1264.9	171.2
barren	751.0	83.23
forest	3255.9	1168.75
wetlands	1229.1	737.93
water	203.9	28.70
Total	**13451**	**7471**

Figure 5 Land Use of Big Timber Creek at Blackwood Terrace (Site ID# 01467329)

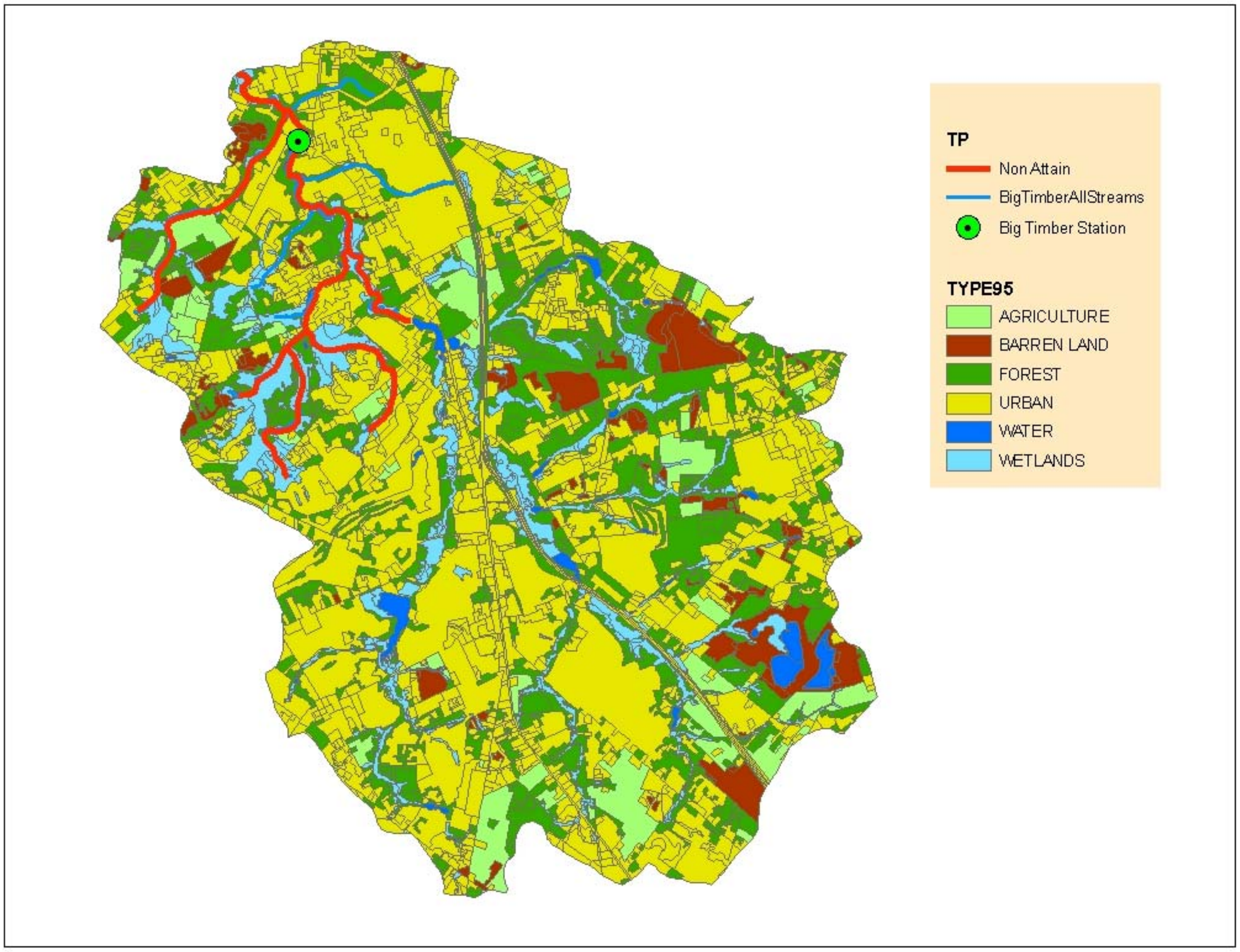


Figure 6 Land Use of Oldmans Creek at Porches Mill (Site ID # 01477510)

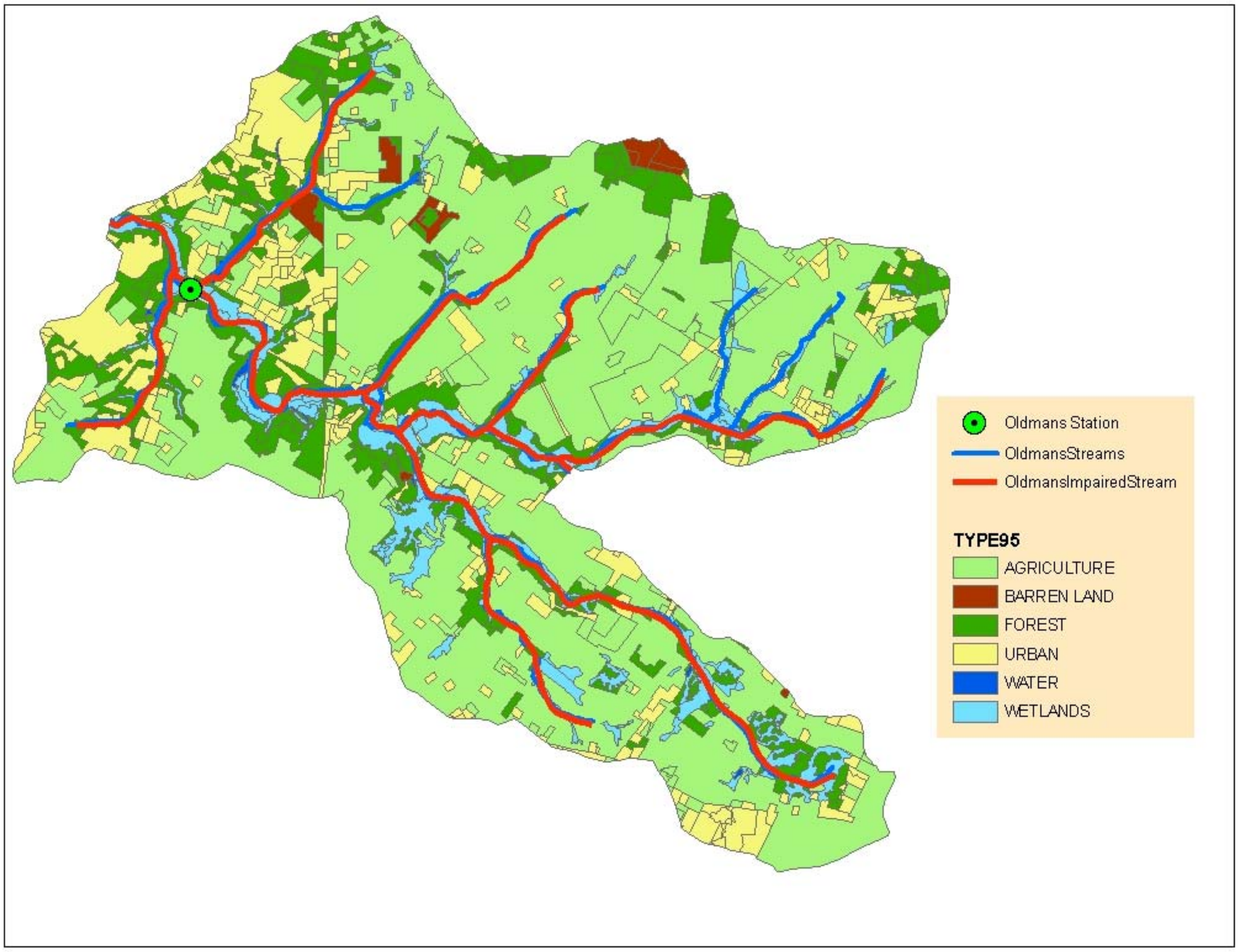
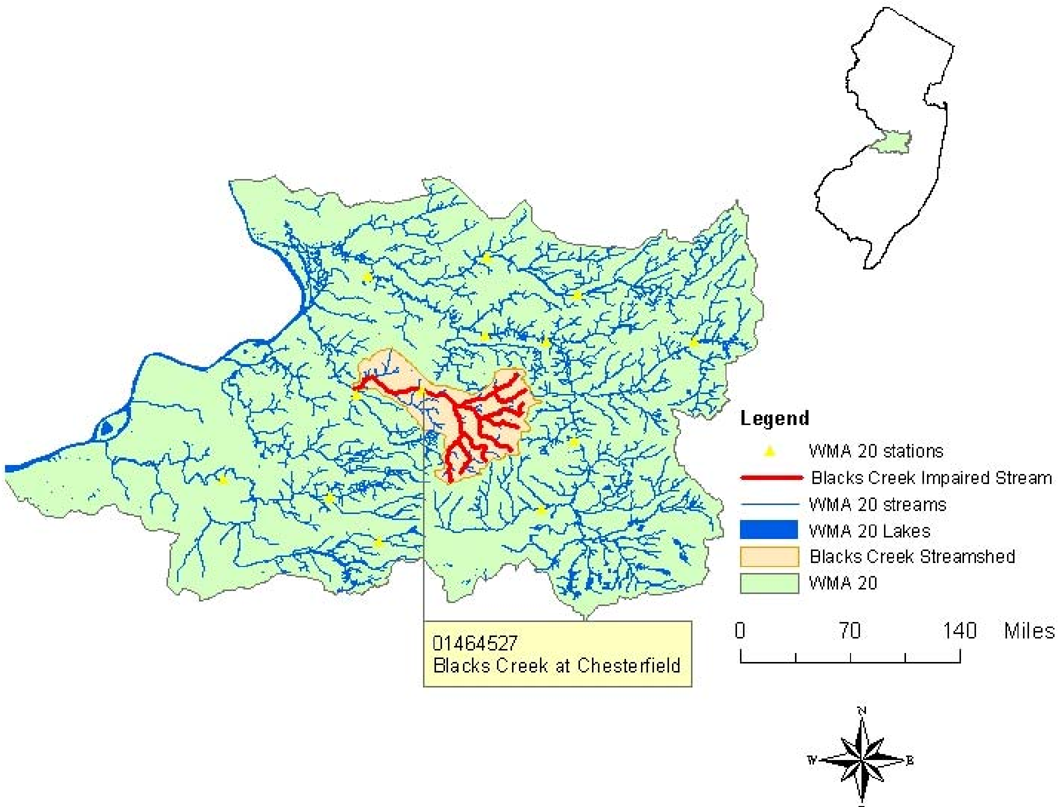


Figure 7 Spatial extent of impaired segment and affected drainage area: WMA 20



WMA 20:

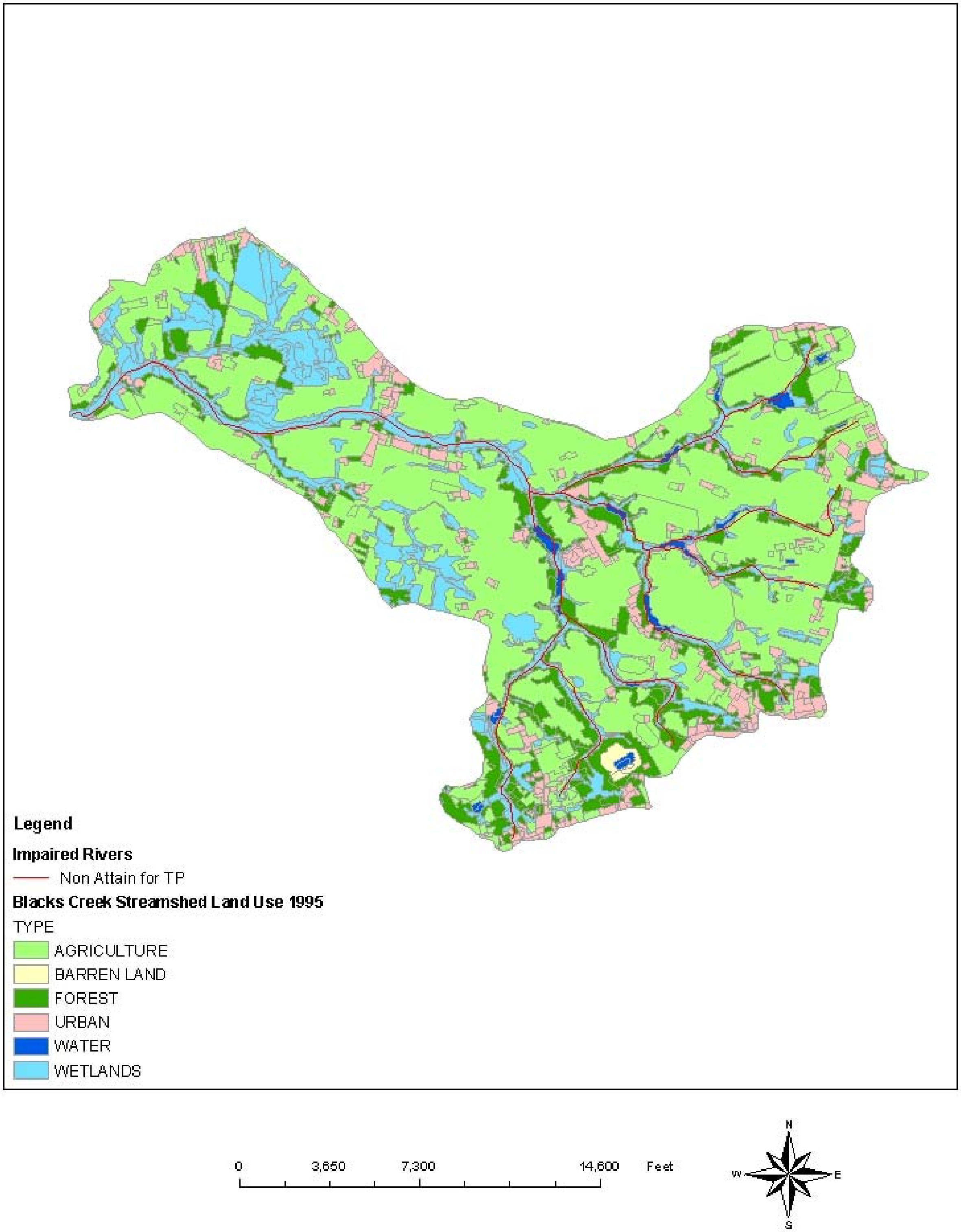
Watershed Management Area 20 includes the Assiscunk, Blacks, Crafts, Crosswicks, Doctors, Duck and Mill Creeks. This management area includes 26 municipalities spanning four counties: Burlington, Mercer, Monmouth and Ocean encompassing 253 square miles.

Crosswicks Creek is 25 miles long and drains an area of 146 square miles to the Delaware River at Bordentown. Major tributaries include Jumping Brook, Lahaway Creek, North Run and Doctors Creek. Tides affect this stream up to the Crosswicks Mill Dam. Allentown Lake, Oxford Lake, Prospertown Lake and Imlaystown Lake are major impoundments in the Crosswicks Creek Watershed. Important land uses in this watershed include agriculture, forest, residential/commercial and military installations. Land use in the affected drainage area is presented in Table 5 and depicted in Figure 8

Table 5 River miles, Watershed size, and Area by Anderson Land Use Classification WMA 20

	Blacks Creek at Chesterfield Site ID 01464527
River miles and drainage area	
Sublist 5 impaired river miles	20.8
Total river miles within watershed and included in the implementation plan	38.2
Watershed size (acres)	8645
Landuse/Landcover (acres)	
agriculture	4976
medium / high density residential	12.2
low density / rural residential	590.5
commercial	17.3
industrial	6.0
mixed urban / other urban	88.1
barren	30.5
forest	1199.5
wetlands	1621.0
water	103.6
Total	**8645**

Figure 8 Blacks Creek Land Use



The Department's Geographic Information System (GIS) was used to describe characteristics of the affected drainage area. The following is general information regarding the data used:

- Land use/Land cover was taken from: "NJDEP 1995/97 Land use/Land cover Update for New Jersey (by WMA)", published 12/01/2000 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), and delineated by watershed management area.

- "NJDEP 2004 Integrated Report Results for Non-Tidal Rivers", published 6/2004 by NJDEP, Watershed Assessment Group (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_river_conventionals2004.gif

- "NJDEP Streams of New Jersey (1:24000)", published 11/01/1998 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). Online at: http://www.state.nj.us/dep/gis/strmshp.html

- "NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC14)", published 4/5/2000 by NJDEP, New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- "NJDEP Total Maximum Daily Loads (TMDL) for Eutrophic Lakes", published 9/29/2003 by NJDEP, Bureau of Environmental Analysis and Restoration (BEAR). Online at http://www.state.nj.us/dep/gis/digidownload/zips/statewide/tmdl_lakes.zip

- "NJDEP TMDL Lakesheds", unpublished created by NJDEP, Bureau of Environmental Analysis and Restoration.

- "NJDEP 11 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC11)", published 4/5/2000 by NJDEP, New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc11.zip

- "NJDEP 2004 Integrated Report Stations on Non-Tidal Rivers (Conventionals and Toxics)", published 6/2004 by NJDEP, Water Assessment Team (WAT). Online at:

  http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_stations_river2004.gif

- "NJDEP Digital Elevation Grid for New Jersey (10 meter)", published 10/1/2004 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/wmalattice.html

- "Dams in New Jersey", created 6/2003 by NJDEP, Division of Watershed Management (DWM). Unpublished.

- "NJDEP County Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip

- "NJDEP Municipality Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stmun.zip

- "NJDEP Head of Tide Points for Watercourses of New Jersey", published 1986 by NJDEP, Office of Environmental Analysis (OEA), Coast Survey Ltd. (CTD). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/hot.zip

- New Jersey Environmental Management System (NJEMS)

4.0 Source Assessment

In order to evaluate and characterize phosphorus loadings in the waterbodies of interest in these TMDLs, and thus propose proper management responses, source assessments are critical. Source assessments include identifying the types of sources and their relative contributions to phosphorus loadings, in both time and space variables.

For the purposes of TMDL development, point sources include domestic and industrial wastewater treatment plants that discharge to surface water, as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Point sources contributing phosphorus loads within the affected drainage area are limited to stormwater point sources, including the Tier A municipalities listed in Appendix B. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through BMPs. The distinction is that stormwater point sources are regulated under the Clean Water Act.

For the purposes of TMDL development, potential nonpoint sources include stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. Tier B municipalities that are within the impaired stream segments are listed in Appendix B.

The phosphorus loads in the affected watersheds are contributed by stormwater point sources and nonpoint sources. These loads are effectively estimated using loading coefficients for land uses present in the watersheds. Therefore, watershed loads for total phosphorus were estimated using the Unit Areal Load (UAL) methodology, which applies pollutant export coefficients obtained from literature sources to the land use patterns within the watershed, as described in USEPA's Clean Lakes Program guidance manual (Reckhow, 1979b). Land use was determined using the Department's GIS system from the 1995/1997 land use coverage. The Department reviewed phosphorus export coefficients from an extensive database (Appendix A) and selected the land use categories and values shown in Table 6.

Table 6: Phosphorus export coefficients (Unit Areal Loads)

land use / land cover	LU/LC codes[1]	UAL (kg TP/ha/yr)
Mixed density residential	1100	1.2
medium / high density residential	1110, 1120, 1150	1.6
low density / rural residential	1130, 1140	0.7
Commercial	1200	2.0
Industrial	1300, 1500	1.7
mixed urban / other urban	other urban codes	1.0
Agricultural	2000	1.5
forest, wetland, water	1750, 1850, 2140, 2150, 4000, 5000, 6000, 7430, 8000	0.1
barren land	7000	0.5
Units:	1 hectare (ha) = 2.47 acres 1 kilogram (kg) = 2.2 pounds (lbs) 1 kg/ha/yr = 0.89 lbs/acre/yr	

5.0 Water Quality Analysis

The United States Geological Survey (USGS) in collaboration with NJDEP has collected monitoring data on the Cohansey River at Seeley (01412800), Big Timber Creek S Br at Blackwood Terrace (01467329) and Oldmans Creek at Porches Mill (01477510) since 1975. Data for Barrett Run at Bridgeton (01413013) and Blacks Creek at Chesterfield (01464527) has been collected beginning in 2000. An outlier was found in the Big Timber data set and was removed for the TMDL calculation (see Appendix C). Although the monitored stations and

[1] LU/LC code is an attribute of the land use coverage that provides the Anderson classification code for the land use. The Anderson classification system is a hierarchical system based on four digits. The four digits represent one to four levels of classification, the first digit being the most general and the fourth digit being the most specific description.

monitoring schedule have changed over the years, the historical data were reviewed to understand changes and trends in water quality, the most recent data was chosen for the TMDL calculations as best reflecting the current condition of the waterbodies. Thus, data that was collected before 1990 was excluded from the TMDL calculation. A summary of the data utilized in the TMDL is presented in Table 7, actual data is included in Appendix D

Table 7 Summary of Total Phosphorus sampling data

Water Quality Sample Locations	Site Number	Date Years	# of samples	Average (mg/L)	% exceeding 0.05 mg/L	% exceeding 0.1 mg/L
Barrett Run at Bridgeton	01413013	2000-2002	8	0.07	25 %	25%
Cohansey River at Seeley	01412800	1975-2003	65	0.06	53.8%	13.8%
Big Timber Creek S Br at Blackwood Terrace	01467329	1975-1997	41	0.11	82.5%	26.8%
Oldmans Creek at Porches Mill	01477510	1975-1997	40	0.11		32.5%
Blacks Creek at Chesterfield	01464527	2000-2003	12	0.15		66.7%

Figure 9 Location of monitoring site on Barrett Run at Bridgeton (Site ID # 01413013)

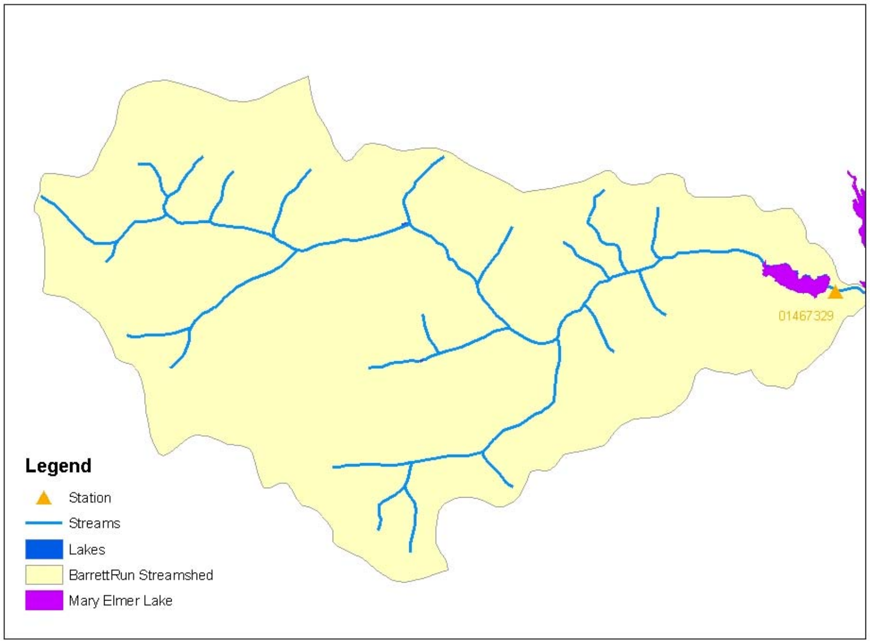


Figure 10 Location of monitoring site on Cohansey River at Seeley (Site ID # 01412800)

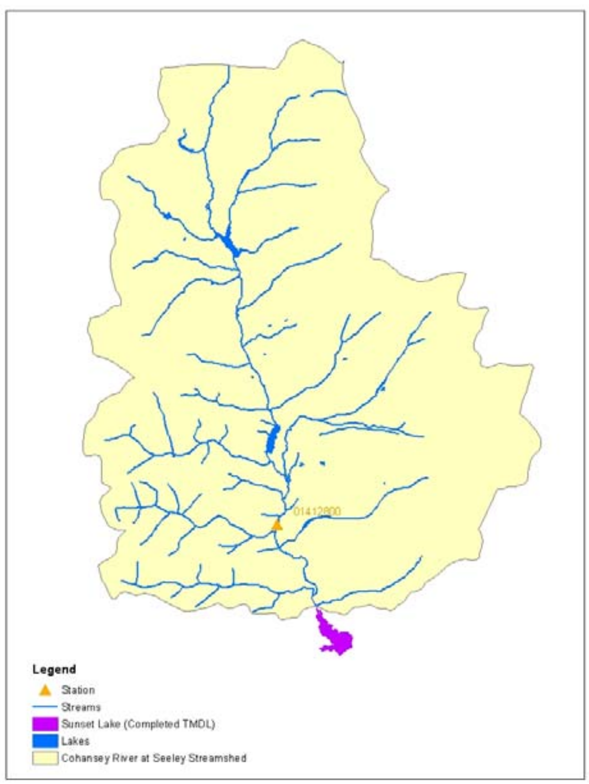


Figure 11 Location of monitoring site on Big Timber Creek SB at Blackwood Terrace (Site ID # 01467329)

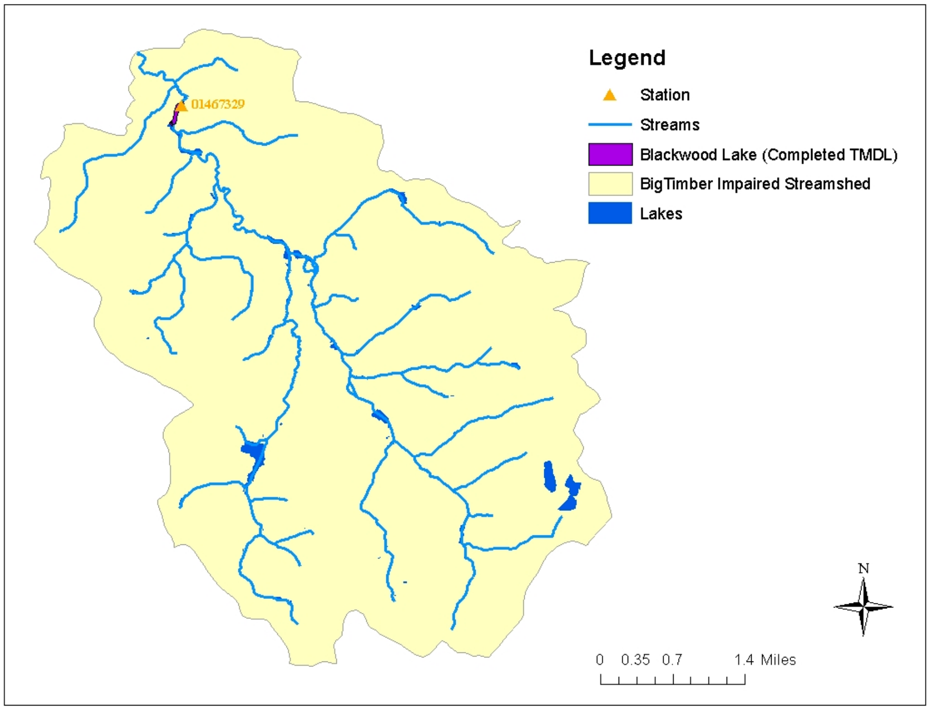


Figure 12 Location of monitoring site on Oldmans Creek at Porches Mill (Site ID # 01477510)

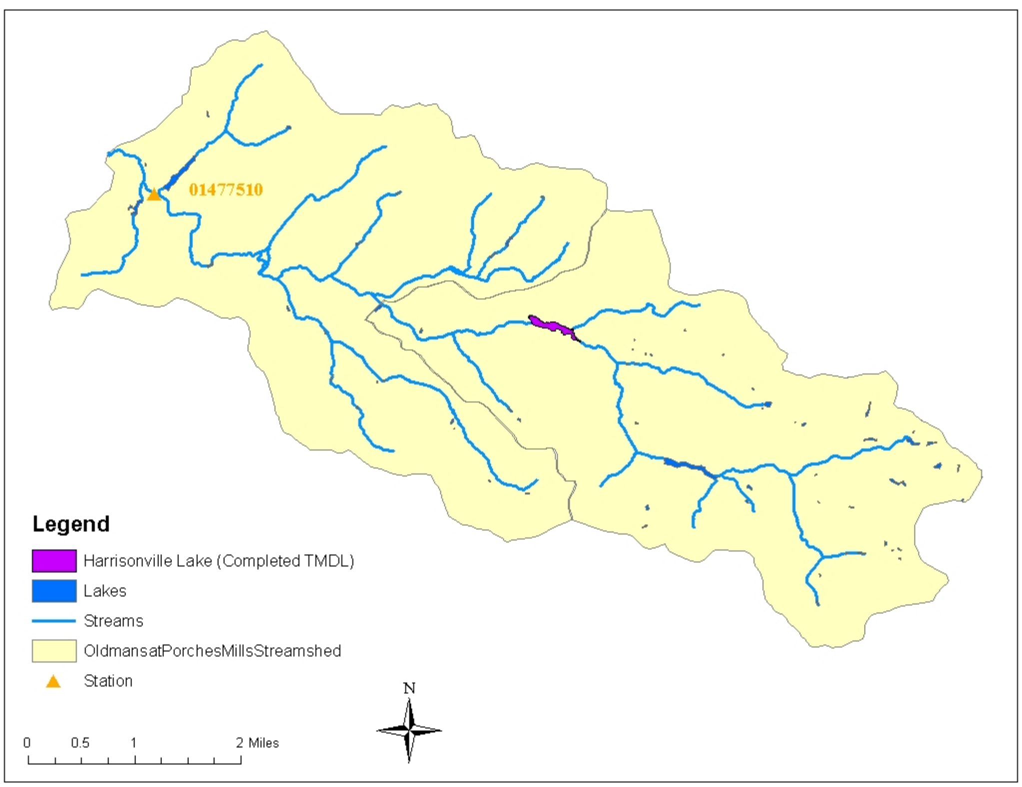
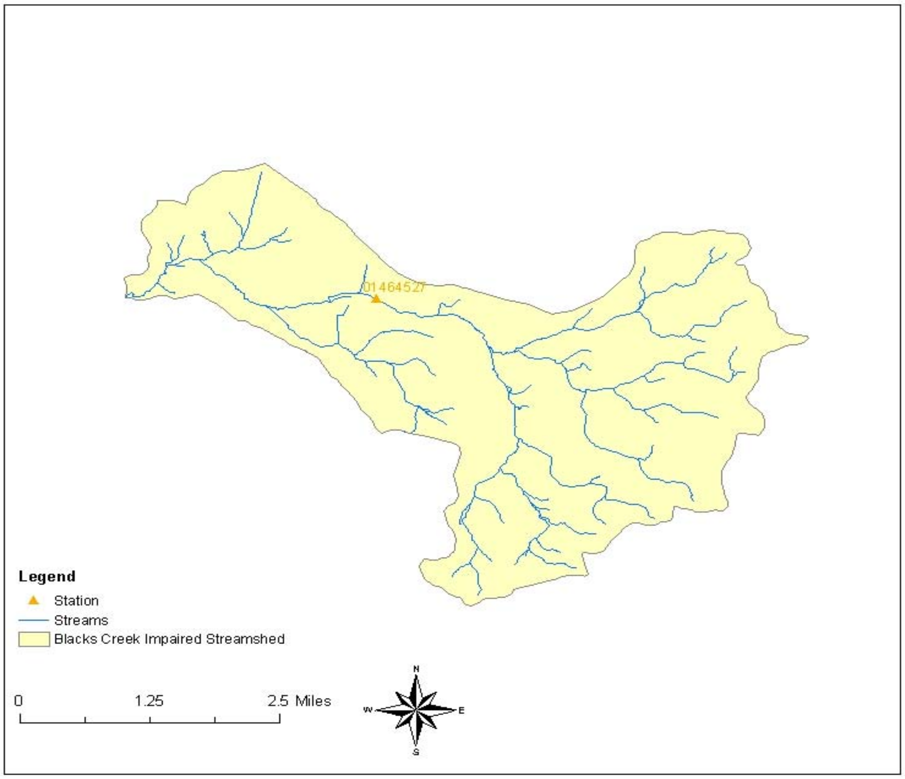
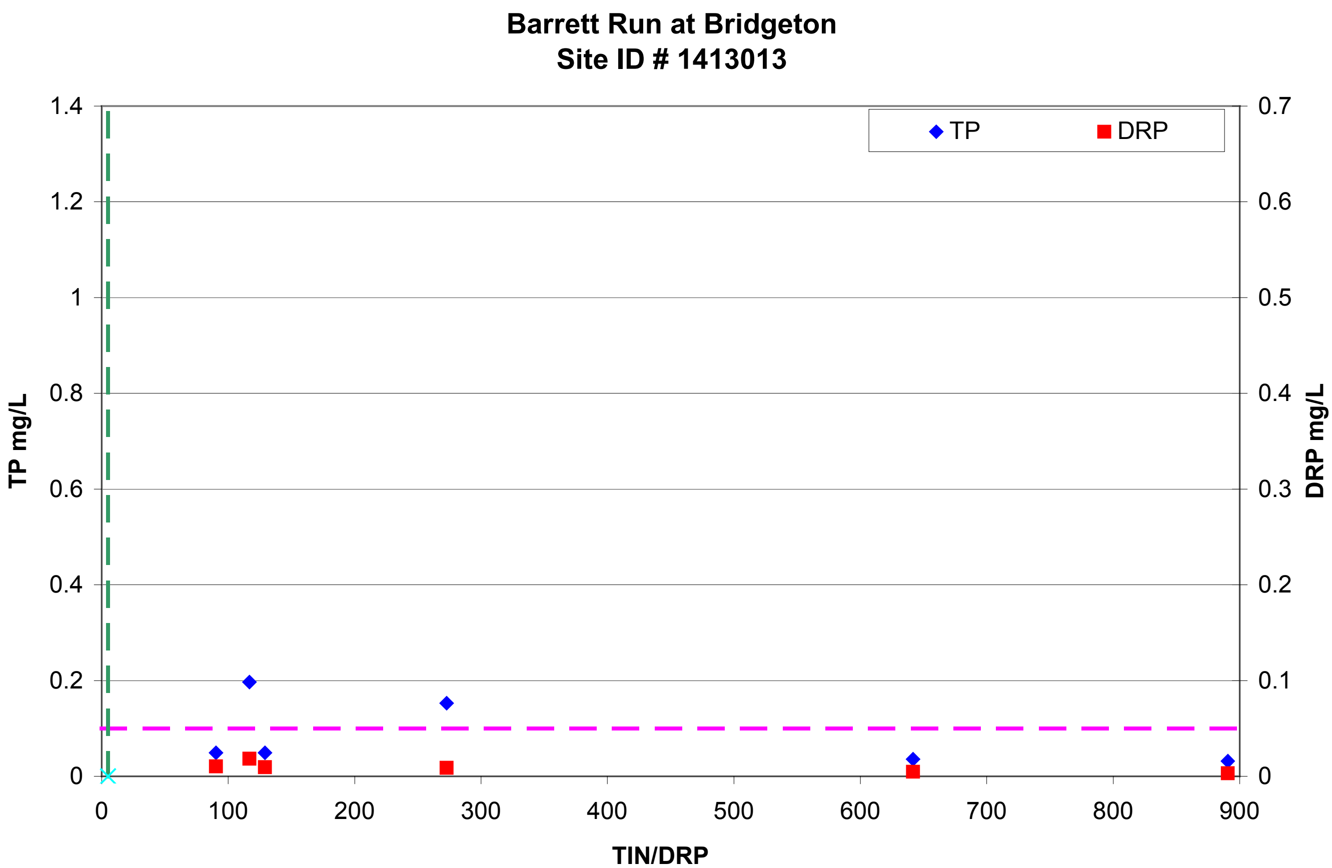


Figure 13 Location of the monitoring site on Blacks Creek (Site ID #01464527)



The Department's March 2003 guidance document, entitled *"Technical Manual for Phosphorus Evaluations (N.J.A.C. 7:9B-1.14(c)) for NJPDES Discharge to Surface Water Permits"*, recommends considering ratios of nitrogen and phosphorus to suggest whether phosphorus is the limiting nutrient. When the ratio of total inorganic nitrogen (TIN) to total orthophosphate (TOP) or dissolved reactive phosphorus (DRP) is smaller than or equal to 5, then phosphorus is not limiting the system. This document may be downloaded from the Department's web page at www.state.nj.us/dep/dwq/techmans/phostcml.pdf. This analysis was performed on all the waterbodies for which this data was available and Figures 14-18 depict the relationship of these two key nutrients at for each of the impaired stream segments. A more detailed explanation of the nitrogen-phosphorus relationship is given in Appendix E.

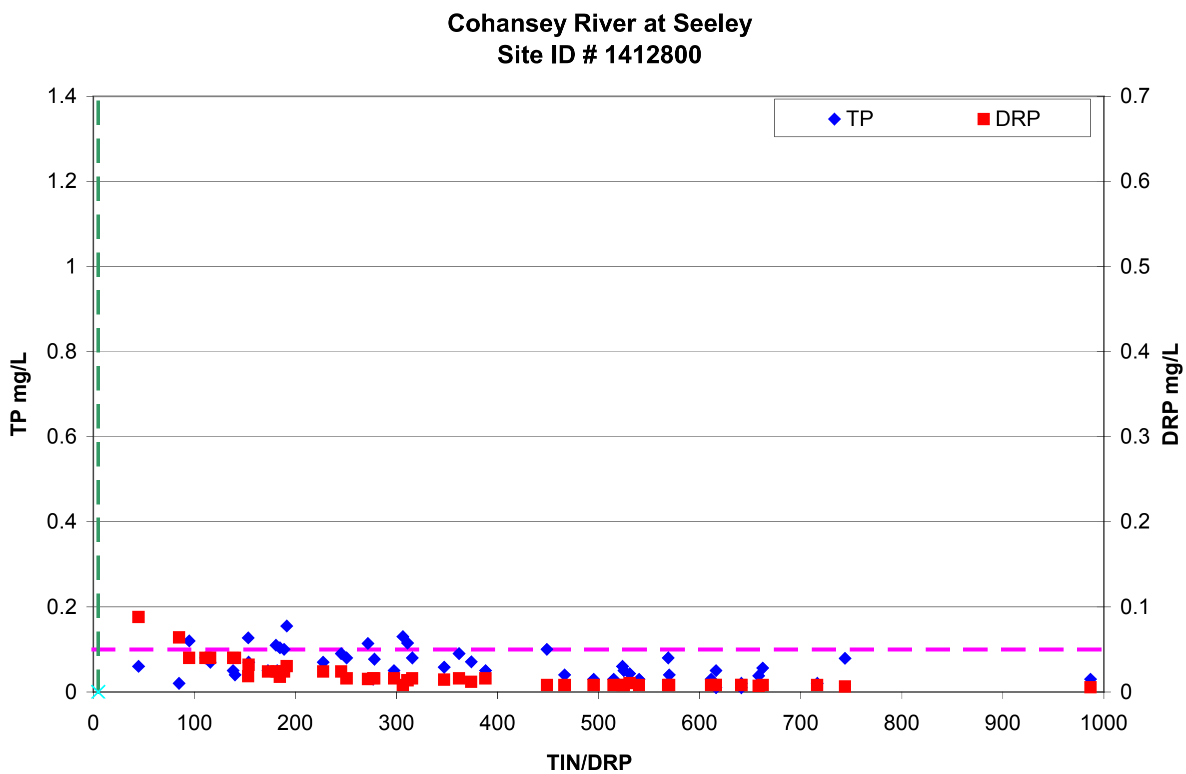
Figure 14 Limiting Nutrient Analysis for Barrett Run at Bridgeton (01413013)



TIN = dissolved nitrite, nitrate and ammonia. TIN calculated as: a sum of dissolved ammonia (P00608) & dissolved nitrite and nitrate (P00631) or a sum of total ammonia (P00610) and total nitrite & nitrate (P00630)
DRP = dissolved reactive phosphorus: orthophosphorus (P00671) if available, or 80% dissolved phosphorus (P00666)

The above figure depicts the relationship of these two key nutrients at Barrett Run at Bridgeton Station. At this station, when the total phosphorus exceeded 0.1 mg/L and the DRP < 0.05 mg/L, the ratio TIN/DRP greatly exceeds 5. This suggests that phosphorus is the limiting nutrient and the criterion applies.

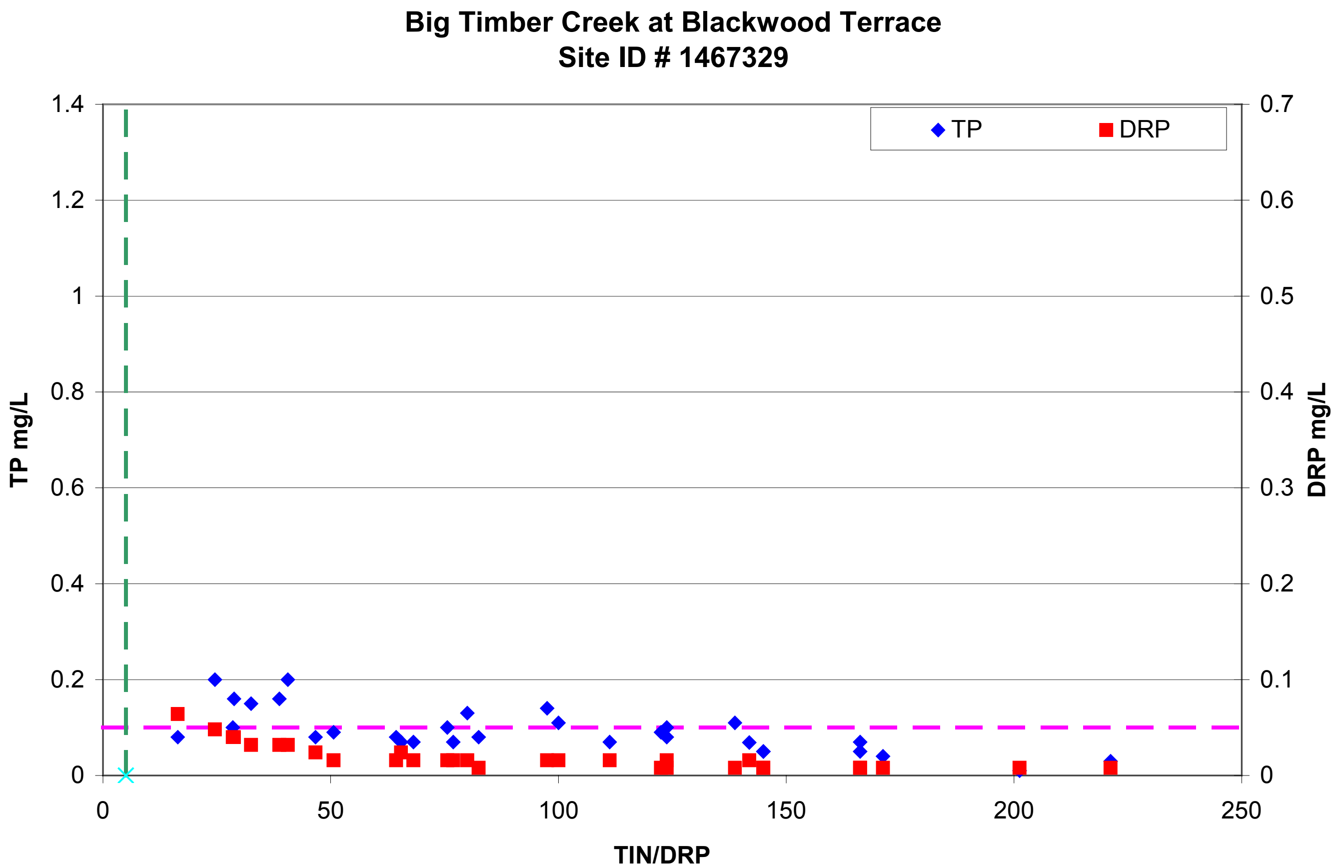
Figure 15 Limiting Nutrient Analysis for Cohansey River at Seeley (01412800)



TIN = dissolved nitrite, nitrate and ammonia. TIN calculated as: a sum of dissolved ammonia (P00608) & dissolved nitrite and nitrate (P00631) or a sum of total ammonia (P00610) and total nitrite & nitrate (P00630)
DRP = dissolved reactive phosphorus: orthophosphorus (P00671) if available, or 80% dissolved phosphorus (P00666)

The above figure depicts the relationship of these two key nutrients at the Cohansey River at Seeley Station. At this station, when the total phosphorus exceeded 0.1 mg/L and the DRP < 0.05 mg/L, the ratio TIN/DRP greatly exceeds 5. This suggests that phosphorus is the limiting nutrient and the criterion applies.

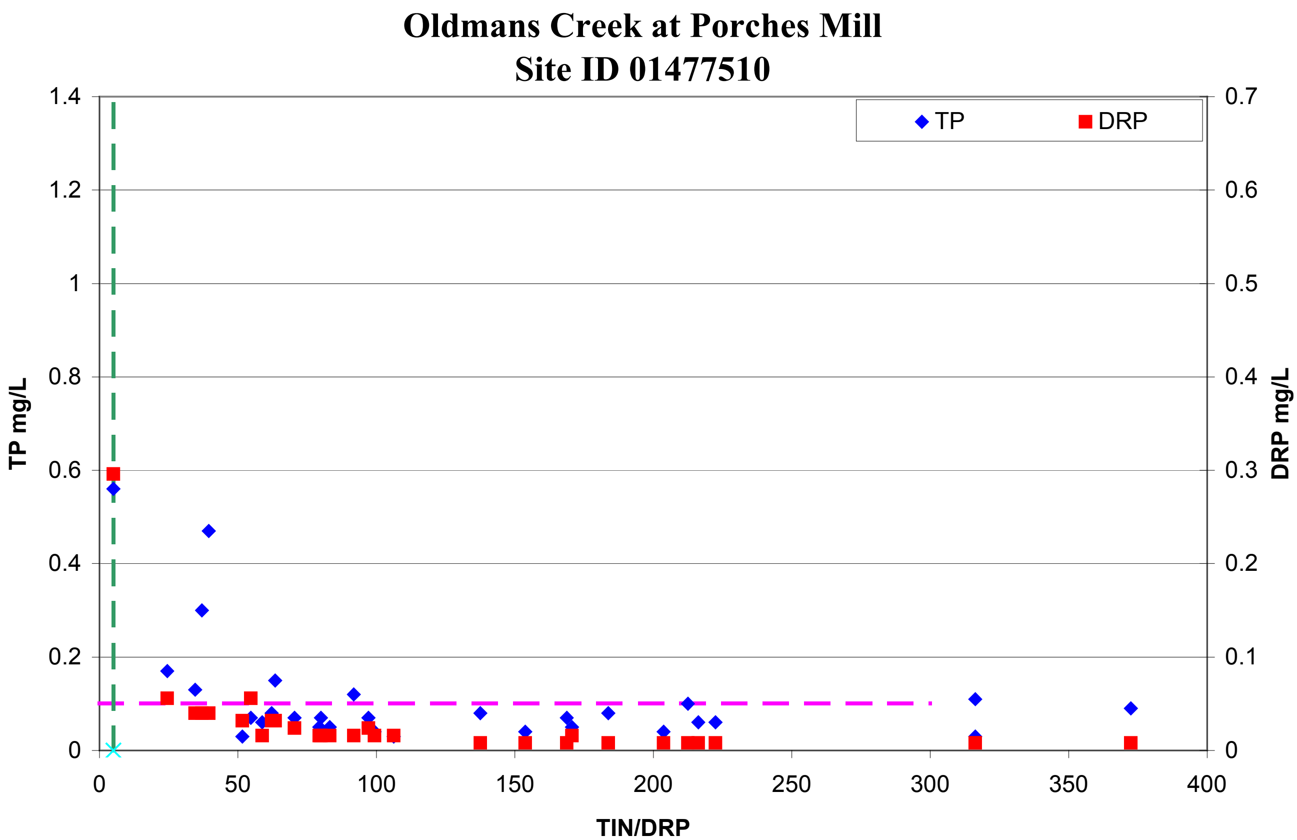
Figure 16 Limiting Nutrient Analysis for Big Timber Creek (01467329)



TIN = dissolved nitrite, nitrate and ammonia. TIN calculated as: a sum of dissolved ammonia (P00608) & dissolved nitrite and nitrate (P00631) or a sum of total ammonia (P00610) and total nitrite & nitrate (P00630)
DRP = dissolved reactive phosphorus: orthophosphorus (P00671) if available, or 80% dissolved phosphorus (P00666)

The above figure depicts the relationship of these two key nutrients at the Big Timber Creek at Blackwood Terrace Station. At this station, when the total phosphorus exceeded 0.1 mg/L and the DRP < 0.05 mg/L, the ratio TIN/DRP greatly exceeds 5. This suggests that phosphorus is the limiting nutrient and the criterion applies.

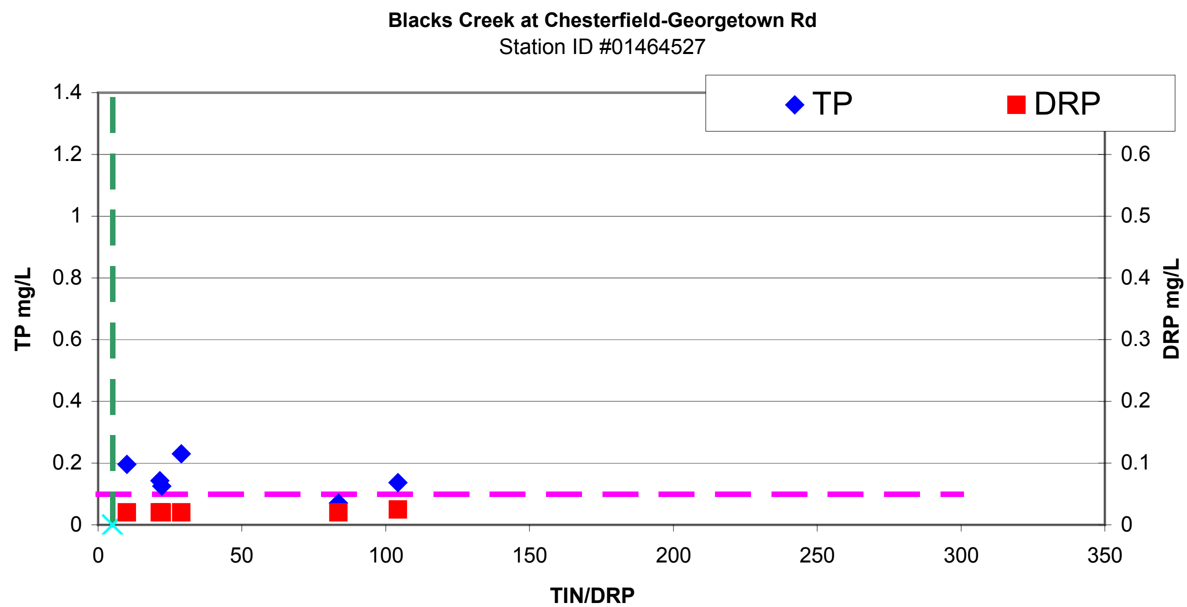
Figure 17 Limiting Nutrient Analysis for Oldmans at Porches Mill Station ID # (01477510)



TIN = dissolved nitrite, nitrate and ammonia. TIN calculated as: a sum of dissolved ammonia (P00608) & dissolved nitrite and nitrate (P00631) or a sum of total ammonia (P00610) and total nitrite & nitrate (P00630)
DRP = dissolved reactive phosphorus: orthophosphorus (P00671) if available, or 80% dissolved phosphorus (P00666)

The above figure depicts the relationship of these two key nutrients at the Oldmans Creek at Porches Mills Station. At this station, when the total phosphorus exceeded 0.1 mg/L and the DRP < 0.05 mg/L, the ratio TIN/DRP greatly exceeds 5. This suggests that phosphorus is the limiting nutrient and the criterion applies.

Figure 18 Limiting Nutrient Analysis for Blacks Creek at Chesterfield-Georgetown Rd Station ID # (01464527)



TIN = dissolved nitrite, nitrate and ammonia. TIN calculated as: a sum of dissolved ammonia (P00608) & dissolved nitrite and nitrate (P00631) or a sum of total ammonia (P00610) and total nitrite & nitrate (P00630)
DRP = dissolved reactive phosphorus: orthophosphorus (P00671) if available, or 80% dissolved phosphorus (P00666)

The above figure depicts the relationship of these two key nutrients at the Blacks Creek at Chesterfield-Georgetown Road. At this station, when the total phosphorus exceeded 0.1 mg/L and the DRP < 0.05 mg/L, the ratio TIN/DRP exceeds 5. This suggests that phosphorus is the limiting nutrient and the criterion applies.

Seasonal Variation/Critical Conditions

The application of a flow-integrated regression technique for determining loading reductions for impaired segments works well in watersheds that exhibit most of the loading exceedances from nonpoint and stormwater point sources of pollution. The analytical technique used to calculate these TMDLs represents the entire range of flows and all seasons for which the total phosphorus data were collected. Since the technique uses data from annual monitoring programs, seasonal variation and critical conditions are incorporated into the analysis by assessing the loadings over the entire range of flows. Therefore, the method implicitly represents all seasonal meteorological and hydrological conditions. The loading reduction calculated to attain SWQS will do so under all conditions, according to the data available. In this way, the TMDL addresses seasonal variation and critical conditions.

6.0 TMDL Calculations

A regression technique, derived from a load duration method (Stiles 2002), was developed by the Department for data-limited TMDLs where nonpoint and stormwater point sources are predominant. For this technique, linear regression is used to develop a flow-integrated relationship between measured pollutant concentrations and the associated flows at a single monitoring site. The method, known as the Flow-Integrated Reduction of Exceedances (FIRE), provides an accurate estimation of the load that will not cause an exceedance of the water quality standard. The FIRE method is applied over the entire range of flows, eliminating the need to establish a single target flow to estimate an average annual loading reduction. For this approach, calculated phosphorus loads based on actual data are plotted against corresponding flows. The regression relationship between the load and flow for exceedances of the SWQS is established and the regression line drawn. The target load line corresponding with the TP concentration of 0.1 mg/L is plotted on the same graph with the linear exceedance regression line. For this technique, a zero-intercept for the regression line is assumed. The zero intercept is within the 95 percent confidence interval, so the zero intercept cannot be rejected as the point of origin. In addition, given the predominance of nonpoint sources, at zero flow there would be zero load. Given parallel slopes, the difference between the two lines is equal to the per cent load reduction needed to attain SWQS. The resultant percent reduction is the same whether the y-axis is expressed as pounds per day, pounds per year, or as metric units of kilograms per day or per year.

A Margin of Safety (MOS) must be provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). A MOS accounts for uncertainty in the loading estimates, physical parameters and the model itself. The MOS, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). For this TMDL calculation, an explicit MOS has been incorporated as described below.

A percent loading reduction that includes a margin of safety is estimated by taking the difference between the upper 95 percent confidence limit of the slope of the exceedance regression line and the slope of the target loading. The margin of safety component is the difference between the exceedance regression line and the 95 percent confidence limit for the regression.

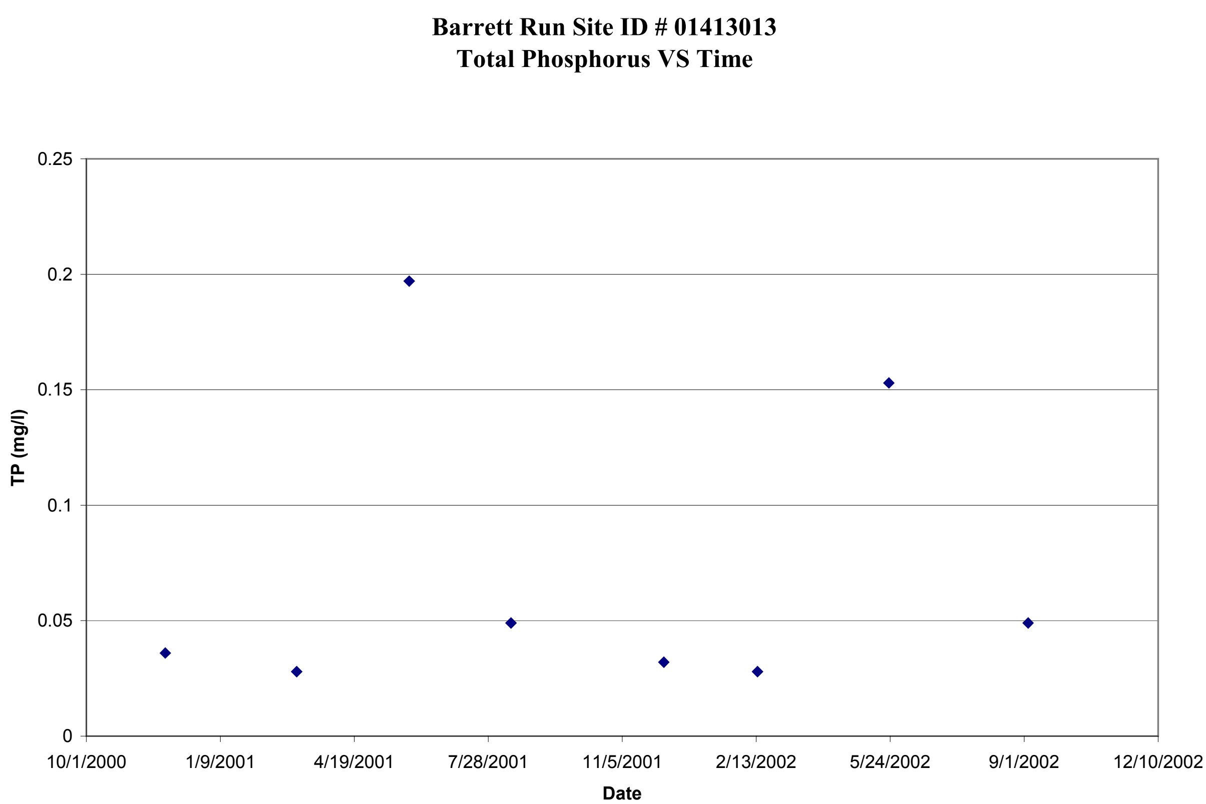
Results from applying the technique for Cohansey River at Seeley, Big Timber at Blackwood Terrace, Oldmans Creek at Porches Mills and Blacks Creek at Chesterfield-Georgetown Rd impairements are presented below. For Barrett Run at Bridgeton the regression technique discussed above could not be used, due to the lack of flow data. An alternative method was used in this segment and is explained below.

Watershed Management Area 17:

Barrett Run at Bridgeton:

The Barrett Run stream segment lies within the watershed of Mary Elmer Lake, which has an approved lake TMDL. The segment was evaluated to determine if the loading reduction needed to meet the in-stream criterion or that which was calculated to be needed to meet the lake criterion in the previous TMDL would drive stream segment TMDL. For the Barrett Run stream segment, (01413013), the FIRE method could not be applied because of the lack of flow data. The load reduction that would be needed to attain compliance in the stream was tested by assuming a linear relationship between load reduction and in-stream concentration exists. The load reduction needed to attain the SWQS for streams was calculated, based on the highest recorded data point. The station lies at the outlet of Mary Elmer Lake; because this lake has an approved TMDL it is expected that the water quality at this station will be reflective of attainment of the lake criterion, and therefore 0.05mg/l was used as the target concentration. Data for these stations is presented in Figure 19.

Figure 19 Barrett Run Estimated Percent Reduction Using an Alternative Method



The reduction required to achieve a SWQS of 0.05 mg/L for the highest TP concentration result (0.197 mg/L) is 74.6 %. The total phosphorus reduction, as calculated from the Reckhow model for the Mary Elmer Lakeshed, is 91%. It is concluded that the 91% load reduction needed to address the impairment in Mary Elmer Lakeshed, will attain the in stream SWQS of 0.1 mg/L TP, and the expected water quality of 0.05 mg/L because the station is at the lake outlet.

Cohansey River at Seeley:

The Cohansey River at Seeley stream segment lies within the watershed of Sunset Lake, which has an approved lake TMDL. The station is a tributary to the lake and, to be conservative, the 0.05 mg/l criterion that applies as the tributary enter the lake, was used as the endpoint. The segment was evaluated to determine if the loading reduction to meet the in-stream criterion or the loading reduction to meet the lake criterion from the approved TMDL would drive the stream segment TMDL. For the Cohansey River stream segment, (01412800), the load reduction needed to attain the endpoint for the stream was calculated, using the FIRE Method presented in Figure 20 and Table 8.

Figure 20 Estimated Percent Reduction for the Cohansey River at Seeley Using a Regression Method

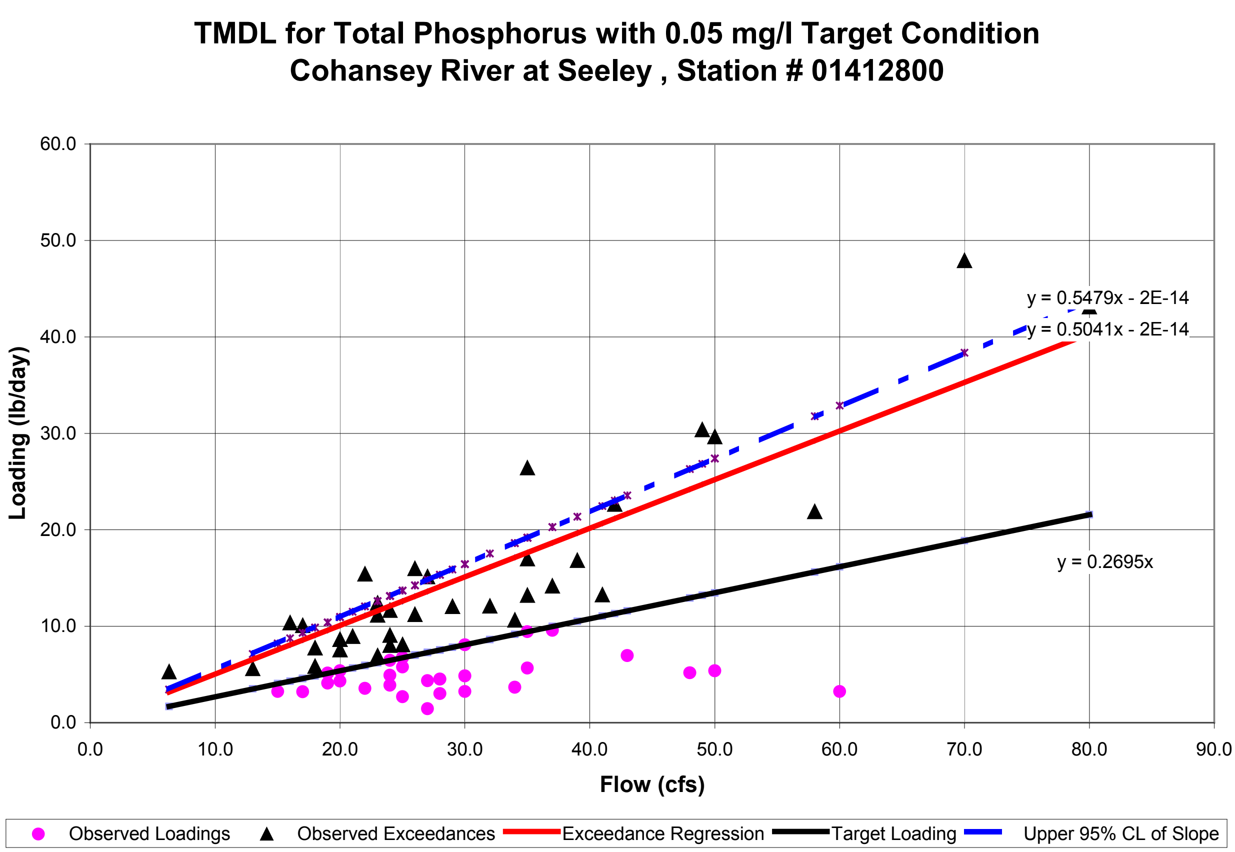


Table 8 Cohansey River at Seeley

Results from Regression Analysis	
Target Loading Slope	= 0.2695
Exceedance Regression Slope	= 0.5041
Upper 95% Confidence Limit of Slope	= 0.5479

To achieve SWQS within the Cohansey impaired segment, the required reductions are as follows:

Target Load (lb/day) for the given TP endpoint:

= 0.2695 x flow (cfs)

Overall Percent TP Loading Reduction, including MOS

$$(1-\frac{0.2695}{0.5479})x100\% = 0.5081x100\% = 50.8\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{0.5041}{0.5479})x100\% = 0.0799x100\% = 7.99\%$$

The reduction required to achieve the 0.05 mg/l TP endpoint in the stream using the FIRE method is 50.8%. The total phosphorus reduction required as calculated from the Reckhow model for the Sunset Lake Lakeshed is 92%. It is concluded that the 92% load reduction needed to address the impairment in Sunset Lakes will attain the endpoint of 0.05 mg/L TP in stream and, therefore the Lake TMDL will apply.

Watershed Management Area 18:

Big Timber Creek SB at Blackwood Terrace:

The Big Timber Creek at Blackwood Terrace stream segment lies within the watershed of Blackwood Lake, which has an approved lake TMDL. The segment was evaluated to determine if the reduction to meet the criterion in-stream or the reduction to meet the lake criterion from the approved TMDL would drive the stream segment TMDL. The station is located at the outlet of the lake; because this lake has an approved TMDL it is expected that the water quality at this station will be reflective of the lake quality and therefore 0.05mg/l was used as an endpoint. For the Big Timber Creek stream segment, (01467329), the load reduction needed to attain the endpoint was calculated, using the FIRE Method presented in Figure 21 and Table 9.

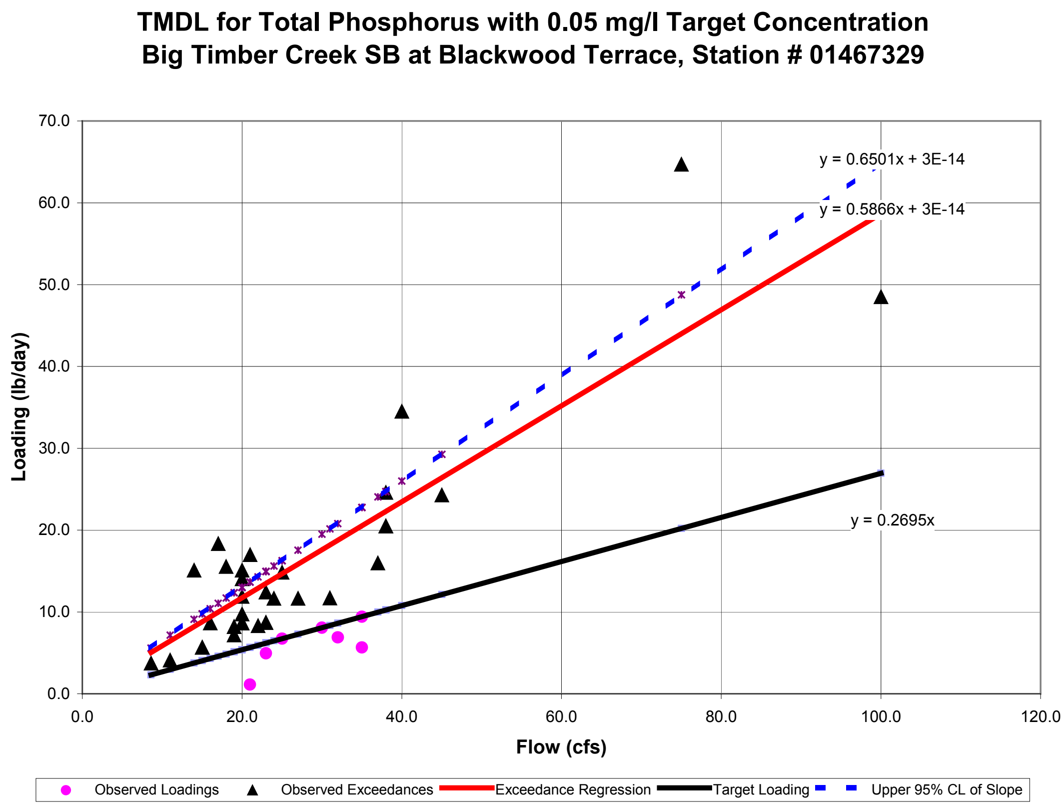


Figure 21 Estimated Percent Reduction for Big Timber Creek SB at Blackwood Terrace Using a Regression Method

Table 9 Big Timber Creek at Blackwood Terrace

Results from Regression Analysis		
Target Loading Slope	=	0.2695
Exceedance Regression Slope	=	0.5866
Upper 95% Confidence Limit of Slope	=	0.6501

To achieve SWQSs within the Big Timber Creek impaired segment, the required reductions are as follows:

Target Load (lb/day) for the given TP endpoint:

= 0.2695 x flow (cfs)

Overall Percent TP Loading Reduction, including MOS:

$$(1-\frac{0.2695}{0.6501})x100\% = 0.5854x100\% = 58.54\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{0.5866}{0.6501})x100\% = 0.0977x100\% = 9.77\%$$

The reduction required to achieve the 0.05 mg/l of phosphorus endpoint in stream using the FIRE method is 58.5%. The total phosphorus reduction required, as calculated from the Reckhow model for the Blackwood Lake Lakeshed, is 88%. It is concluded that the 88% load reduction needed to address the impairment in Blackwood Lake will attain the endpoint of 0.05 mg/L TP in stream; therefore; the Lake TMDL will apply.

Oldmans Creek at Porches Mill:

Figure 22 Estimated Percent Reduction for Oldmans Creek at Porches Mills Using a Regression Method

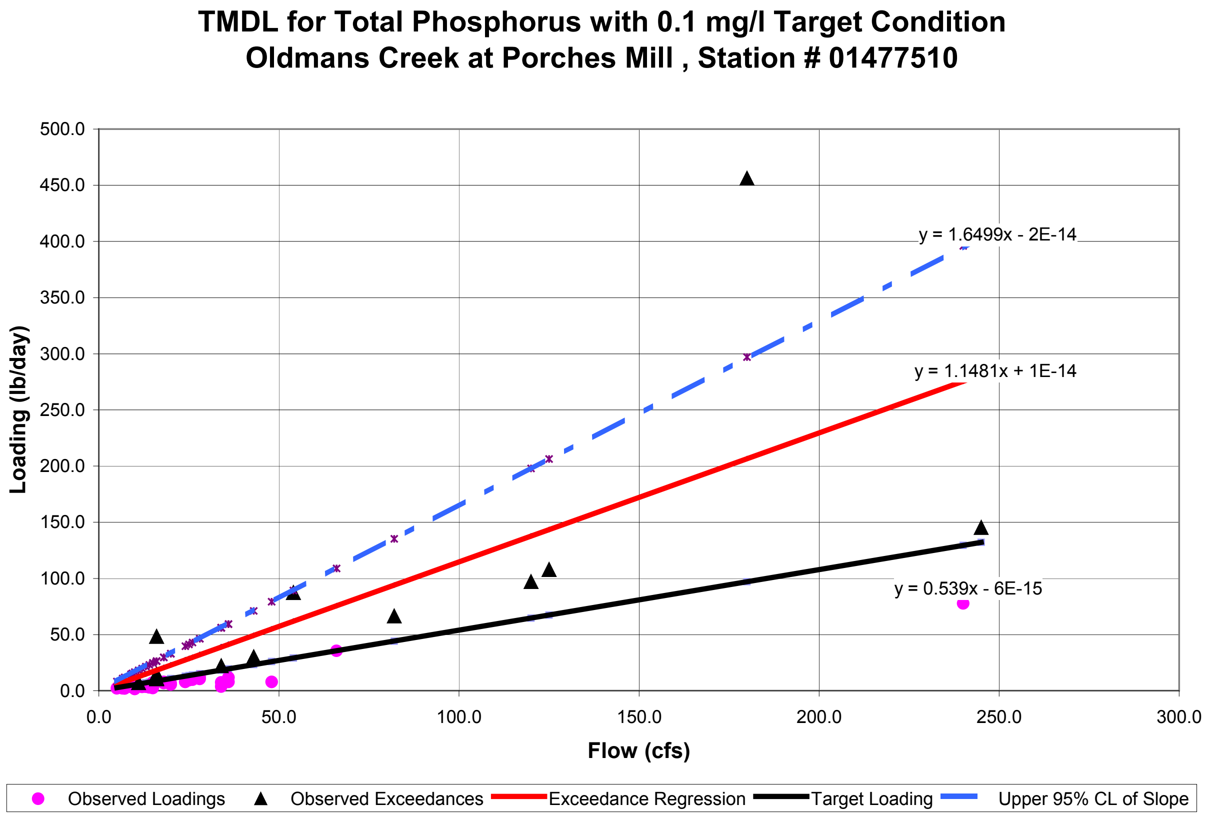


Table 10: Oldmans Creek at Porches Mills

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	1.1481
Upper 95% Confidence Limit of Slope	=	1.6499

To achieve SWQSs within the Oldmans Creek impaired segment, the required reductions are as follows:

Target Load (lb/day) for the given TP SWQS:

= 0.539 x flow (cfs)

Overall Percent TP Loading Reduction, including MOS:

$$(1-\frac{0.539}{1.6499})x100\% = 0.6733x100\% = 67.3\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{1.1481}{1.6499})x100\% = 0.3042x100\% = 30.4\%$$

Watershed Management Area 20:

Blacks Creek at Chesterfield:

Figure 23 Estimated Percent Reduction for Blacks Creek at Chesterfield-Georgetown Rd. Using a Regression Method

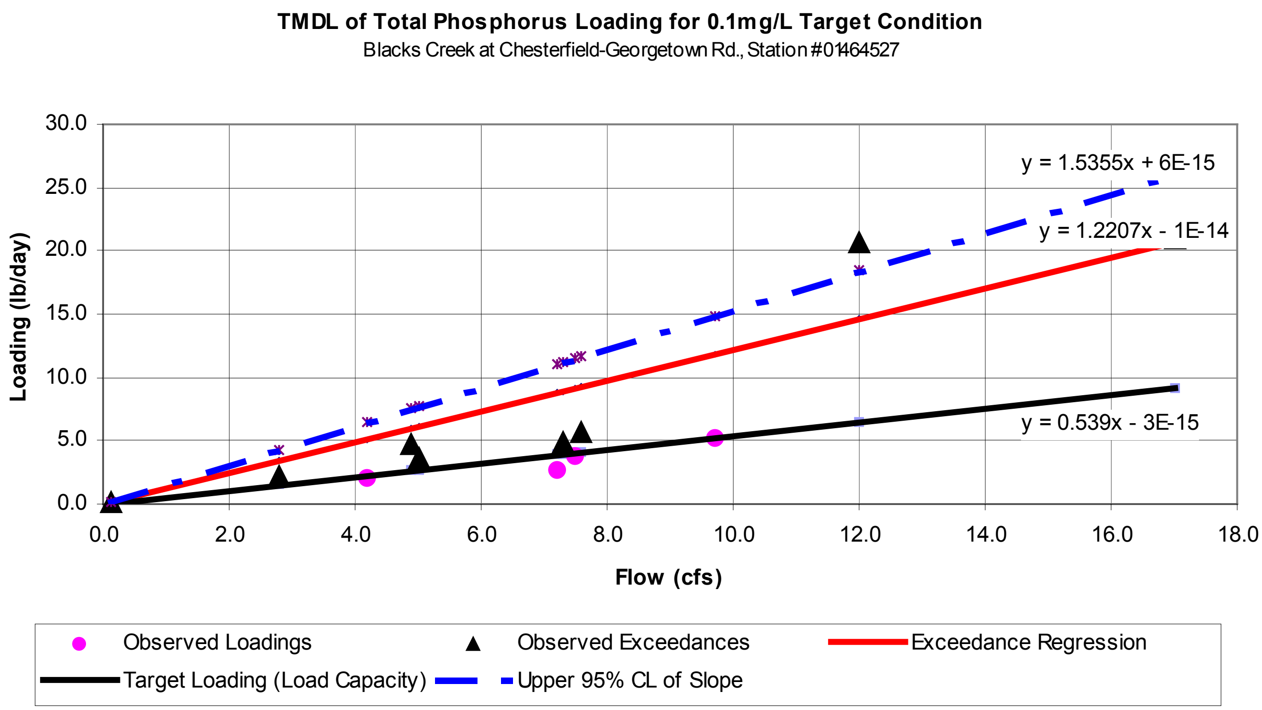


Table 11 Blacks Creek at Chesterfield-Georgetown Rd. (01464527)

Results from Regression Analysis		
Target Loading Slope (Load Capacity)	=	0.5390
Exceedance Regression Slope	=	1.2207
Upper 95% Confidence Limit of Slope	=	1.5355

To achieve SWQSs within the Blacks Creek impaired segment, the required reductions are as follows:

Target Load (lb/day) for the given TP SWQS:

= 0.539 x flow (cfs)

Overall Percent TP Loading reduction, including MOS:

$$(1-\frac{0.539}{1.5355})x100\% = 0.6489x100\% = 64.9\%$$

MOS component of reduction is calculated as follows:

$$\text{MOS} = (1-\frac{1.2207}{1.5355})x100\% = 0.2050x100\% = 20.5\%$$

To determine the TMDL for each stream segment, the target load is calculated as shown above. The load that corresponds to the MOS is calculated and then subtracted from the target load. The result is the allocable load. Loads from some land uses, specifically forest, wetland, water and barren land, are not adjustable because there are no measures that can reasonably be applied to runoff from these sources to reduce the loads generated. As a result, existing loads from these sources are equal to the future loads. Therefore, in order to achieve the TMDL, the load reduction from land uses for which reduction measures can reasonably be applied must be increased proportionally. Additional detail on the method used to derive load reductions that are assigned to each land use from the FIRE outputs is provided in Appendix F.

Wasteload Allocations and Load Allocations

WLAs are established for all point sources, while LAs are established for nonpoint sources, as these terms are defined in "Source Assessment." There are no point sources, other than stormwater point sources, in the affected streamsheds. Both WLAs and LAs are expressed as percent reductions for particular stream segments, and are differentiated as discussed below.

Stormwater discharges can be a point source or a nonpoint source, depending on NJPDES regulatory jurisdiction, yet the suite of measures to achieve reduction of loads from stormwater discharges is the same, regardless of this distinction. Stormwater point sources receiving a WLA are distinguished from stormwater generating areas receiving a LA on the basis of land use. This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing

WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously. Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore allocations are established according to source categories as shown in Table 12. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the residential, commercial, industrial and mixed urban runoff source categories that are not NJPDES-regulated. Nothing in these TMDLs shall be construed to require the Department to regulate a stormwater source under NJPDES that would not already be regulated as such, nor shall anything in these TMDLs be construed to prevent the Department from regulating a stormwater source under NJPDES.

Table 12 Distribution of WLAs and LAs among source categories

Source category	**TMDL allocation**
Nonpoint and Stormwater Sources	
medium / high density residential	WLA
low density / rural residential	WLA
commercial	WLA
industrial	WLA
Mixed urban / other urban	WLA
agricultural	LA
forest, wetland, water	LA
barren land	LA

Wasteload allocations and load allocations for sources within the drainage area of the impaired segments are presented in Tables 13 through 19 and Figures 24 through 30.

Watershed Management Area 17

Barrett Run at Bridgeton

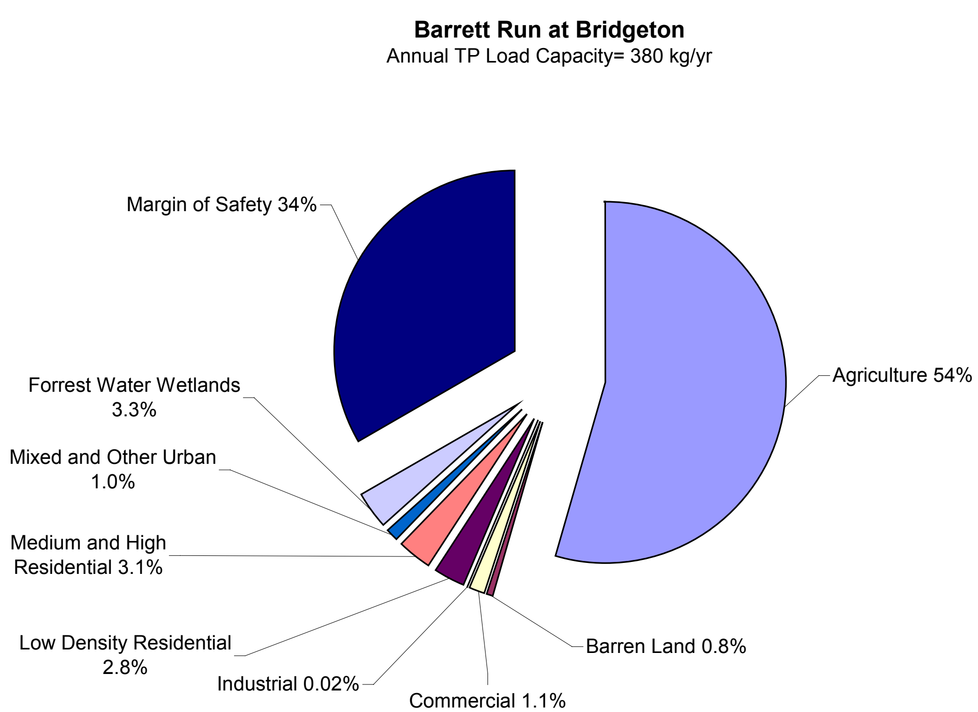
Table 13 Final TMDL calculations for Barrett Run (from Mary Elmer Lake TMDL Approved 9/30/2003)

	Barrett Run		**% reduction**
	kg TP/yr / (lb/yr)	**% of LC**	
Loading capacity (LC)	380 (836)	100%	n/a
Load allocation			
Point Sources other than Stormwater	N/a		
Nonpoint and Stormwater Sources			
medium / high density residential	12 (26.4)	3.0%	91%
low density / rural residential	11 (24.2)	2.9%	91%

	Barrett Run		% reduction
	kg TP/yr / (lb/yr)	% of LC	
commercial	4.4 (9.68)	1.1%	91%
industrial	0.1 (.22)	0.02%	91%
mixed urban / other urban	3.8 (8.36)	1.0%	91%
agricultural	210 (462)	54%	91%
forest, wetland, water	13 (28.6	3.3%	0%
barren land	2.9 (6.38)	0.8%	0%
Lake Deposition	0.6 (1.23)	0.2%	0%
Margin of Safety	129 (284)	34 %	n/a

*Percent reductions shown for individual sources are necessary to achieve overall reductions
+ Loadings and reductions were not recalculated but were taken from the Approved TMDL

Figure 24 Final Phosphorus Allocations for Barrett Run at Bridgeton



Cohansey River at Seeley

TMDL calculations using both the FIRE Method (Table 14, Figure 25) and Reckhow Model (Table 15, Figure 26) are shown below. As previously stated the TMDL calculations for Sunset Lake using the Reckhow Model is more stringent and therefore represents the final TMDL for the Cohansey at Seeley stream segment.

Table 14 TMDL calculations for Cohansey River at Seeley Stream Segment using FIRE Method

	Cohansey River			
	Kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	Percent Reduction
Loading capacity (LC)	11218.2	5998 (13,195.6)	100%	n/a
	Existing Load	Load Allocation		
Point Sources	N/A			
Nonpoint and Stormwater Sources				
medium / high density residential	106.52	51.38 (114.0)	0.9%	51.8 %
low density / rural residential	454.07	219.0 (481.8)	3.7%	51.8 %
commercial	104.25	50.3 (110.7)	0.8%	51.8 %
industrial	44.18	21.3 (46.9)	0.4%	51.8 %
mixed urban / other urban	209.04	100.8 (221.8)	1.7%	51.8 %
agricultural	10092.9	4868.3 (10710.3)	81.2%	51.8 %
forest, wetland, water	192.93	192.9 (424.4)	3.0%	0%
barren land	14.33	14.3 (31.5)	0.2%	0%
Margin of Safety	N/A	479.5 (1054.9)	8.0%	n/a

*Percent reductions shown for individual sources are necessary to achieve overall reductions

Figure 25 Phosphorus Allocations for Cohansey at Seeley Stream Segment

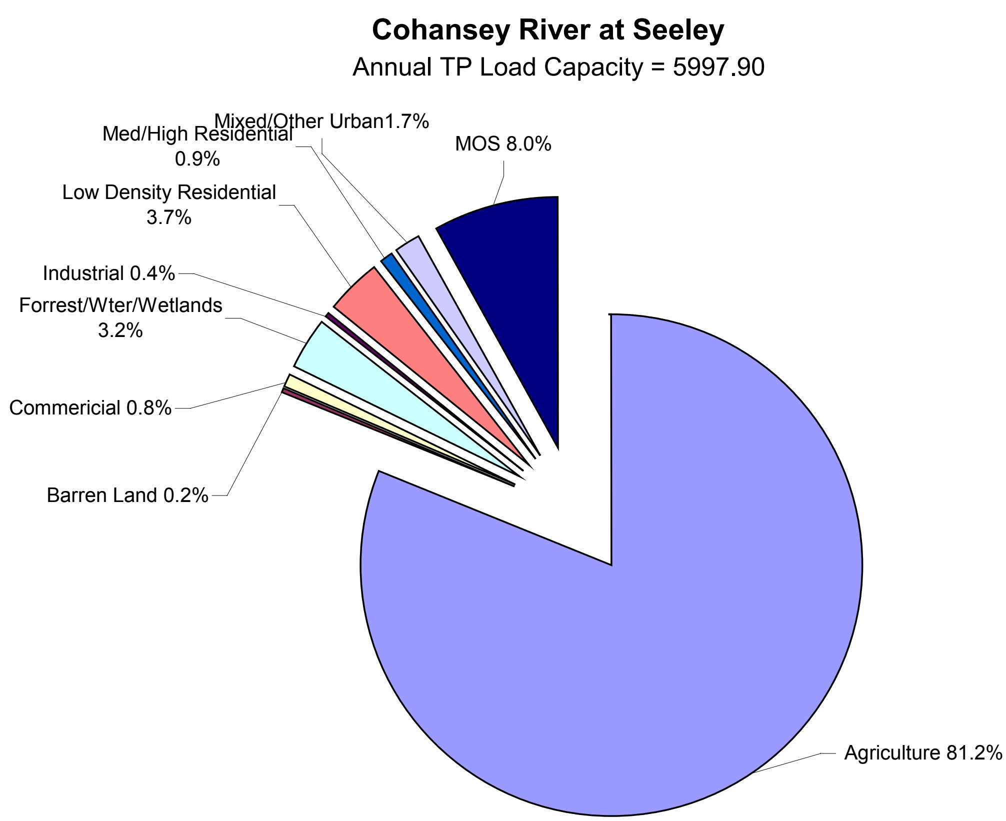
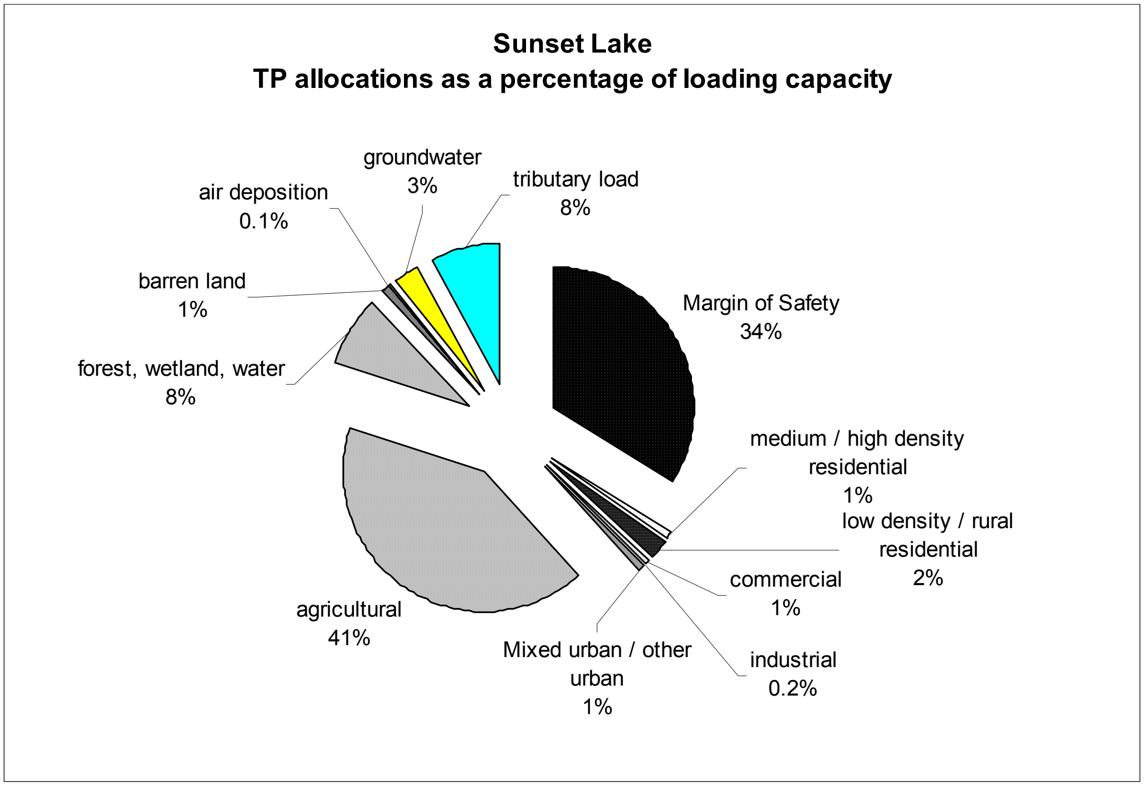


Table 15 Final TMDL Calculations for Cohansey River at Seeley based on the Sunset Lake TMDL (Approved 9/30/2003)

Lake	% reduction	Sunset Lake	
	kg TP/yr (lbs/yr)	% of lC	
loading capacity (LC)	2500 (5500)	100%	n/a
Point Sources other than Stormwater			
minor municipal	n/a		
Nonpoint and Stormwater Sources			
medium / high density residential	25 (55.0)	1.0%	92%
low density / rural residential	52 (114.4)	2.1%	92%
Commercial	14 (30.8)	0.5%	92%
Industrial	3.8 (8.36)	0.2%	92%
Mixed urban / other urban	22 (48.4)	1.0%	92%
Agricultural	1000 (2200)	53%	92%
forest, wetland, water	210 (462)	8.4%	0%
barren land	19 (41.8)	0.5%	0%
septic systems			
Waterfowl			
internal load			
tributary load	190 (418)		
Natural Sources / Background			
air deposition onto lake surface	2.5 (5.5)	0.1%	0%
Groundwater	80(176)		
Other Allocations			
explicit Margin of Safety	850 (1870)	34%	n/a

+ Loadings and reductions were not recalculated but were taken from the Approved TMDL

Figure 26 Final Phosphorus Allocations for Cohansey River at Seeley from Sunset Lake TMDL (Approved 9/30/2003)



Watershed Management Area 18

Big Timber Creek SB at Blackwood Terrace

TMDL calculations using both the FIRE Method (Table 16, Figure 27) and Reckhow Model (Table 17, Figure 28) are shown below. As previously stated the TMDL calculations for Blackwood Lake using the Reckhow Model results in a more stringent loading reduction and therefore represents the final TMDL for the Big Timber Creek stream segment.

Table 16 TMDL calculations for Big Timber Creek Stream Segment using FIRE Method

	Big Timber Creek			
	Kg TP/yr (lbs/yr)	**kg TP/yr (lbs/yr)**	**% of LC**	Percent Reduction
Loading capacity (LC)	1569.3	720.91 (1586)	100%	n/a
	Existing Load	Load Allocation		
Point Sources	N/A			
Nonpoint and Stormwater Sources				
medium / high density residential	682.50	**246.53 (542.4)**	**34.2%**	**63.88%**
low density / rural residential	97.23	**35.12 (77.3)**	**4.9%**	**63.88%**
commercial	217.41	**78.53 (172.8)**	**10.9%**	**63.88%**
industrial	60.93	**22.01 (48.4)**	**3.1%**	**63.88%**
mixed urban / other urban	214.31	**77.41 (170.3)**	**10.7%**	**63.88%**
agricultural	165.84	**59.90 (131.8)**	**8.3%**	**63.88%**
forest, wetland, water	78.68	**78.68 (173)**	**10.9%**	**0 %**
barren land	52.38	**52.38 (115.2)**	**7.3%**	**0%**
Margin of Safety	N/A	**70.35 (154.8)**	**10%**	n/a

*Percent reductions shown for individual sources are necessary to achieve overall reductions

Figure 27 Phosphorus allocations for Big Timber Creek Stream Segment

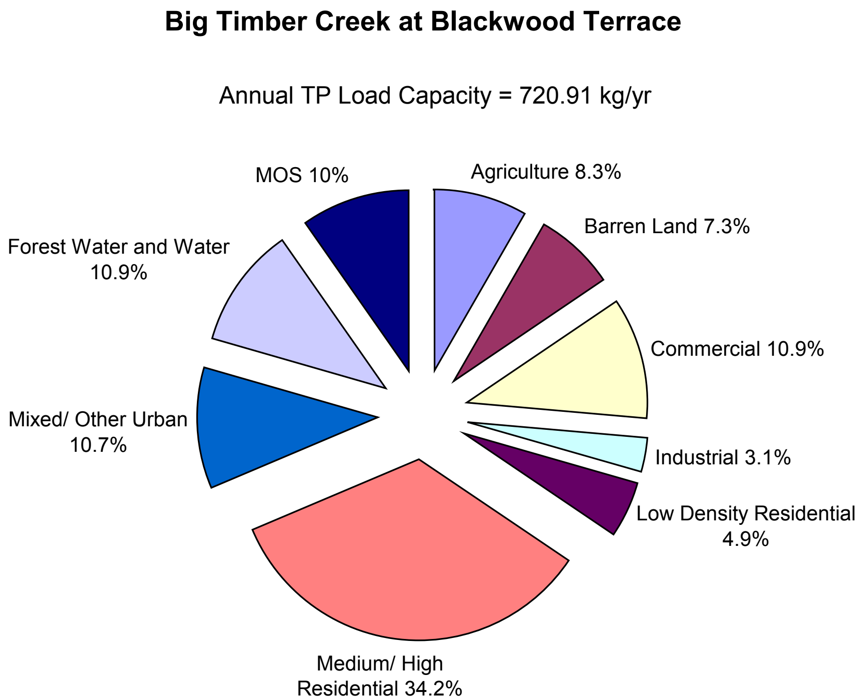
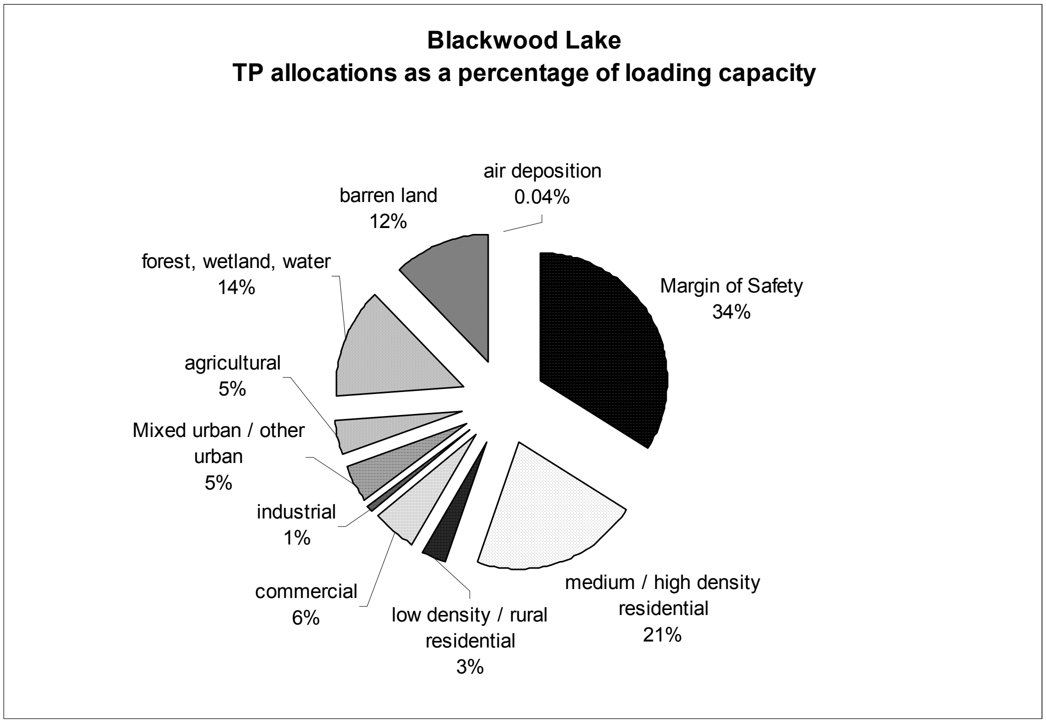


Table 17 Blackwood Lake TMDL Calculation (Approved 9/30/2003)

lake	Blackwood Lake kg TP/yr /(lb/yr)	Blackwood Lake % of IC	% reduction
loading capacity (LC)	1200 (2640)	100%	n/a
Nonpoint and Stormwater Sources			
medium / high density residential	260 (572)	21.8%	88%
low density / rural residential	35 (77)	2.9%	88%
Commercial	69 (152)	5.7%	88%
Industrial	8.8 (19.4)	0.7%	88%
Mixed urban / other urban	57 (125)	4.7%	88%
Agricultural	55 (121)	4.6%	88%
forest, wetland, water	170 (374)	13.7%	0%
Barren land	140 (308)	12.0%	0%
septic systems			
Waterfowl			
Internal load			
Tributary load	n/a		
Natural Sources / Background			
air deposition onto lake surface	0.4 (.88)	0.04%	0%
Groundwater			
Other Allocations			

explicit Margin of Safety	410 (902)	34%	n/a

Figure 28 Phosphorus Allocations for Big Timber at Blackwood Terrace from the Blackwood Lake Lake TMDL (Approved 9/30/2003)



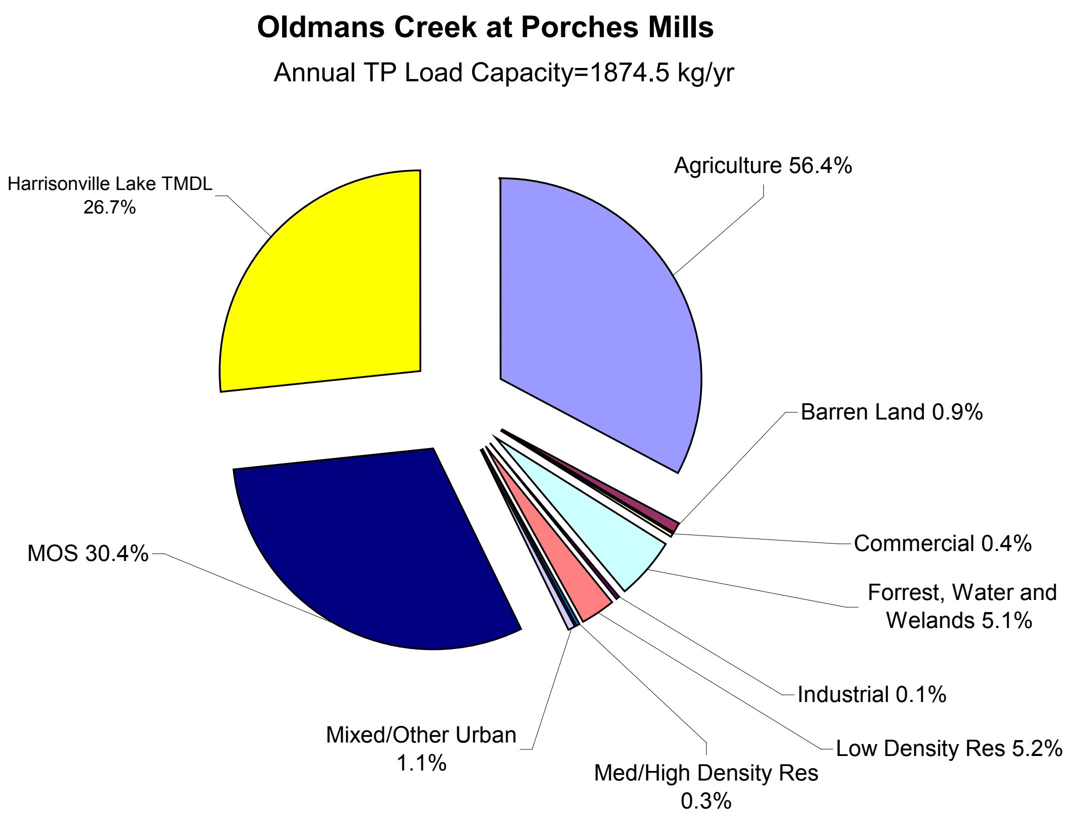
Oldmans Creek at Porches Mill

Table 18 TMDL calculations for Oldmans Creek at Porches Mill

	Oldmans Creek			
	Kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	Percent Reduction
Loading capacity (LC)	3992.5	1874.5 (4123.9)	100%	n/a
	Existing Load	Load Allocation		
Point Sources	N/A			
Nonpoint and Stormwater Sources				
medium / high density residential	17.09 (37.59)	3.50 (7.7)	0.2%	79.55 %
low density / rural residential	277.08 (609.57)	56.7 (124.7)	3.0%	79.55%
commercial	19.28 (42.41)	3.9 (8.6)	0.2%	79.55%
industrial	6.39 (14.06)	1.3 (2.9)	0.1%	79.55%
mixed urban / other urban	60.84 (133.86)	12.4 (27.3)	0.7%	79.55%
agricultural	2998.79 (6597.34)	613.4 (1349.5)	32.7%	79.55%
forest, wetland, water	96.51 (212.3)	96.5 (212.3)	5.1%	0%
barren land	16.57 (36.5)	16.6 (36.5)	0.9%	0%
Harrisonville Lake TMDL *	500 (1100)	500 (1100)	26.7%	0%
Margin of Safety	N/A	570.2 (1254.4)	30.4%	n/a

*** The upstream watershed of Oldmans Creek has an approved Lake TMDL therefore the Loading Capacity from the lake TMDL was used as the loading of the upstream watershed.**

Figure 29 Phosphorus Allocations for Oldmans Creek at Porches Mills



Watershed Management Area 20

Blacks Creek at Chesterfield-Georgetown rd.

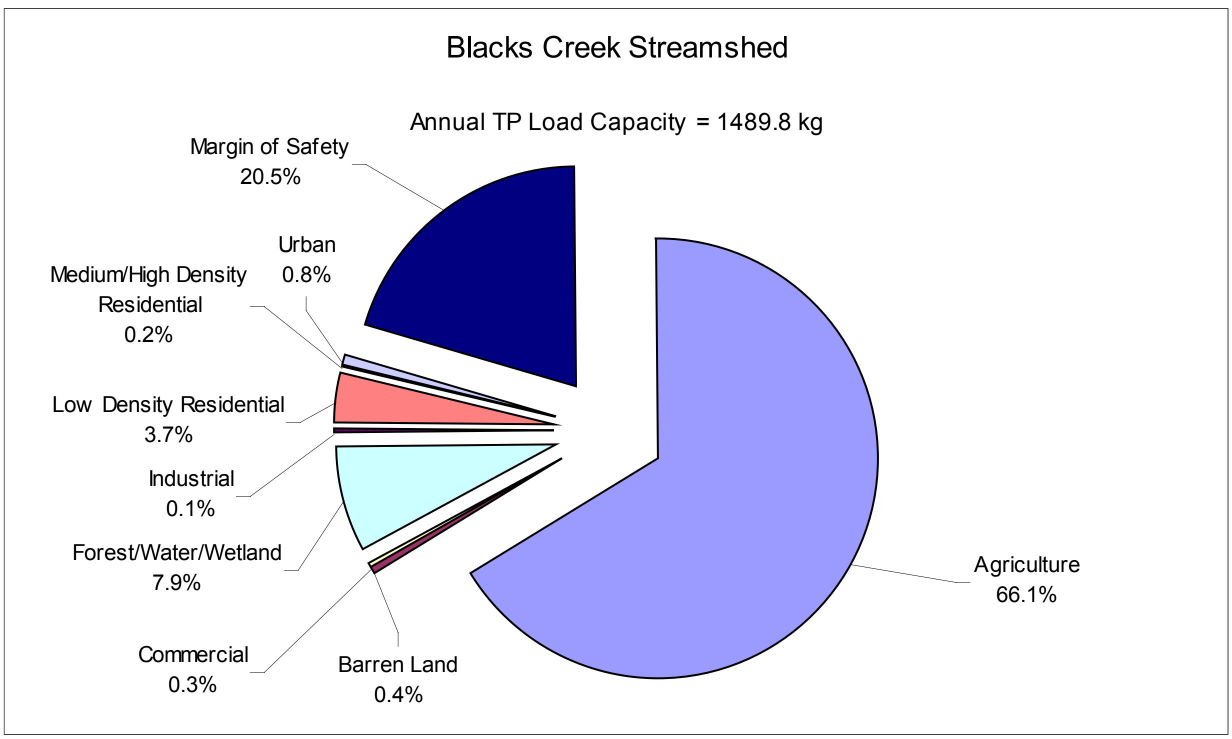
Table 19 TMDL calculations for Blacks Creek

	Blacks Creek		% reduction	Existing Load
	kg TP/yr (lb/yr)	% of LC		kg TP/yr (lb/yr)
Loading capacity (LC)	1489.8 (3277.6)	100%	n/a	3374.1 (7423.0)
Load allocation				
Point Sources other than Stormwater	n/a			
Nonpoint and Stormwater Sources				
medium / high density residential	2.6 (5.7)	0.2	67.4%	7.88 (17.3)
low density / rural residential	54.6 (120.1)	3.7	67.4%	167.3 (368.1)
commercial	4.6 (10.1)	0.3	67.4%	14.0 (30.8)
industrial	1.3 (2.9)	0.1	67.4%	4.11 (9.04)
mixed urban / other urban	11.6 (25.5)	0.8	67.4%	35.7 (78.5)
agricultural	985.2 (2167.4)	66.1	67.4%	3020.6 (6645.3)
forest, wetland, water	118.3 (260.2)	7.9	0%	118.3 (260.3)
barren land	6.2 (13.6)	0.4	0%	6.2 (13.6)
Margin of Safety	305.4 (671.9)	20.5	n/a	n/a

	Blacks Creek		% reduction	Existing Load
	kg TP/yr (lb/yr)	% of LC		kg TP/yr (lb/yr)

*Percent reductions shown for individual sources are necessary to achieve overall reductions

Figure 30 Phosphorus allocations for Blacks Creek



Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included at this time. The loading capacity of each stream is expressed as a function of the current load, and both WLAs and LAs are expressed as percentage reductions for particular stream segments. Therefore, the percent reductions from current levels must be attained in consideration of any new sources that may accompany future development.

7.0 Follow-up Monitoring

The Water Resources Division of the U.S. Geological Survey and the Department have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. A second ambient monitoring network, DEP's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from this these networks have been used to assess the quality of freshwater streams and percent load reductions. The ambient networks, as well as targeted studies, will be the means to determine the effectiveness of TMDL implementation and the need for additional management strategies.

8.0 Implementation Plan

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

The Department recognizes that TMDLs alone are not sufficient to restore impaired stream segments. The TMDL establishes the required pollutant reduction targets while the implementation plan identifies some of the regulatory and non-regulatory tools to achieve the reductions, matches management measures with sources, and suggests responsible entities for non-regulatory tools. This provides a basis for aligning available resources to assist with implementation activities. Projects proposed by the State, local government units and other stakeholders that would implement the measures identified within the impaired watershed are a priority for available State (for example, CBT) and federal (for example, 319(h)) funds. In addition, the Department's ongoing watershed management initiative will develop detailed watershed restoration plans for impaired stream segments in a priority order that will identify more specific measures to achieve the identified load reductions.

Urban and agricultural land use sources must be the focus for implementation. Urban land use will be addressed primarily by stormwater regulation. Agricultural land uses will be addressed by implementation of conservation management practices tailored to each farm. Other measures are discussed further below.

Stormwater measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction for nonpoint sources and are applied to the land use categories that correspond to the areas regulated under industrial and municipal stormwater programs. The BMPs required through stormwater permits, including the additional measure discussed below, are generally expected to achieve the required load reductions. The success of these measures will be assessed through follow up monitoring. As needed through adaptive management, other additional measures may need to be identified and included in stormwater permits. Follow up monitoring or watershed restoration plans may determine that other additional measures are required, which would then be incorporated into Phase II permits. Additional measures that may be considered include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to include nutrient removal. A more detailed discussion of stormwater source control measures follows.

On February 2, 2004 the Department promulgated two sets of stormwater rules: The Phase II New Jersey Pollutant Discharge Elimination System (NJPDES) Stormwater Rules, N.J.A.C. 7:14A and the Stormwater Management Rules, N.J.A.C. 7:8

The Phase II NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" to develop stormwater management programs consistent with the NJPDES permit requirements. The stormwater discharged through "municipal separate storm sewer systems" (MS4s) is regulated under the Department's Phase II NJPDES stormwater rules. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development.

Each impaired watershed was assessed for the applicability of a mandatory low phosphorous fertilizer ordinance to aid in the reduction of phosphorus loading from nonpoint sources. If the watershed contained a high percentage of agricultural land uses, it was determined that the greatest nonpoint source reductions would be achieved through the implementation of agricultural BMPs, and therefore the low phosphorus fertilizer ordinance for urban land uses was not required as an additional measure. However, in those subwatersheds which contained a small percentage of agricultural land uses, and a high percentage of urban land uses, it was determined that the low phosphorus fertilizer ordinance was necessary in order to effectively reduce the phosphorus load originating from the urban land uses.

In the Big Timber Creek Watershed it was determined that the low phosphorus fertilizer ordinance was required based on the guidelines provided above.

The municipalities identified in Appendix B as needing an additional measure will be required to adopt an ordinance as an additional measure that prohibits the outdoor application of fertilizer other than low phosphorus fertilizer, consistent with a model ordinance provided by the Department. Fertilizer does not include animal or vegetable manure or compost. This model ordinance has been posted on www.njstormwater.org. The additional measure is as follows:

Low Phosphorus Fertilizer Ordinance

Minimum Standard – Municipalities as noted in Appendix B shall adopt and enforce an ordinance, consistent with a model ordinance provided by the Department, to prohibit the outdoor application of fertilizer other than low phosphorus fertilizer, except:

Any application of fertilizer at a commercial farm that is exempted by the Right to Farm Act, N.J.S.A. 4:1C-1 et seq.

Any application of fertilizer needed for establishing new vegetation after land disturbance in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

Measurable Goal - Municipalities as noted in Appendix B shall certify annually that they have met the Low Phosphorus Fertilizer Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities listed in Appendix B shall have fully implemented the Low Phosphorus Fertilizer Ordinance minimum standard.

The Stormwater Management Rules have been updated for the first time since their original adoption in 1983. These rules establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department’s Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, and Waterfront Development.

The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients.

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities will also be updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules within approximately two years of the issuance of the NJPDES General Permit Authorization.

Furthermore, the New Jersey Stormwater Management Rules establish a 300-foot special water resource protection area (SWRPA) around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. C1 waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. There are no C1 waters located within the impaired watersheds of the stream segments addressed in this document. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at www.state.nj.us/dep/wmm/sgwqt/sgwqt.html.

Agricultural and other measures

Generic management strategies for nonpoint source categories, beyond those that will be implemented under the Phase II stormwater management program, and responses are summarized below.

Table 20 Nonpoint source management measures

Source Category	Responses	Potential Responsible Entity	Possible Funding options
Human Sources	Septic system management programs	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Non-Human Sources	Goose management programs, riparian buffer restoration	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Agricultural practices	Develop and implement conservation plans or resource management plans	Property owner	EQIP, CRP, CREP

Human and Non-Human measures

Where septic system service areas are located in close proximity to impaired waterbodies, septic surveys should be undertaken to determine if there are improper effluent disposal practices that need to be corrected. Septic system management programs should be implemented in municipalities with septic system service areas to ensure proper design, installation and maintenance of septic systems. Where resident goose populations are excessive, community based goose management programs should be supported. Through stewardship programs, areas such as commercial/corporate lawns should be converted to alternative landscaping that minimizes goose habitat and areas requiring intensive landscape maintenance. Where existing developed areas have encroached on riparian buffers, riparian buffer restoration projects should be undertaken where feasible.

Agricultural measures

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

> **The Environmental Quality Incentive Program (EQIP**) is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

The Conservation Reserve Program (CRP) is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

Conservation Reserve Enhancement Program (CREP) The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, signed a $100 million CREP agreement earlier this year. This program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP will be part of the USDA's Conservation Reserve Program (CRP). There will be a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

Implementation Projects
WMA 17

- The Gloucester County Department of Parks and Recreation received $19,000 in 319(h) funding in FY 2000 for a Backyard BMPs and Wildlife Habitat Project. This project encouraged residents to manage their properties in a manner that would improve water quality and provide habitat for local wildlife.

- The Salem County Department of Planning received $101,000 in 319(h) funding in FY 2000 to develop a Salem County Greenkeepers Plan.

- Rutgers Univeristy in cooperation with Rutgers Cooperative Extension and Cumberland County Soil Conservation District completed the Upper Cohansey Watershed Management Project. This study focused on the approximately two miles of the Cohansey River located in Alloway Township, Salem County and Upper Deerfield Township, Cumberland County, from Beal Road in Salem County to Seeley Pond in Cumberland County. The objective of the Upper Cohansey River Watershed Management Project was to monitor water quality, identify locations where water quality was degraded, and to enhance water quality through the adoption of conservation and management practices adapted to nursery and other agricultural operations. Surface water quality was monitored and evaluated at four locations in the Upper Cohansey River Watershed. A nursery operation was monitored and evaluated to determine its impact on water quality prior to and after a tailwater recovery system was installed. The locations of non-point source contaminants were identified, and options were developed to reduce non-point source contaminants through the development and adoption of attenuation procedures. Conservation practices have been installed and continue to be installed in areas where agricultural non-point sources have been identified.

Priority Stream Segment Restoration Plans

In addition to the generic and specific, current and future implementation measures identified above, the Department, through its watershed management program, is undertaking the development of watershed restoration plans for priority stream segments. These restoration plans will identify specific measures and the means to accomplish them, beyond those identified in this TMDL report, that will assist in attainment of the required load reductions. Due to the number of TMDLs recently generated, the Department must prioritize which stream segments will be the focus of initial consideration. The Department's nutrient policy states that, "Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the water unsuitable for the designated uses (N.J.A.C. 7:9B-1.5(g)3)." With respect to nutrient TMDLs, the initial priority will be given to those streams where use impairments exist in the impaired stream or downstream lakes, beyond simple exceedance of the water quality criterion. Other priority considerations include:

- Headwater area;
- Proximity to drinking water supply;
- Proximity to recreation area;
- Possibility of adverse human health conditions;
- Proximity to a lake intake;
- Existence of eutrophication;
- Phosphorus is identified as the limiting nutrient;
- Existence of use impairments;
- Ability to create a measurable change;
- Probability of human source;
- Stream Classifications;
- High success level.

9.0 Reasonable Assurance

Commitment to carry out the activities described in the implementation plan to reduce phosphorus loads provides reasonable assurance that the SWQS will be attained for phosphorus in the impaired segments. Follow-up monitoring will identify if the strategies implemented are completely, or only partially successful. It will then be determined if other management measures can be implemented to fully attain the SWQS or if it will be necessary to consider other approaches, such as use attainability.

10.0 Public Participation

The Water Quality Management Planning Rules at NJAC 7:15-7.2 require the Department to initiate a public process prior to the development of each TMDL and to allow public input to the Department on policy issues affecting the development of the TMDL. Further, the Department shall propose each TMDL as an amendment to the appropriate area-wide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g).). Electronic maps showing the spatial extent of the impaired segments and a PowerPoint presentation describing the TMDL process and method used were posted online at http://www.state.nj.us/dep/watershedmgt/tmdl_segments.htm on June 1st, 2005 and public comment was solicited.

In accordance with N.J.A.C. 7:15–7.2(g), these TMDLs were proposed by the Department as an amendment to the Lower Delaware, Monmouth County and the Tri-County WQMPs. The notice proposing the TMDLs was published on July 5, 2005 in the New Jersey Register and in Burlington County Times, The Asbury Park Press, Gloucester County Times, Today's Sunbeam, and the Bridgeton Evening News. Notice of the proposal and the hearing was also provided to affected municipalities and DPAs. The TMDL documents were made available at the Department, upon request by mail, and on the Department's website. The Department conducted non-adversarial public hearings on August 10, 2005 and August 11, 2005 at Rutgers Cooperative Extension Salem County in Woodstown, New Jersey and the Cherry Hill Department of Recreation, Cherry Hill, NJ. Each hearing was preceded by an informational presentation explaining the development of the TMDLs. The public comment period ended on August 26, 2005.

Department initiated changes include the following:

1. The New Jersey Environmental Management System (NJEMS), which contains NJPDES permitted facility information evaluated during TMDL development, has been listed under "Data Sources". This has been added to the document.
2. Addition of the priority designation for the subject TMDLs on Sublist 5 of the Integrated List.
3. Addition of an addendum demonstrating the methodology to convert the percent reductions obtained from applying FIRE to percent reductions per land use category.
4. Addition of an explanation regarding selection of municipalities that will be required to adopt a low phosphorus fertilizer ordinance.
5. Addition of a column identifying existing loads in the tables of load allocation for each segment.

One comment letter was received on the proposed TMDLs, from Don Kirchhoffer, New Jersey Conservation Foundation. Fourteen people attended the public hearing on August 10, 2005 (John Brandt, Gary Ziegler, Robert Widdifield, David Lee, Dan Mull, Wil Ward, Nancy Norton, Mil Yonker, Don Kirchhoffer, John Bibeau, George Bradford, Jay Perry, Bernie Lodge, Jasen Berkowitz) ; 6 testified (John Brandt, Wil Ward, John Bibeau, George Bradford, Bernie Lodge, Don Kirchhoffer) no members of the public attended the public hearing on August 11, 2005.

A summary of the comments to the proposal, and the Department's response to the comments follows. The number in parentheses following each comment corresponds to the number of the commenter below.

Oral testimony (August 10, 2005):

1. George W. Bradford
   Municipality of Oldmans
   P.O. Box 416
   Pedricktown, NJ 08067

2. John Brandt
   Citizen
   266 Shell Rd
   Carney's Point, NJ 08069

3. John Bibeau
   CP Sewage
   189 Delaware
   Carney's Point, NJ 08069

4. Don Kirchhoffer (Written)
   New Jersey Conservation Foundation
   200 Lees Lane
   Collingswood, NJ 08108

5. Jay Perry
   Oldmans Planning Board
   290 Perkintown Rd
   Perdricktown, NJ 08067

6. Will Ward
   Greensward Farm
   56 Commissioners Pike
   Woodstown, NJ 08098

<u>Comment 1.</u> Commenter stated that the explanation at the hearing of the background analysis that preceded the proposal was impressive and offered compliments to the Department for its work. (4)

<u>Response 1.</u>
The Department appreciates the support.

Comment 2.
What will be done to implement the TMDL and eventually get phosphorus levels for Oldmans Creek to acceptable levels, given the difficulties in reducing non-point source pollution in streams flowing through agricultural and residential land. (4)

Response 2.
The Department anticipates that the reductions needed from agricultural land uses, which are extensive in the Oldmans Creek watershed, will be obtained by working with farmers, through the Department of Agriculture and the NRCS, to develop and implement, with assistance from EQIP, CRP and CREP funding sources, conservation and resource management plans that have been designed to reduce phosphorus loads to the streams. The municipalities in the Oldmans Creek watershed are categorized as Tier B under the municipal stormwater permitting program and have not been identified at this time as being required to adopt low phosphorus fertilizer ordinances. Reductions from this land use rely upon measures that will be effected through watershed management initiatives and water quality management plan amendments, such as goose management, riparian restoration and septic system management programs. If, through follow-up monitoring, it is determined that these measures are insufficient to achieve the surface water quality standards, then additional measures will be identified and implemented, as needed.

Comment 3
The Department identifies agricultural as a source but not septic systems.

Response 3
To clarify, the Department does recognize that septic systems are a potential source of phosphorus and lists them as such in the nonpoint source assessment section of the TMDL document. Areas reliant upon septic systems are identified as targets for septic system management programs, which would be implemented through water quality management plan amendments as wastewater management plans are developed for the affected area.

Comment 4
Commenter requested clarification as to why one stream segment is ranked higher than another. (2)

Response 4.
To clarify, the list that the commenter is referring to was not intended to suggest a ranking; it is a list of the stream segments for which Total Phosphorus TMDLs are being established numbered in alphabetical order.

Comment 5
Commenters do not understand why the Department is developing a TMDL for phosphorus when it has not moved forward with approving a Water Allocation Permit and a Water Quality Management Plan amendment in Carneys Point. (1, 2, 3, 5)

Response 5

The Department is obligated to develop TMDLs for impaired waterways that appear on the 303(d) list. Development of these TMDLs does not interfere with processing WQMP amendments that are administratively and technically complete. The subject amendment is deficient, but addressing this issue is outside the scope of this hearing and response. The Department's WQMP program should be contacted in this regard.

Comment 6

How will the TMDL affect farmers in the drainage area, especially those that have already implemented significant BMPs to improve water quality. (6)

Response 6

Implementation of agricultural BMPs will be accomplished in partnership with the Department of Agriculture/NRCS, identifying agricultural areas still in need of conservation or resource management plans and using funding sources such as EQIP, CRP and CREP.

Comment 7

Commenter expressed concerned about enforcement activities as well as water quality monitoring activities occuring on private agricultural lands.

Response 7

Water quality monitoring activities

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Appendices

Appendix A: Database of Phosphorus Export Coefficients

In December 2001, the Department concluded a contract with the USEPA, Region 2, and a contracting entity, TetraTech, Inc., the purpose of which was to identify export coefficients applicable to New Jersey. As part of that contract, a database of literature values was assembled that includes approximately four-thousand values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. In conjunction with the database, the contractor reported on recommendations for selecting values for use in New Jersey. Analysis of mean annual rainfall data revealed noticeable trends, and, of the categories analyzed, was shown to have the most influence on the reported export coefficients. Incorporating this and other contractor recommendations, the Department took steps to identify appropriate export values for these TMDLs by first filtering the database to include only those studies whose reported mean annual rainfall was between 40 and 51 inches per year. From the remaining studies, total phosphorus values were selected based on best professional judgment for eight land uses categories.

The sources incorporated in the database include a variety of governmental and non-governmental documents. All values used to develop the database and the total phosphorus values in this document are included in the below reference list.

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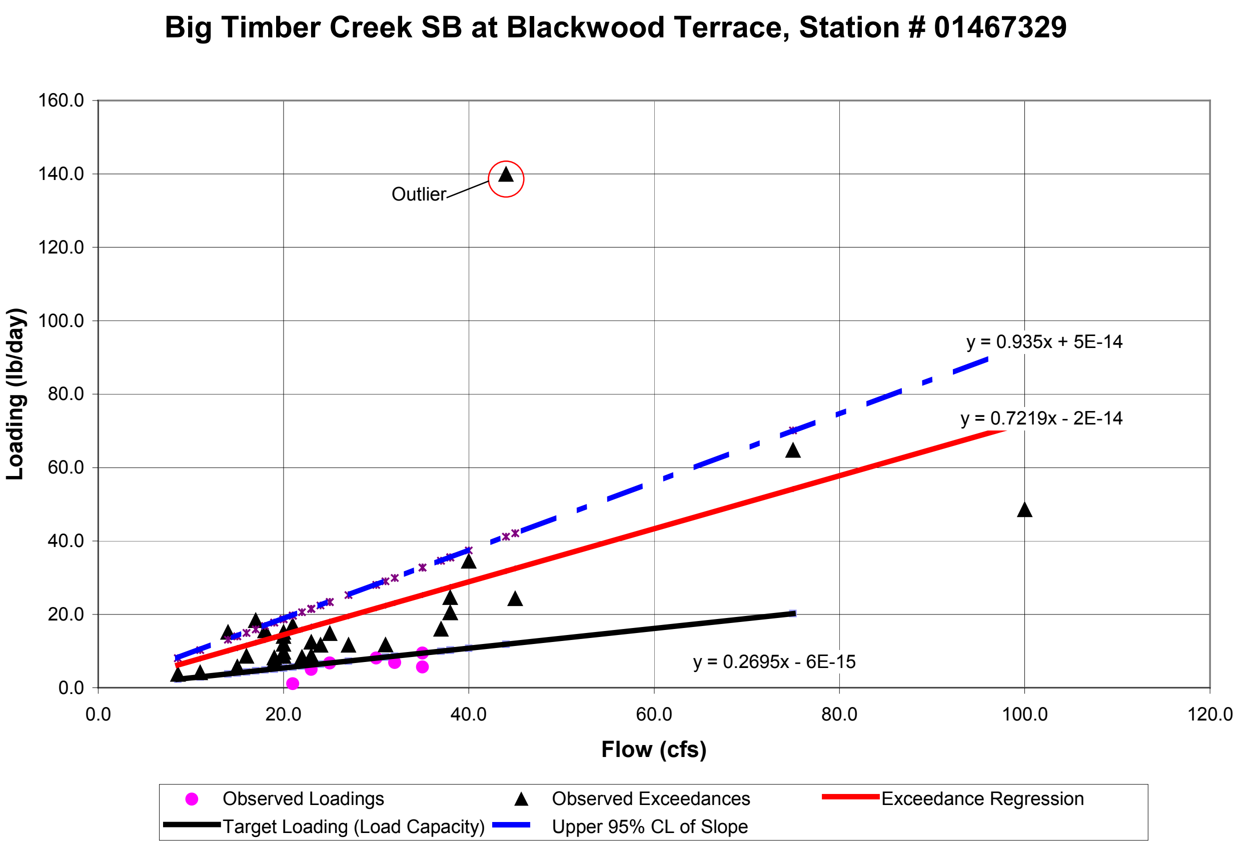
Appendix B: Tier A and B Municipality Designations

WMA	Segment	NJPDES Permit Number	Municipality	Discharge Type	Additional Measures
17	Barrett Run	NJG0154903	Hopewell TWP	Tier B	None
		NJG0154962	Stow Creek TWP	Tier B	None
		NJG0154857	Shiloh Boro	Tier B	None
		NJG0147826	Bridgeton City	Tier A	None
17	Cohansey at Seeley	NJG0155110	Upper Pittsgrove Twp	Tier B	None
		NJG0152731	Alloway Twp	Tier B	None
		NJG0149624	Upper Deerfield Twp	Tier B	None
		NJG0154903	Hopewell Twp	Tier B	None
		NJG0154962	Stow Creek Twp	Tier B	None
		NJG0154857	Shiloh Boro	Tier B	None
18	Big Timber	NJG0152153	Deptford Township	Tier A	Low phosphorus ordinance
		NJG0148695	Gloucester Township	Tier A	Low phosphorus ordinance
		NJG0153664	Washington Township	Tier A	Low phosphorus ordinance
18	Oldmans Creek	NJG0150738	Woolwich Twp	Tier B	None
		NJG0152226	South Harrison Twp	Tier B	None
		NJG0152714	Pilesgrove Twp	Tier B	None
20	Blacks Creek	NJG0153559	Chesterfield Twp	Tier B	None
	Blacks Creek	NJG0148156	North Hanover Twp	Tier B	None

	Blacks Creek	NJG0	Upper Freehold Twp	Tier B	None

Appendix C: Big Timber Outlier

The data point that occurred on May 31, 1990 which consisted of a TP concentration of 0.59 mg/l and a flow of 44 cfs, was tested and found to be an outlier. This data point lies outside both the 95 % and the 99% confidence limit. Figure 1.



Appendix D: Total Phosphorus Data by sampling date, expressed in mg/L

Barrett Run at Bridgeton

11/29/2000	0.036
3/7/2001	0.028
5/30/2001	0.197
8/14/2001	0.049
12/6/2001	0.032
2/14/2002	0.028
5/23/2002	0.153
9/4/2002	0.049

Cohansey River at Seeley

1/31/1990	0.14
4/24/1990	0.03
5/23/1990	0.05
7/19/1990	0.09
8/9/1990	0.1
10/25/1990	0.02
1/28/1991	0.02
4/15/1991	0.02
5/22/1991	0.08
8/6/1991	0.06
11/12/1991	0.02
2/13/1992	0.05
4/27/1992	0.03
6/1/1992	0.07
7/21/1992	0.11
11/19/1992	0.08
2/17/1993	0.11
4/13/1993	0.06
6/17/1993	0.07
8/11/1993	0.08
11/4/1993	0.05
2/16/1994	0.09
4/13/1994	0.1
6/22/1994	0.05
8/11/1994	0.05
11/9/1994	0.03
2/16/1995	0.09
4/5/1995	0.01
5/31/1995	0.03
7/27/1995	0.04
11/2/1995	0.05
2/20/1996	0.07
3/26/1996	0.05

6/3/1996	0.08
7/24/1996	0.06
11/6/1996	0.02
1/23/1997	0.02
3/18/1997	0.01
6/4/1997	0.03
6/18/1997	0.13
8/6/1997	0.07
12/11/1997	0.07
3/11/1998	0.1
6/2/1998	0.03
8/27/1998	0.04
12/8/1998	0.05
2/16/1999	0.04
5/20/1999	0.12
8/18/1999	0.08
11/23/1999	0.056
2/8/2000	0.062
5/15/2000	0.038
8/21/2000	0.079
11/27/2000	0.058
2/26/2001	0.048
5/22/2001	0.115
8/29/2001	0.077
12/11/2001	0.043
2/14/2002	0.035
6/18/2002	0.114
8/22/2002	0.155
11/21/2002	0.104
2/26/2003	0.127
5/20/2003	0.03
9/8/2003	0.071

Big Timber at Blackwood Terrace

1/31/1990	0.12
4/5/1990	0.10
5/31/1990	0.59
7/23/1990	0.10
8/22/1990	0.08
10/10/1990	0.07
1/28/1991	0.04
3/21/1991	0.07
5/21/1991	0.09
8/1/1991	0.13
10/22/1991	0.07
1/22/1992	0.069
4/16/1992	0.07
5/21/1992	0.14

7/22/1992	0.16
11/17/1992	0.10
1/20/1993	0.07
4/19/1993	0.08
6/14/1993	0.10
8/3/1993	0.20
10/25/1993	0.08
2/15/1994	0.08
4/18/1994	0.16
6/23/1994	0.20
8/9/1994	0.15
11/14/1994	0.07
2/1/1995	0.01
4/4/1995	0.11
5/30/1995	0.07
7/31/1995	0.08
11/21/1995	0.05
2/21/1996	0.16
4/2/1996	0.09
6/5/1996	0.11
7/25/1996	0.09
11/6/1996	0.05
1/21/1997	0.03
3/25/1997	0.05
6/2/1997	0.10
6/16/1997	0.04
8/4/1997	0.08

Oldmans Creek at Porches Mill

2/5/1990	0.15
3/29/1990	0.02
5/29/1990	0.13
7/30/1990	0.12
8/8/1990	0.07
10/23/1990	0.12
2/4/1991	0.06
3/25/1991	0.06
5/30/1991	0.05
8/7/1991	0.07
10/24/1991	0.04
2/6/1992	0.05
4/16/1992	0.03
6/2/1992	0.17
8/3/1992	0.06
12/3/1992	0.07
2/17/1993	0.15
4/20/1993	0.3

6/21/1993	0.56
8/2/1993	0.05
11/4/1993	0.05
2/17/1994	0.07
4/14/1994	0.47
6/22/1994	0.03
8/10/1994	0.13
11/17/1994	0.04
2/15/1995	0.09
3/27/1995	0.06
5/30/1995	0.12
8/1/1995	0.08
11/20/1995	0.06
2/21/1996	0.16
3/28/1996	0.07
5/30/1996	0.08
7/24/1996	0.08
11/13/1996	0.04
1/27/1997	0.11
3/25/1997	0.03
6/3/1997	0.1
8/7/1997	0.07

Blacks Creek at Chesterfield-Georgetown Rd

12/21/2000	0.32
2/22/2001	0.1
5/14/2001	0.137
8/16/2001	0.182
11/28/2001	0.093
2/5/2002	0.088
5/7/2002	0.143
8/22/2002	0.196
11/20/2002	0.137
2/10/2003	0.07
5/20/2003	0.126
8/18/2003	0.23

Appendix E Is Phosphorus Limiting?

The limiting nutrient can be evaluated using available nutrient concentrations by using the following thresholds to exclude phosphorus as the limiting nutrient (The acronyms TIN and DRP refer to biologically-available forms of nitrogen and phosphorus, respectively: TIN = dissolved nitrite, nitrate and ammonia; DRP = dissolved reactive phosphorus):

IF	[DRP] $\geq$ 0.05 mg/l
OR	TIN/DRP $\leq$ 5
THEN	phosphorus can be excluded as the limiting nutrient

Figures 2 and 3 show examples of how to plot pairs of TP and DRP data along a TIN/DRP axis to visually evaluate the phosphorus limitation thresholds at a particular location. By making the TP range twice the DRP range, the thresholds of 0.1 mg/l TP and 0.05 mg/l DRP coincide, simplifying the interpretation. Episodes when TP > 0.1 mg/l AND DRP $\leq$ 0.05 mg/l and TIN/DRP $\geq$ 5 can be identified by seeing TP in the upper right quadrant while DRP is in the lower right quadrant. If phosphorus cannot be excluded as the limiting nutrient for more than 10% of the samples that exceed the 0.1 mg/l threshold (a minimum of 2 samples), then the 0.1 mg/l criterion is applicable.

Figure 2: Example of site where 0.1 mg/l criterion is applicable and exceeded

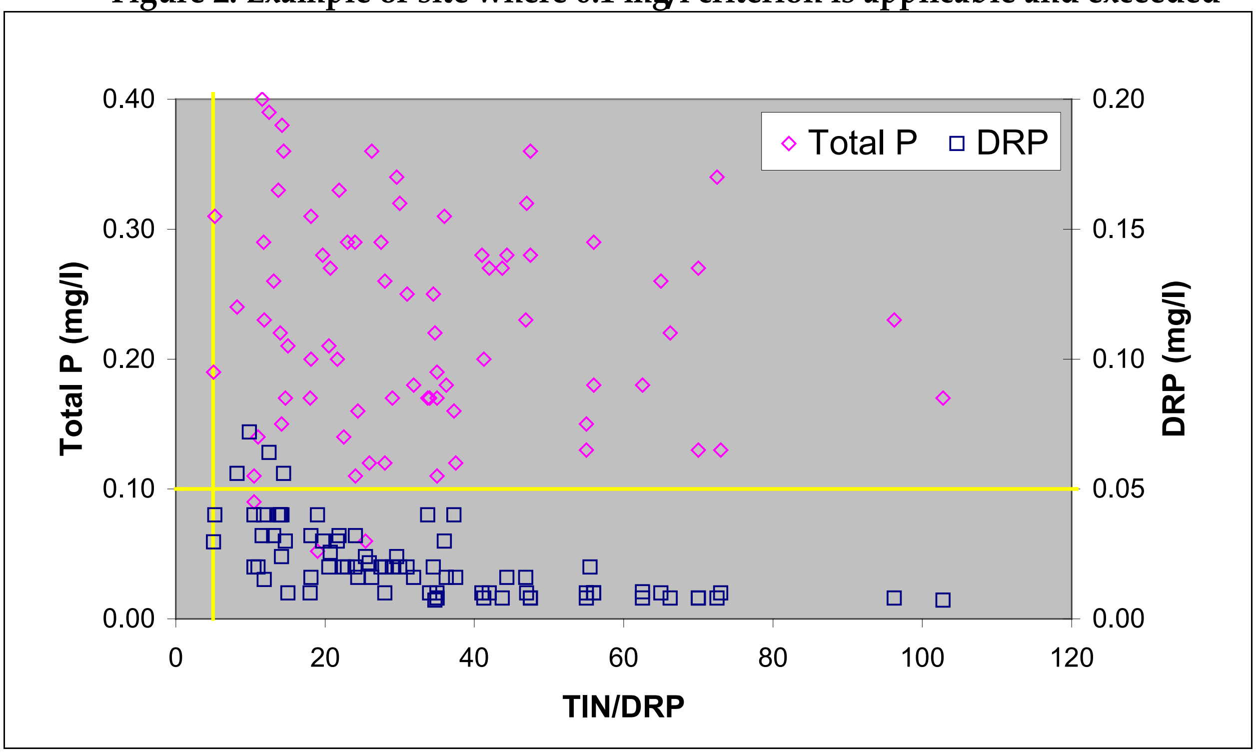
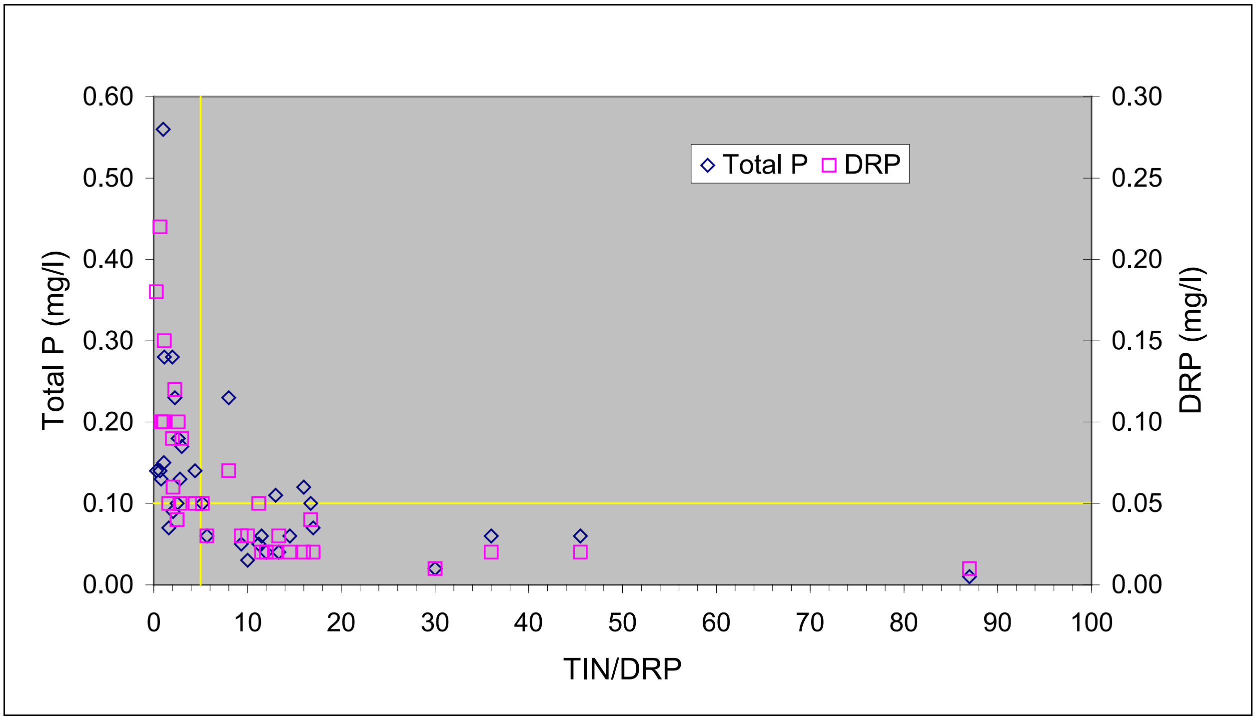


Figure 3: Example of site where phosphorus is not limiting algal growth when 0.1 mg/l threshold is exceeded



Appendix F Methodology for Applying Percentage reductions to Land Use Loadings

The outputs of the FIRE method establish a percent reduction needed to meet the target load (that which will attain the applicable SWQS) and a margin of safety. These values are then applied to the existing land use loadings within the impaired streamshed to determine the load allocations for various land uses.

Existing loads are determined as follows. GIS is used to determine the area in acres of each of the land uses in the impaired watershed. The loading coefficients identified in the TMDL report are applied to the acres of land use to calculate an existing load for each land use in the impaired streamshed. Existing loads for point sources, other than stormwater point sources (essentially, wastewater treatment plants), if any, in the impaired streamshed are calculated using the average flow and concentration data from the discharge monitoring reports for the facilities. This load is added to the existing TP load calculated from land use.

To calculate the overall target load the percent reduction (the difference between the target load and the exceedance regression) as determined through FIRE is applied to the total existing load. The load associated with the margin of safety as determined through FIRE (the difference between the 95% confidence interval and the exceedance regression) is then removed from the overall target load (target loading line), leaving a reduced amount of loading now available to allocate. The load from any discharges is determined by taking the full permitted flow and assigning an effluent concentration. This load is also removed from the potential allocable load leaving a further reduced amount of allocable load for land uses.

There are a number of land uses from which a reduction in current load cannot be taken. These land uses include Forest, Water, Wetlands, and Barren land. The current loads for these land uses as calculated for existing load are carried over entirely as a component of the future load allocations. Therefore, for these land uses, the existing load and future load are equal. The sum of the non-reduceable land use loads is then removed from the reduced allocable land use load leaving the final allocable land use load to be allocated among the land uses that are amenable to load reduction (urban and agricultural). This final allocable land use load is then applied to each land use category in proportion to the amount of each land use in the watershed.

The final percent reduction is calculated by comparing the final WLA or LA for each land use to the existing loads of those land uses. Because of the adjustments made in removing the loads associated with the MOS, the non-reduceable land uses, and discharges, the percent reduction associated with the final allocable land use load is higher than that which appears as an output to FIRE.

Example:

Land- Use	**Existing Load**	**Percent Reduction**	**Allocation**
Agriculture	100	88.85%	11.15
Barren	15	0%	15.00
Commercial	300	88.85%	33.45
Forest	125	0%	125.00
Low Density	40	88.85%	4.46
High Density	250	88.85%	27.88
Other Urban	15	88.85%	1.67
Water	100	0%	100.00
Wetlands	30	0%	30.00
Discharger A	25	0%	25.00
MOS			95.87
TOTAL	**1000**		**469.5**

Output from FIRE

Margin of Safety		**= 20.42%**
Target Loading		**= 46.95%**

Target Load

Target Load = 0.4695 * Existing Load
= 0.4695 * 1000
Target Load = 469.5 lb/yr

Margin of Safety

MOS = 0.2042* Target Load
= 0.2042* 469.5 lb/yr
= 95.87 lb/yr

Allocable Load

AL = Target Load – MOS
= 469.5 –95.87
= 373.63 lb/yr

Allocable Land Use Load

ALUL = AL- Future Discharge Load
= 373.6 – 25
= 348.63 lb/yr

SUM of Non Reducable Land Use Loads

Non Reduceable Land use Load = Existing Forest + Water & Wetlands Load + Barren Land Load
= 125 + 100 + 30 + 15
= 270 kg/yr

Final Allocable Land use Load

Final Allocable Land use Load = Allocable Land use Load – Non Reduceable Land use Load
= 348.6 – 270
= 78.6 lb/yr

Final Percent Reduction

Final Percent Reduction = 1 – (Final allocable Land use load / Sum of existing load of reducable land uses)
= 1 – (78.6/ 15+250+40+300+100)
= 1 – (78.6/705)
= 0.8885
= 88.85 %