Amendment to the Sussex County and Upper Delaware Water Quality Management Plans

Total Maximum Daily Loads for Phosphorus to Address Seven (7) Stream Segments in the Northwest Water Region

WMA 2 and WMA 11
(Black Creek, Wawayanda Creek,
Lockatong Creek and Wickecheoke Watersheds)

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 Northwest Water Region, the 2004 Integrated List of Waterbodies Sublist 5 identifies the 5 waterbodies in Table 1 as impaired with respect to phosphorus, as indicated by the presence of phosphorus concentrations in excess of standards. Four additional waterbodies were identified on Sublist 3, indicating that there was insufficient data to determine the status with respect to impairment. 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 proposed to address the phosphorus impairment in the waterbodies identified in Table 1.

Table 1: Phosphorus Impaired Stream Segments identified on the *2004 Integrated List of Waterbodies* addressed in this Report

TMDL Number	WMA	Station Name/Waterbody	Site ID	Sublist	Proposed Action
1	02	Black Creek near Vernon	01368950, 01367620, Wallkill H	5	TMDL
2	02	Black Creek at Rt. 94 and Rt. 517 in Vernon	Wallkill F	5	TMDL
3	02	Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange	01368900	5	TMDL
4	02	Black Creek at Sand Hill Road in Vernon	Wallkill G	3	TMDL
5	11	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBC0013	5	TMDL
6	11	Wickecheoke Creek near Sergentsville	01461282/EWQ	3	TMDL
7	11	Wickecheoke Creek at Stockton	01461300/ DRBC0012	5	TMDL
	11	Plum Brook near Locktown	01461262	3	Affected by Implementation Plan
	11	Wickecheoke Creek at Croton	01461220	3	Affected by Implementation Plan

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 were proposed and will be adopted by the Department as amendments to the appropriate areawide 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 waterbody 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 7 TMDLs that address phosphorus impairment in 62.94 river miles with respect to the waterbodies identified in Table 2. These TMDLs include management approaches to reduce phosphorus loadings 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. In addition to the above mentioned phosphorus impairments, Black Creek near Vernon (01368950) and Black Creek at Rt. 94 and Rt. 517 in Vernon (Walkill F) are also listed for temperature. Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange (01368900) is listed for mercury in fish tissue and Black Creek at Sand Hill Road in Vernon (Wallkill G) is listed for dissolved oxygen. In the Lockatong and Wickecheoke Creek Watersheds, the Lockatong at Rosemont-Raven Rock Rd Bridge (DRBC0013) and the Wickecheoke Creek at Stockton (01461300/ DRBC0012) are also impaired for temperature. These waterbodies will remain on Sublist 5 with respect to these pollutants and will be addressed in future TMDLs. In addition, Wickecheoke Creek near Sergentsville (01461282), Wickecheoke Creek at Stockton (01461300/ DRBC0012), and Plum Brook near Locktown (01461262) have established fecal coliform TMDLs pending approval with USEPA.

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 Northwest Water Region identified in Table 2, phosphorus concentrations either exceeded New Jersey's SWQS, found at N.J.A.C. 7-9B (TMDLs 1, 2, 3, 5 and 7) or there was insufficient data to make a proper determination regarding phosphorus impairment (TMDLs 4 and 6). Based on currently available data, the Department believes that Black Creek at Sand Hill Road in Vernon (Wallkill G) will prove to be unimpaired in the next listing cycle. However, analysis of additional data indicates Wickecheoke Creek at Stockton (DRBC0012/ 1461300) is impaired, and a TMDL is warranted at this time. All of these waterbodies have a medium priority ranking, with the exception of Wickecheoke Creek near Sergentsville (01461282) and Wickecheoke Creek at Stockton (DRBCN0012/1461300), both of which are high.

Table 2: Waterbodies listed for phosphorus impairment in the Northwest Water Region

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	02	Black Creek near Vernon	01368950, 01367620, Wallkill H	Sussex	8.58
2	02	Black Creek at Rt. 94 and Rt. 517 in Vernon	Wallkill F	Sussex	3.65
3	02	Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange	01368900	Sussex	3.89
4	02	Black Creek at Sand Hill Road in Vernon	Wallkill G	Sussex	8.30
5	11	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBC0013	Hunterdon	14.55
6	11	Wickecheoke Creek near Sergentsville	01461282	Hunterdon	18.50
7	11	Wickecheoke Creek at Stockton	DRBC0012/ 1461300	Hunterdon	5.47
Total Impaired River Miles:					**62.94**

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 63.16 impaired river miles within the Northwest Water Region. Based on the detailed county hydrography stream coverage, approximately 114.44 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 Figure 1 (WMA 2) and Figure 3 (WMA 11).

WMA 2

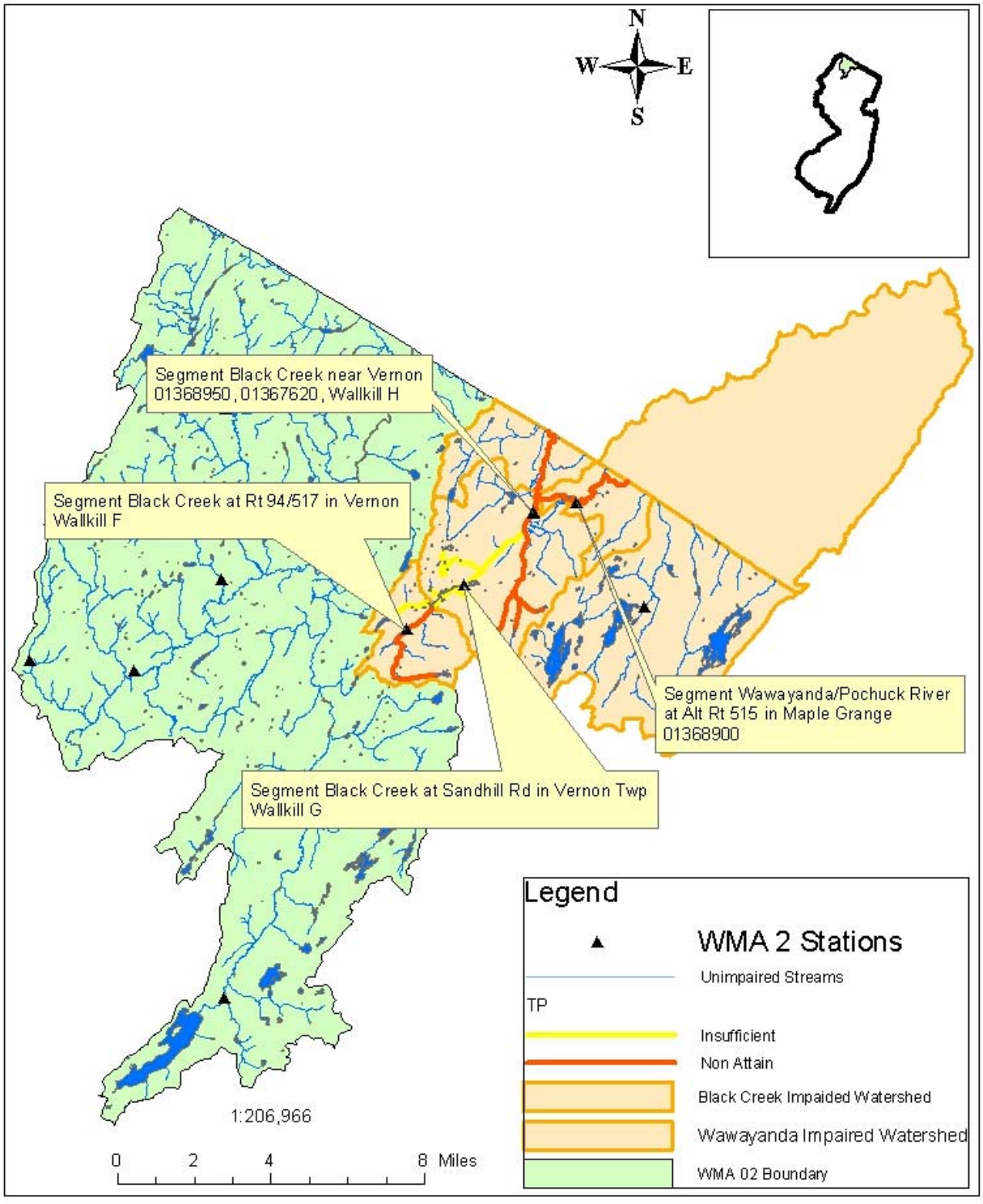
Watershed Management Area 2 is also known as the Wallkill River Watershed and includes 13 townships in Sussex County. WMA 2 is approximately 208 square miles, and is comprised of 4 sub-watersheds that include the Wallkill River, Papakating Creek, Rutgers Creek, and Pochuck Creek Tributaries.

The Pochuck Creek drainage basin is 54 square miles. This subwatershed includes the Black Creek, Wawayanda Creek and the Pochuck Creek. The Black Creek watershed is approximately 26 square miles, and flows in a northerly direction until it merges into the Pochuck Creek and flows into New York. The New Jersey portion of the Wawayanda Creek Watershed is approximately 28 square miles. The headwaters of the Wawayanda Creek originate in New Jersey, and flow into New York before returning to New Jersey. The Wawayanda Creek empties into the Pochuck Creek, downstream of the confluence with the Black Creek. The Pochuck then flows northward into New York State, eventually ending in the Wallkill River above Eden, New York.

The 2004 Integrated List of Waterbodies lists two phosphorus impaired segments in the Black Creek Watershed (Sublist 5) and one segment with insufficient data (Sublist 3). The Sublist 3 segment in the Black Creek watershed (Black Creek at Sandhill Road in Vernon, Site G) was placed on Sublist 3 with only one recorded exceedance of the SWQS. The Department has determined that the exceedance was the result of a discrete set of circumstances related to a construction activity that occurred in the proximity of this monitoring point, and is not indicative of the true water quality of this segment. However, this segment is located directly downstream of Black Creek at Rt. 94 and Rt. 517 in Vernon, and directly upstream of Black Creek at Vernon. Therefore, based on its location, this Sublist 3 segment will be addressed in this TMDL report.

The land uses in the affected drainage area are depicted in Figure 2 and presented in Tables 3 and 4 below.

Figure 1 Spatial extent of impaired segments and affected drainage areas in WMA 2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W
E
S
Segment Black Creek near Vernon
01368950, 01367620, Wallkill H
Segment Black Creek at Rt 94/517 in Vernon
Wallkill F
Segment Wawayanda/Pochuck River
at Alt Rt 515 in Maple Grange
01368900
Segment Black Creek at Sandhill Rd in Vernon Twp
Wallkill G
Legend
WMA 2 Stations
Unimpaired Streams
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Black Creek Impaided Watershed
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WMA 02 Boundary
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Figure 2 Land Uses in the Black Creek and Wawayanda Watersheds

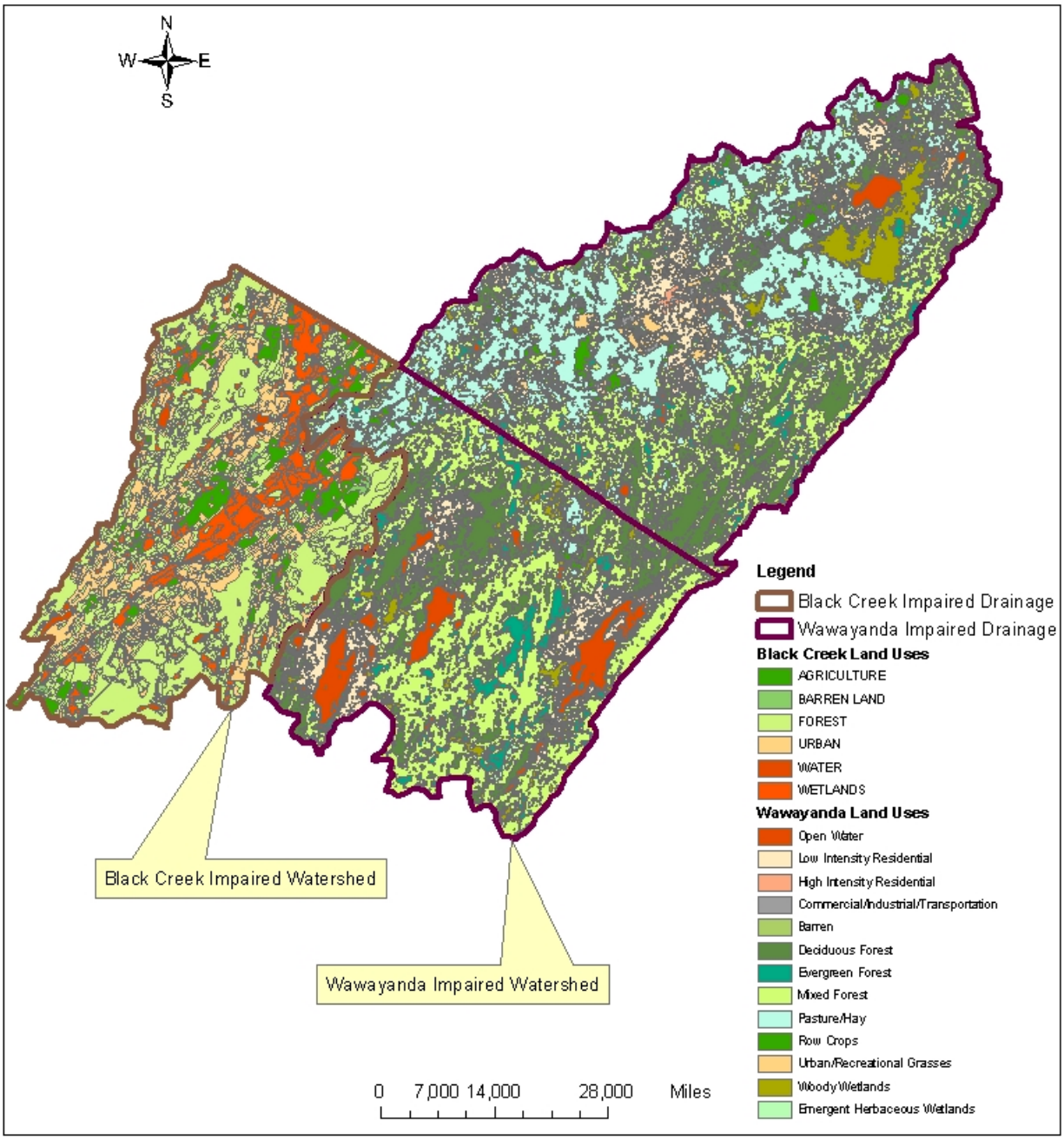


Table 3 River miles, Watershed size, and Area (by Anderson Land Use Classification) affected by phosphorus impairments in Black Creek Watershed, WMA 02

River miles and drainage area	Black Creek
Sublist 5 impaired river miles	12.22
Total river miles within watershed and included in the implementation plan	52.85
Watershed size (acres)	16621
Landuse/Landcover (acres) (% of LU/LC)	
medium / high density residential	709.60 (4.3)
low density / rural residential	1480.52 (8.9)
commercial	246.39 (1.5)
industrial	38.96 (0.2)
mixed urban / other urban	971.40 (5.8)
agricultural	1401.83 (8.4)
forest, wetland, water	11663.06 (70.2)
barren land	109.36 (0.6)

Table 4 River miles, Watershed size, and Area (by Anderson Land Use Classification) affected by phosphorus impairments in Wawayanda Watershed, WMA 02

River miles and drainage area	Wawayanda/ Pochuck River	
Sublist 5 impaired river miles	3.89	
Total river miles within watershed and included in the implementation plan	6.37	
Watershed size (acres)	43140	
Landuse/Landcover- acres (% of Landuse/Landcover)	**New Jersey**	**New York**
high intensity residential	230 (0.53)	145 (0.35)
low intensity residential	1312 (3.04)	1616 (3.75)
commercial/industrial/transportation	156 (0.36)	194 (0.45)
urban/recreational grasses	35 (0.08)	561 (1.3)
row crops	187 (0.43)	856 (1.98)
pasture/hay	798 (1.85)	6470 (15)
mixed forest	7935 (18.39)	7954 (18.44)
evergreen forest	1528 (3.54)	1061 (2.46)
deciduous forest	3905 (9.05)	4737 (10.98)
emergent herbaceous wetlands	94 (0.21)	83 (0.19)
woody wetlands	742 (1.72)	1030 (2.39)
open water	1239 (2.87)	268 (0.62)
barren	2 (0.004)	2 (0.004)

WMA 11

WMA 11, or the Central Delaware Tributaries, covers a 272 square miles area and includes all or parts of 24 municipalities within Hunterdon, Mercer, and Monmouth County. The northern section of the Central Delaware Tributaries is located within the Highlands Region, while the southern and eastern sections are located within the Inner Coastal Plain, and the remaining of central sections are primarily within the Piedmont physiographic province. Land uses in this area range from agricultural to urban. Area 11 includes the City of Trenton. The area has also been heavily impacted by suburban development. Population for this area over the past 10 years has greatly increased. Its development has stressed its water resources and impacted water quality.

The Lockatong Creek/Wickecheoke Creek watershed drainage basin, as shown in Figure 3, covers 55 square miles. Located in Central Hunterdon County, it includes all or portions of Franklin Township, Delaware Township, Raritan Township, Kingwood Township, and Stockton Borough. The Lockatong Creek is thirteen miles long and rises from springs and wetlands near Quakertown in Franklin Township. It flows south through farms and woodlands in Franklin, Kingwood and Delaware Townships falling 500 feet in elevation before emptying into the Delaware & Raritan Canal (and Delaware River). It drains a 27.8 mile^2 watershed. The Wickecheoke is 14 miles long and rises from wetlands in Franklin and Raritan Townships, flowing south through Delaware and Kingwood Townships to the D&R Canal and Delaware River at Prallsville Mills in Stockton. The Wickecheoke drains a 26.57 mile^2 watershed (Regional Planning Partnership, 2001).

The 2004 Integrated List of Waterbodies lists one phosphorus impaired segment in the Wickecheoke Creek watershed (Sublist 5) and three segments with insufficient data (Sublist 3). One of the segments, (Wickecheoke Creek at Sergeantsville, station 01461282/EWQ), from Sublist 3 was reassessed using additional water quality data and found to be impaired. Two additional segments from Sublist 3 would be also covered by the Wickecheoke Creek TMDLs because these additional segments (see Table 1) are contributing phosphorus loadings to the impaired segments. The reduction rates calculated for the Wickecheoke Creek at Stockton station (01461300/DRBC0012) will be applied to the entire Wickecheoke Creek watershed.

A map of land uses is presented in Figure 4 and the land use distribution in the affected drainage area is presented in Table 5 below.

Figure 3 Spatial extent of impaired segments and affected drainage areas: WMA 11

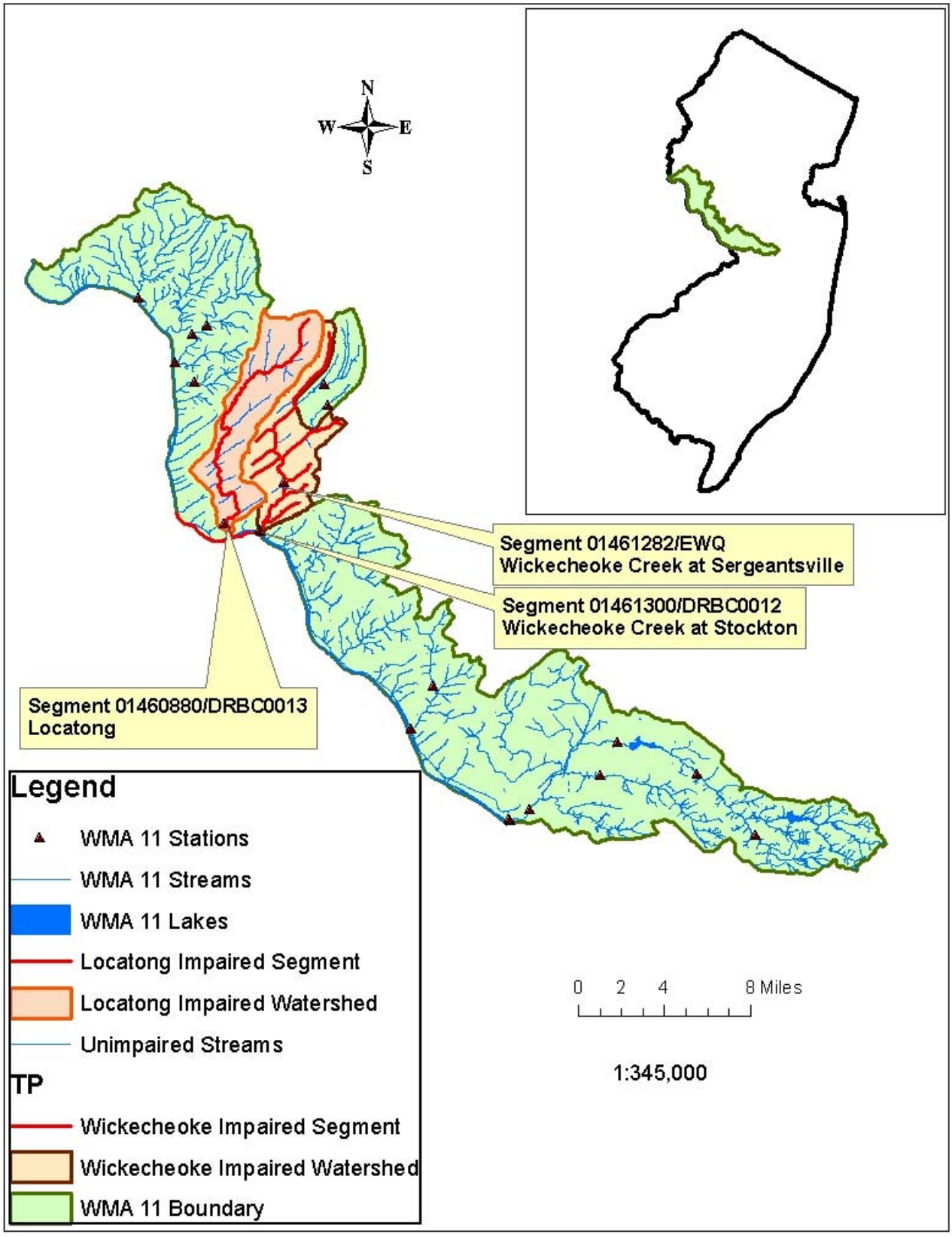


Figure 4 Land Uses in the Lockatong Creek and Wickecheoke Creek Watersheds

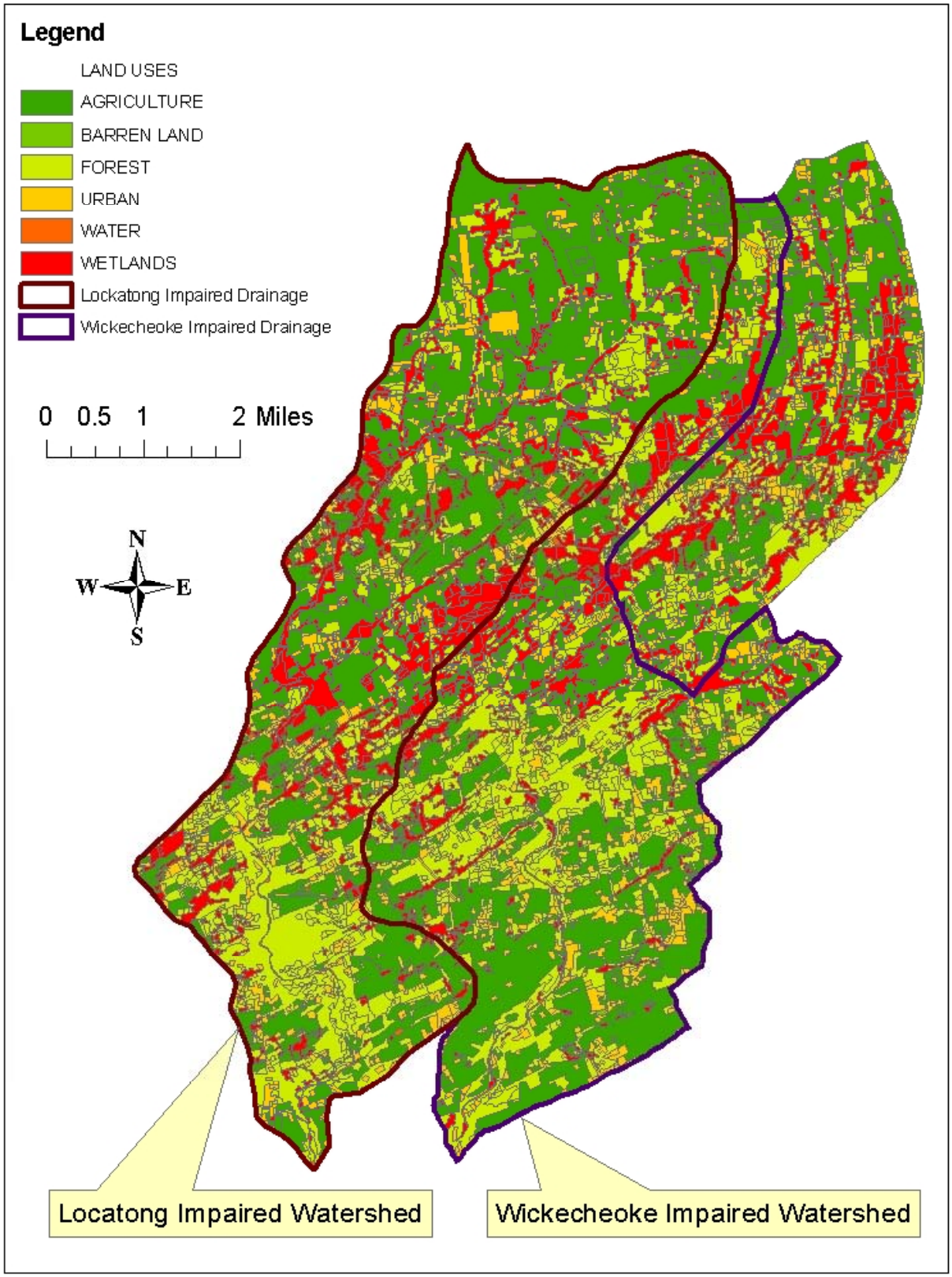


Table 5 River miles, Watershed size, and Area (by Anderson Land Use Classification) affected by phosphorus impairments in WMA 11

River miles and drainage area	Wickecheoke Creek	Lockatong Creek
Sublist 5 impaired river miles	5.56	14.69
Total river miles within watershed and included in the implementation plan	37.53	14.69
Watershed size (acres)	17018	14862
Landuse/Landcover –acres (% of Landuse/Landcover)		
medium / high density residential	22.27 (0.1)	4.758 (0.03)
low density / rural residential	1544 (9.1)	1271 (8.6)
commercial	40.99 (0.2)	48.68(0.3)
industrial	18.74 (0.1)	15.86 (0.1)
mixed urban / other urban	164.7 (1.0)	112.1 (0.8)
agricultural	7503 (44.1)	6595 (44.4)
forest, wetland, water	7651 (45.0)	6785 (45.6)
barren land	72.53 (0.4)	33.11 (0.2)

Data Sources

Geographic Information System (GIS) data from the Department and for New York was used extensively to describe the Black Creek, Wawayanda Creek, Lockatong Creek and Wickecheoke Creek Watershed characteristics. In concert with the USEPA's November 2001 listing guidance, the Department is using Reach File 3 (RF3) from the 2004 Integrated Report to represent rivers, stream, lakes and lakesheds (watersheds of the lakes). The following is general information regarding the data used to describe the watershed management area:

- 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

- Detailed stream coverage of New Jersey: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). "NJDEP Streams of New Jersey (1:24000)." 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 Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- NJDEP Digital Elevation Grid for New Jersey (10 meter) published 10/01/2004 by NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/wmalattice.html

- "NJPDES Surface Water Discharges in New Jersey, (1:12,000)", published 09/12/2002 by NJDEP, Environmental Regulation (ER), Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1). Online at: http://depnet/gis/digidownload/images/statewide/njpdesswd.gif

- "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 Surface Water Quality Standards of New Jersey", published 11/2003 by NJDEP, Division of Landuse Management, Bureau of Freshwater & Biological Monitoring. Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swqs.zip

- "Hydrological Features of New Jersey Feature Map Service, New Jersey State Plane NAD83", published 2005 by New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS). Online at: Live Data and Maps (ArcIMS Feature Service) - Server=http://njgin.state.nj.us; Service=NJ_Hydrology_FS; ServiceType=feature

- "Municipal, County and State Boundaries of New Jersey Feature Map Service, New Jersey State Plane NAD83", published 2004 by New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS). Online at: Live Data and Maps (ArcIMS Feature Service) Server=http://njgin.state.nj.us; Service=NJ_GovtBounds_FS; ServiceType=feature

- "Water Quality Management Areas", created 3/2002 by NJDEP, Water Assessment Team (WAT). Unpublished.

- Hydrography (Census 2000) shapefiles downloaded from Cornell University Geospatial Information Repository (CUGIR) - Streams and lakes located in New York State, (Shapefile: 2001). http://cugir.mannlib.cornell.edu/browse_map/browse_map.html

- National Land Cover Data (NLCD) for New York, last updated in July 2000, and for New Jersey, last updated in March 2000. The data was produced under the direction of the USGS as part of the Multi-Resolution Land Characterization (MRLC) Regional Land Cover Characterization Project. The data used the NLCD Land Cover Classification Systems to categorize land use. http://edcsgs9.cr.usgs.gov/pub/data/landcover/states/

- New York State Digital Elevation Models (DEM) in the format of ASCII DEM was downloaded for the Sloatsburg and Nyack areas from Cornell University Geospatial Information Repository (CUGIR). This information was published by the USGS in August 1998. http://cugir.mannlib.cornell.edu/browse_lis/dem_list.html

- The 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.

Assessment of Point Sources

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 include stormwater point sources, identified as 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. In addition, there are three wastewater dischargers that are a significant source of phosphorus loads within the affected drainage areas.

WMA 2

There are 2 NJPDES point sources, other than stormwater point sources, in the affected drainage areas that were identified as being a significant source of phosphorus. Those two facilities are Lounsberry Hollow Middle School STP and Legends Resort and Country Club. Both facilities discharge to tributaries within the Black Creek impaired streamshed. Lounsberry Hollow Middle School (NJ0023841) is classified as a Minor Municipal facility (MMI), with a permitted flow of 0.032 MGD. The NJPDES permit for this facility identifies the phosphorus limit to be 0.5 mg/l. The permit for Legends Resort and Country Club (NJ0023949) allows this facility to operate the discharge to surface water from the April 1 through October 31. The permitted flow is 0.35 MGD, with a current phosphorus limit of 1.0 mg/l. Effective in June 2008, the phosphorus limit will be lowered to 0.211 mg/l.

For the Wawayanda Creek Watershed, there are no point sources, other than stormwater point sources, that contribute a significant load of phosphorus in the New Jersey portion on the watershed. However, there are two dischargers in the New York portion of the watershed that were identified as being a potentially significant source of phosphorus. The permit for the Village of Warwick (NY0023680) has an interim permitted flow of 0.5 MGD, and a final permitted flow of 1.0 MGD. This permit is for a sanitary discharge with tertiary treatment. There are no phosphorus limits included in this permit. Based on the final permitted flow and an estimated discharge concentration of 1.0 mg/l for tertiary treatment, this facility would have an annual load of approximately 1,381 kg/yr (3,038 lbs/yr).

The permit for the Town of Warwick (NY0021890) has a permitted flow of 0.36 MGD. This is also a sanitary discharge with tertiary treatment with no phosphorus limits included in the permit. Based on

the final permitted flow of 0.36 MGD and an estimated discharge concentration of 1.0 mg/l for tertiary treatment, this facility would have an annual load of 497 kg/yr (1094 lbs/yr).

The estimated loading from these facilities has been incorporated into the calculations for the Wawayanda Creek watershed in order to perform the TMDL analysis. However, the State of New York will be responsible for the allocation of reductions in the New York portion of the watershed between point and nonpoint sources of phosphorus. It is not the intent of this TMDL to make any allocation assignments (WLA or LA) in New York. It is only expected that the SWQS of New Jersey will be attained at the state boundary. It is anticipated that New York will assess actual point and nonpoint source loads before allocations are assigned.

Table 6 Point Source Dischargers in Black Creek Watershed, WMA 2 with phosphorus monitoring or phosphorus limits

WMA	NJPDES Permit Number	Facility Name	Discharge Type	Receiving Waterbody	Actual Average Flow (MGD)	Permitted Flow (MGD)	Actual Monthly Average TP (mg/l)	TP Effluent Limit (mg/l)
02	NJ0023841	Lounsberry Hollow Middle School STP	MMI	Lounsberry Hollow Brook	0.01353	0.032 MGD	0.263 mg/l concentration, 0.014 kg/day	0.5 wkly mg/l concentration, 0.06 kg/day
02	NJ0023949	Legends Resort and Country Club	MMI	Black Creek	0.134	0.35 MGD	0.2460	Currently 1.0 mg//L, from 4/1/2008 0.211 mg/L

Notes:

1. From the NJPDES Permit Number, NJ0023949, the current effluent limit for phosphorus is 1.0 mg/L; as of 4/1/2008 the monthly average will be 0.211 mg/l.
2. The Legends Resort and Country Club (NJ0023949) is permitted to discharge its treated effluent to the Black Creek from November through March.

WMA 11:

The Delaware Township Municipal Utility Authority, permit NJ0027561, is the only significant point source, other than stormwater point sources, of phosphorus that discharges to the phosphorus impaired stream segment. In the current permit, the facility has a phosphorus concentration limit of 1 mg/L TP. The monitoring results from the last 57 monthly reports (DMR) were utilized to calculate an existing average annual phosphorus loading of 20.2 kg/year (44.4 lbs/yr).

Table 7 Point Source Dischargers in WMA 11 with phosphorus monitoring or phosphorus limits

WMA	NJPDES Permit Number	Facility Name	Discharge Type	Receiving Waterbody	Actual Average Flow (MGD)	Permitted Flow (MGD)	Monthly Average TP (mg/l)	TP Effluent Limit (mg/L)
11	NJ0027561	Delaware Twp MUA	Domestic Surface Water Discharge	Unnamed Tributary to Wickechoke Creek (below Sergentsville)	0.028	0.065	0.561	1.0 (Average Monthly)

Assessment of Nonpoint Sources

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.

To a great extent, 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 uses were 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 Tables 8 and 9.

Table 8 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, 6000, 5000, 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	

[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.

The land use classification categories, and their associated loadings for the Wawayanda watershed are shown in Table 9. An alternative system of land use classifications and associated loadings were used in this watershed to provide consistency between the data from the states of New Jersey and New York. A National Land Cover Data (NLCD) land use coverage including data for both states was used as the basis for the categorization. All land use totals and loading estimates that appear in this document for the Wawayanda watershed are based on the Unit Areal Loads listed in Table 9 below.

Table 9 Phosphorus export coefficients (unit Areal Loads) used for the Wawayanda Watershed

land use / land cover	Grid Code[2]	UAL (kg TP/ha/yr)
Open water	11	0.1
Low Intensity Residential	21	0.7
High Intensity Residential	22	1.6
Commercial/Industrial/Transportation	23	2.0
Barren	32	0.5
Deciduous Forest	41	0.1
Evergreen Forest	42	0.1
Mixed Forest	43	0.1
Pasture/Hay	81	1.5
Row Crops	82	1.5
Urban/Recreational Grasses	85	1.0
Woody Wetlands	91	0.1
Emergent Herbaceous Wetlands	92	0.1
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

WMA 2

The United States Geological Survey (USGS) in collaboration with NJDEP collected monitoring data on the Black Creek near Vernon from 1977 to 1997 (Station 01367620) and then again from 2001-2002 under the EWQ Network (Station 01368950). In addition to USGS/NJDEP monitoring sites, the Wallkill River Watershed Management Area (WMA) 2 Technical Advisory Committee (TAC) collected water samples at this location from 2002 through 2004 (Wallkill H). For the purpose of this TMDL document, the data from 1990-2004 has been utilized.

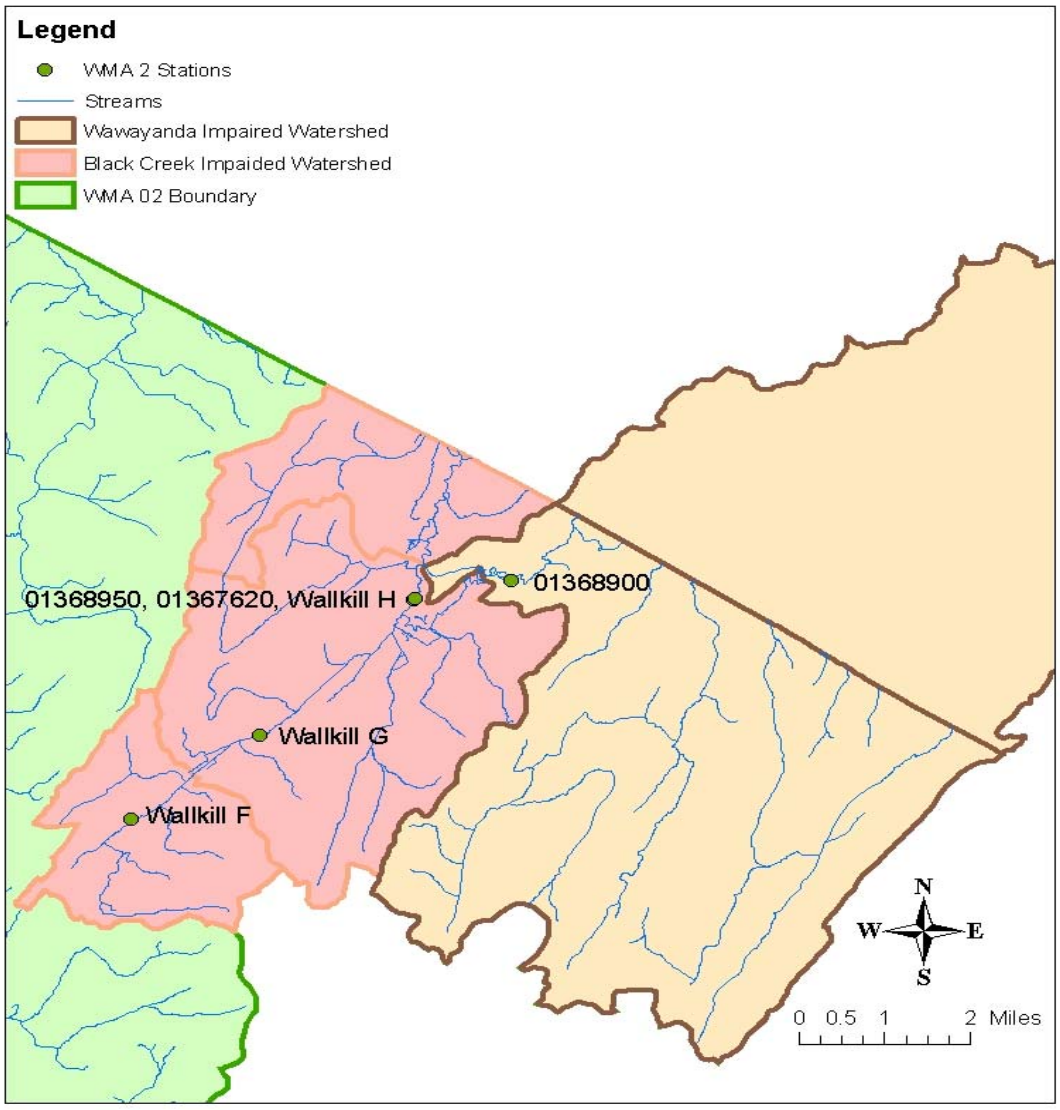
The Wallkill River WMA 2 TAC also collected data on the Black Creek at Rt. 94 and Rt. 517 in Vernon site (Wallkill F) from 2002 through 2004, and the Black Creek at Sand Hill Road in Vernon site (Wallkill G) from 2002 through 2004. USGS/NJDEP monitoring data was collected on the Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange from 2000-2002. Table 10 lists all stations where water quality data were collected and Figure 5 shows sampling locations.

[2] The Grid Code is an attribute of the land use coverage that was used for the Wawayanda Watershed. For consistency of data, a GIS coverage which included both New Jersey and New York land use information was used for these calculations. The data coverage used is the National Land Cover Data (NLCD) for New York, last updated in July 2000, and for New Jersey, last updated in March 2000. The data was produced under the direction of the USGS as part of the Multi-Resolution Land Characterization (MRLC) Regional Land Cover Characterization Project. The data used the NLCD Land Cover Classification Systems to categorize land use. http://edcsgs9.cr.usgs.gov/pub/data/landcover/states/

Table 10 Summary of Total Phosphorus sampling data for WMA 2 Impaired Stream Segments

Water Quality Sample Locations	Site Number	# of samples	Average (mg/L)	% exceeding 0.1 mg/L
Black Creek near Vernon	01368950, 01367620, WallkillH	50	0.057	12
Black Creek at Rt. 94 and Rt. 517 in Vernon	Wallkill F	15	0.933	33.3
Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange	01368900	8	0.187	50
Black Creek at Sand Hill Road in Vernon	Wallkill G	14	0.056	7.1

Figure 5: Location of Monitoring Sites in WMA 02



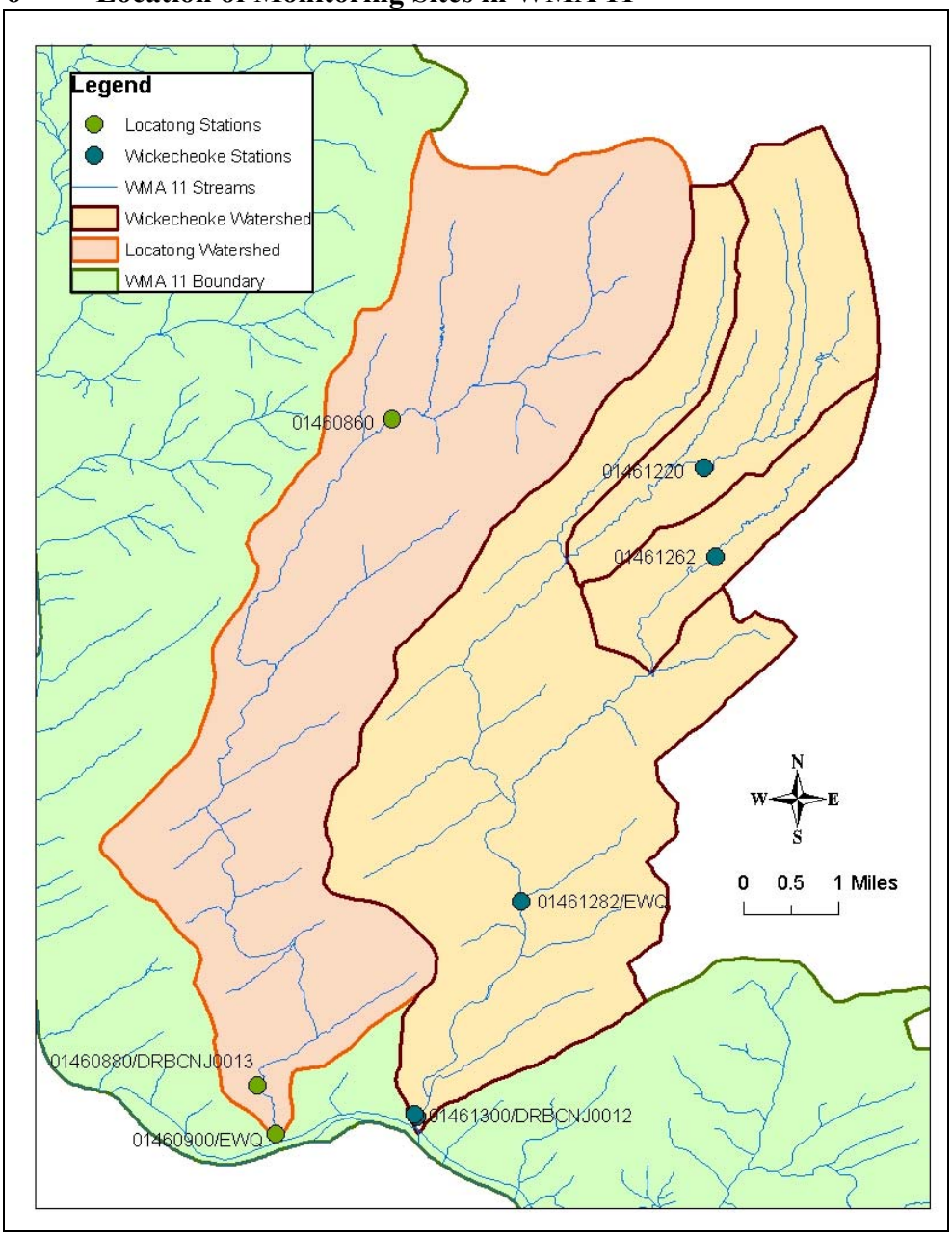
WMA 11

The United States Geological Survey (USGS) in collaboration with NJDEP has collected monitoring data on the Lockatong Creek since 1955 and on Wickecheoke Creek since 1959. Although the monitored stations and monitoring schedule have changed over the years, the historical data were reviewed to understand changes and trends in water quality. In addition to USGS/NJDEP monitoring sites, the Delaware River Basin Commission (DRBC) had been collecting water samples from 1999-2003. Table 11 lists all stations where water quality data were collected and Figure 6 shows sampling locations.

Table 11 Summary of Total Phosphorus sampling data in WMA 11

Water Quality Sample Locations	Site Number	# of samples	Average (mg/L)	% exceeding 0.10 mg/L
Lockatong Creek at Rt 12 at Baptistown	01460860	4	0.060	0
Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013/ 01460880	34	0.077	12
Lockatong Creek near Raven Rock	01460900/EWQ	8	0.073	12.5
Plum Brook near Locktown	01461262	3	0.023	0
Wickecheoke Creek at Croton	01461220	3	0.050	0
Wickecheoke Creek near Sergentsville	01461282	16	0.059	12.5
Wickecheoke Creek at Stockton	DRBCNJ0012/ 01461300	95	0.066	10.5

Figure 6 Location of Monitoring Sites in WMA 11



Lockatong Creek Impaired Segment, WMA 11

The Lockatong Creek impaired segment was sampled at three different locations during different time periods. The most comprehensive data were collected through four consecutive (2000-2003) growing seasons at USGS station 01460880 by DRBC (DRBC0013).

Wickecheoke Creek Impaired Segment, WMA 11

USGS Station 01461282/EWQ, Wickecheoke Creek near Sergeantsville, was monitored from 2000 to 2004. This site was placed on Sublist 3 of the *2004 Integrated List of Waterbodies* because of insufficient data at the time of issuing the report. In 2004 the Department's EWQ program was

completed and the data set was published in 2005 on the EPA's STORET database. The data set of 16 total phosphorus results, where two exceeded SWQS criteria of 0.1 mg/L for streams, confirms that this site is impaired and requires development of a TMDL.

Wickecheoke Creek at Stockton, USGS station 01461300/DRBC0012, was monitored in two time periods. The water quality data was collected by USGS from 1959, but the total phosphorus results and flow rates are available only from 12/9/1976 to 5/20/1991. From 1999 to 2003 this station was monitored again by the Delaware River Basin Commission (DRBC). Through the monitoring periods, total phosphorus exceeded the SWQS of 0.1 mg/L on ten occasions. One TP result, 0.55 mg/L, was excluded from the exceedance analysis because this result is a statistical outlier.

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. Figures 7 through 10 depict the relationship of these two key nutrients at two stations in Lockatong Creek watershed, WMA11. At both station the TIN/DRP ratio is greater than 5. Also at the stations in the Wickecheoke Creek watershed, Figures 9 and 10, the TIN/TOP ratio is greater than 5. This fact suggests that phosphorus is the limiting nutrient in both watersheds and the 0.10 mg/l criterion applies. A more detailed explanation of the nitrogen-phosphorus relationship is given in Appendix B.

Figure 7 Limiting Nutrient Analysis, Lockatong Creek

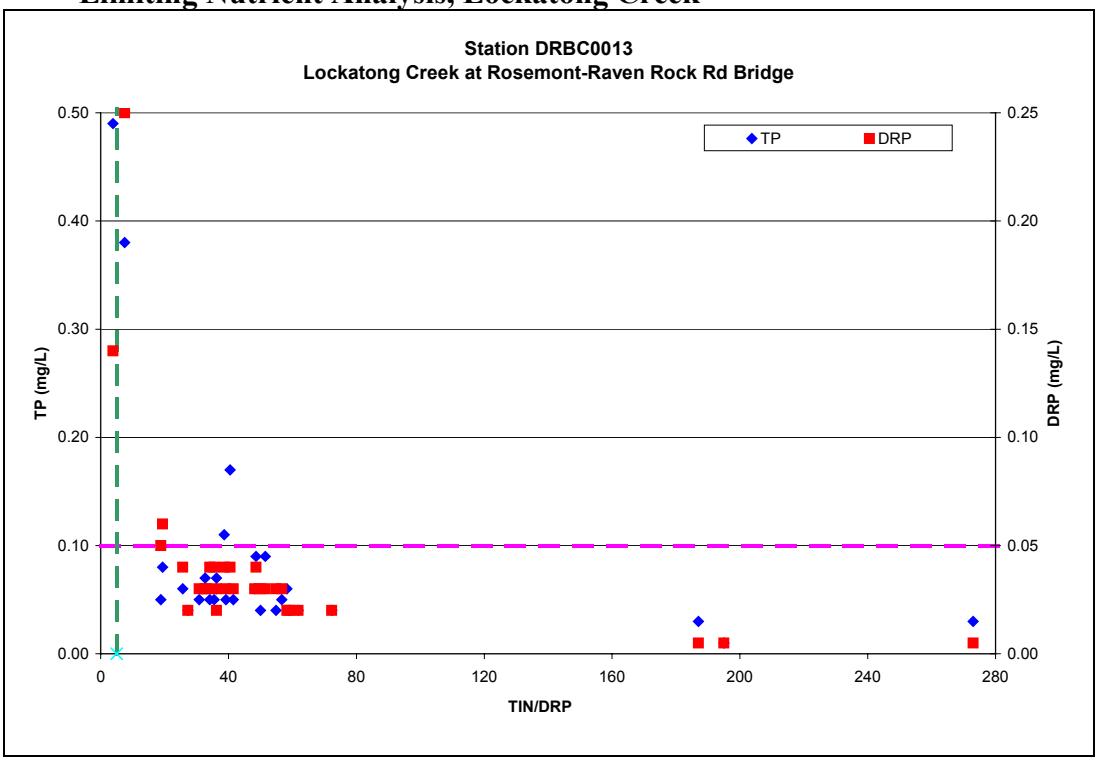


Figure 8 **Limiting Nutrient Analysis, Lockatong Creek**

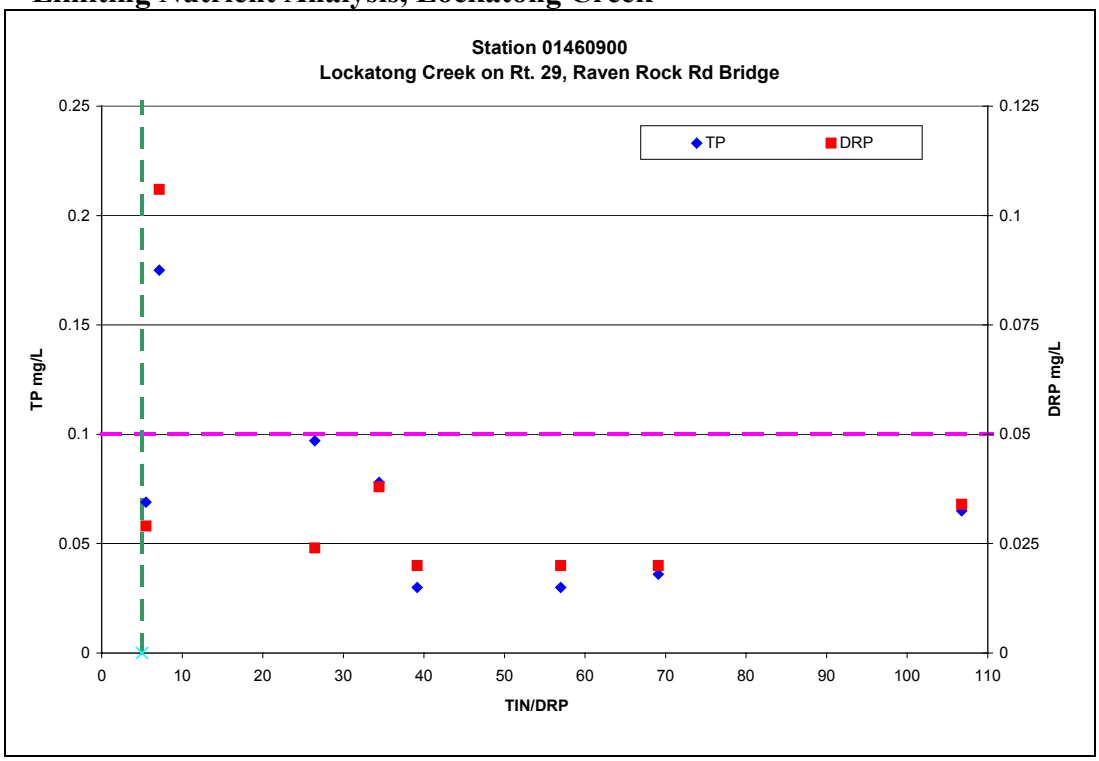


Figure 9 **Limiting Nutrient Analysis, Wickecheoke Creek**

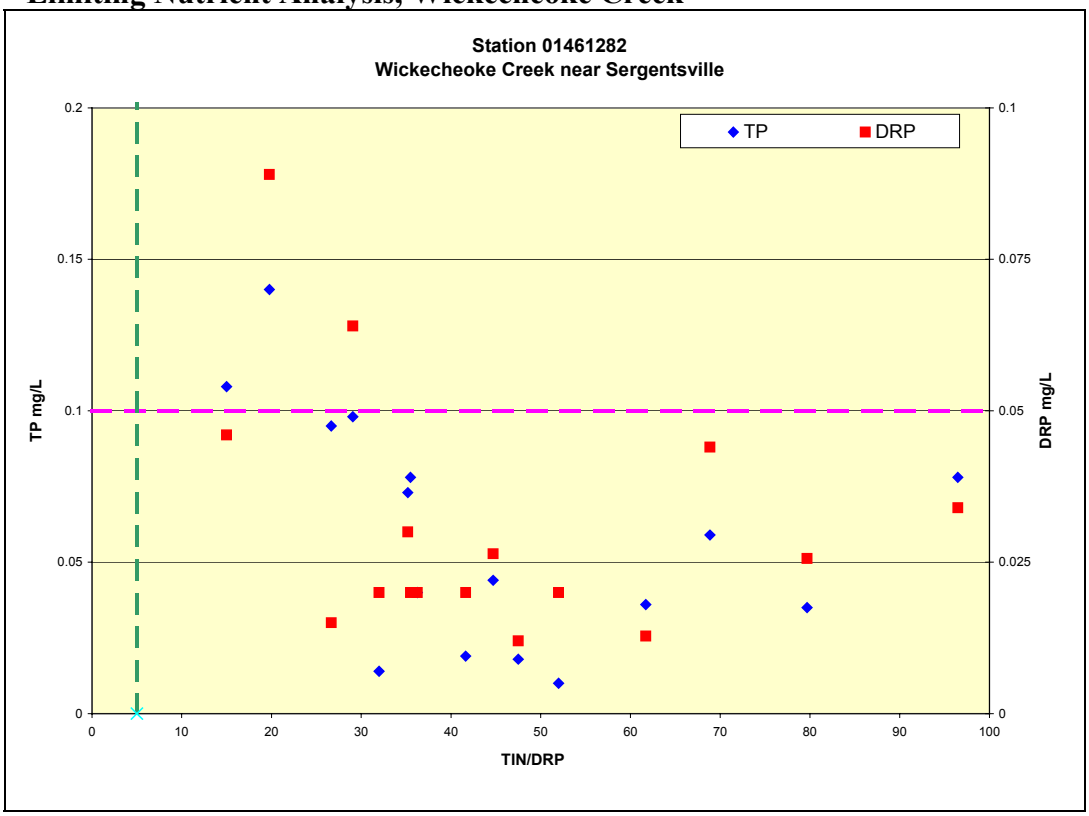
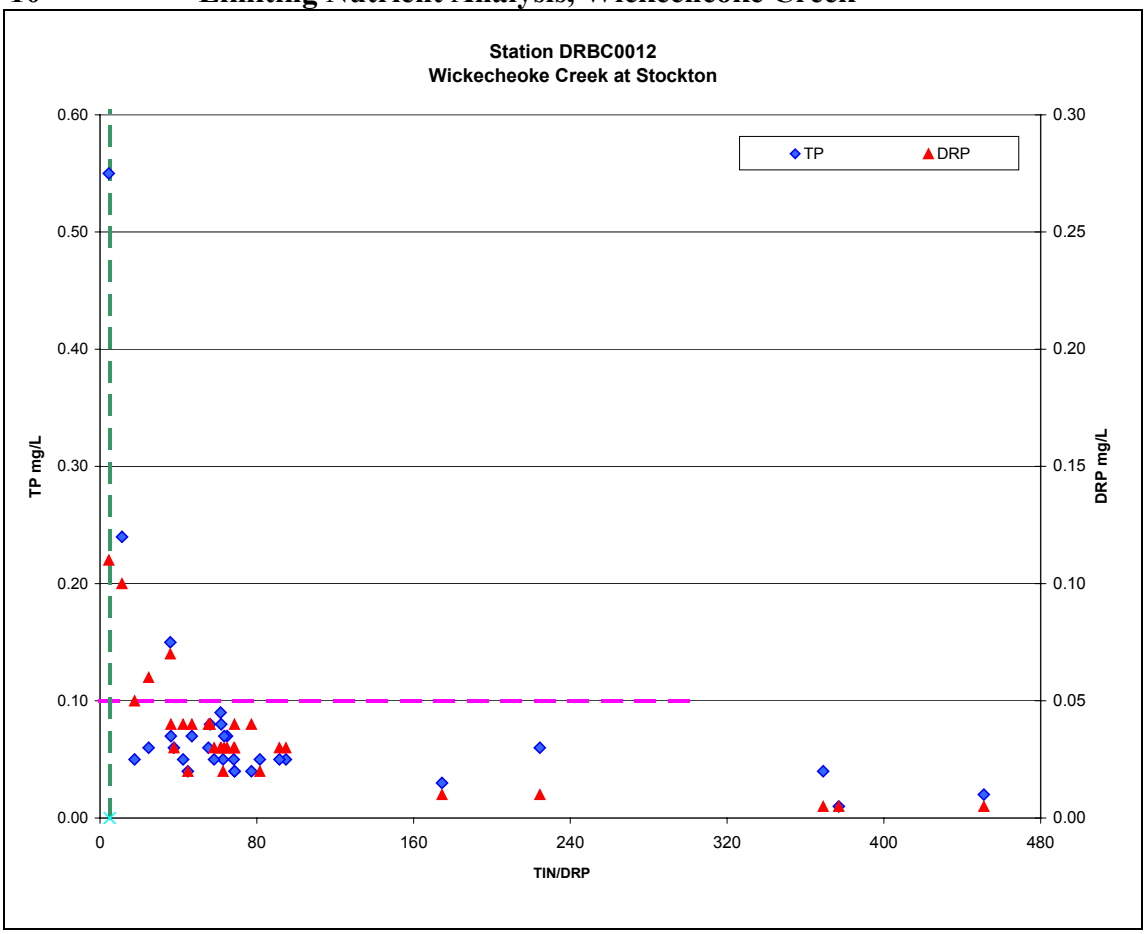


Figure 10 Limiting Nutrient Analysis, Wickecheoke Creek



Notes:

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 TIN/DRP ratios, as presented in Figures 7 through 10, is above 5. This fact suggests that phosphorus could be the limiting nutrient at each station.

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 lines with a common intercept, the difference between the slopes of the two lines provides the percent 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.

For Black Creek near Vernon, 01368950, 01367620, Wallkill H, the regression results are presented in Tables 12 and 13, and Figure 11 below.

Table 12: Phosphorus Exceedances at Black Creek at Vernon, Station # 01368950, 01367620, Wallkill H

Station	Date	Flow (cfs)	TP (mg/L)	Agency
01367620	7/18/1995	19	0.16	USGS/NJDEP
Wallkill H	7/30/2002	1.63	0.12	SCMUA
Wallkill H	8/27/2002	0.44	0.12	SCMUA
Wallkill H	9/24/2002	0.5	0.25	SCMUA
01367620	8/22/2001	2.79	0.13	NJDEP
01367620	8/12/2002	0.5	0.145	NJDEP

Figure 11: Estimated Percent Reduction for the Black Creek near Vernon Using a Regression Method

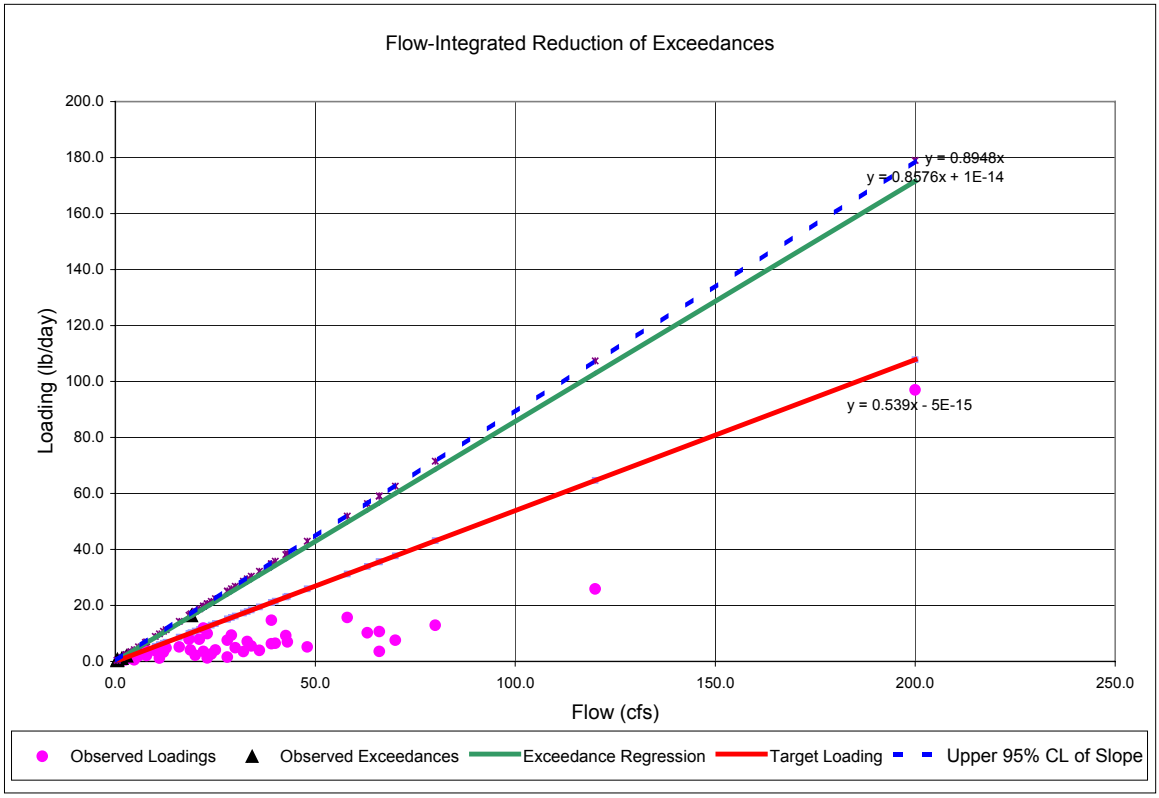


Table 13: Summary Output for Exceedances at Black Creek near Vernon, Station # 01368950, 01367620, Wallkill H

Results from Regression Analysis	
Target Loading Slope	**= 0.5390**
Exceedance Regression Slope	**= 0.8576**
Upper 95% Confidence Limit of Slope	**= 0.8948**

To achieve SWQSs within the impaired Black Creek near Vernon, Station # 01368950, the required reductions are as follows:

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

$$\text{Target Load} = 0.1 \text{ mg/L} \times 5.39 \times \text{flow (cfs)}$$

Percent TP Loading Reduction:

$$(1-\frac{0.539}{0.8576})x100\% = 0.3715x100\% = 37.2\%$$

The portion of the reduction attributed to MOS is calculated as follows:

$$\text{MOS} = (1-\frac{0.8576}{0.8948})x100\% = 0.0415x100\% = 4.2\%$$

For Black Creek at Rt. 94 and Rt. 514, Wallkill F, the regression results are presented in Tables 14 and 15, and Figure 12 below.

Table 14: Phosphorus Exceedances at Black Creek at Rt. 94 and Rt. 514, Station # Wallkill F

Station	Date	Flow (cfs)	TP (mg/L)
Wallkill F	5/28/2002	2.53	0.12
Wallkill F	8/27/2002	0.235	0.11
Wallkill F	9/24/2002	0.062	0.46
Wallkill F	10/29/2002	1.66	0.13
Wallkill F	7/16/2003	2.96	0.11

Figure 12: Estimated Percent Reduction for the Black Creek at Rt. 94 and Rt. 517 in Vernon Using a Regression Method

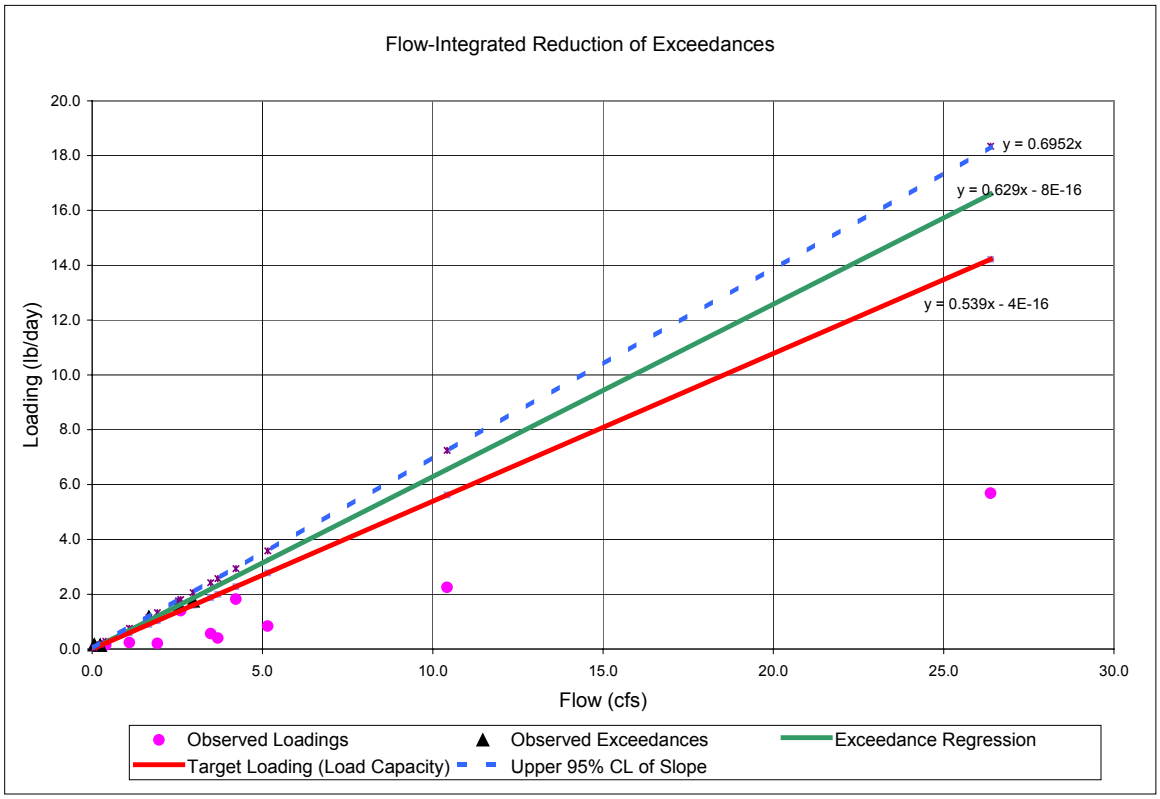


Table 15: Summary Output for Exceedances at Black Creek at Rt. 94 and Rt. 514, Station # Wallkill F

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.6290
Upper 95% Confidence Limit of Slope	=	0.6952

To achieve SWQSs within the Black Creek at Rt. 94 and Rt. 514, Station # Wallkill F impaired segment, the required reductions are as follows:

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

Target Load = 0.1 mg/L x 5.39 x flow (cfs)

Percent TP Loading Reduction:

$$(1-\frac{0.539}{0.6290})x100\% = 0.1430x100\% = 14.3\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{0.6290}{0.6952})x100\% = 0.0952x100\% = 9.52\%$$

For Black Creek at Sand Hill Road in Vernon, Wallkill G, the results are presented in Table 16 below.

Table 16:Phosphorus Exceedances at Black Creek at Sand Hill Road in Vernon, Station # Wallkill G

Station	Date	Flow (cfs)	TP (mg/L)
Wallkill G	9/24/2002	0.26	0.28

Black Creek at Sandhill Road (Wallkill H) was listed on Sublist 3 as the result of having one exceedance during the data collection period. Since the methodology being utilized in the development of these TMDLs is based on a regression analysis of the exceedances, the method requires a minimum of two exceedances. Therefore, no regression was performed on the data from this site. Instead, the results from Black Creek at Rt. 94 and Rt. 514 (Wallkill F) regression were compared to the results from Black Creek near Vernon (01368950, 01367620, Wallkill H) regression. Black Creek near Vernon (01368950, 01367620, Wallkill H), which is the most downstream impairment, was found to require the largest percent reduction and so is the most protective of water quality in the Black Creek watershed as a whole. Therefore, the results of the Black Creek at Vernon regression method will be used as the basis of the TMDL for the entire Black Creek Watershed, and the loading reductions will be calculated based on this reduction level.

For Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange, the regression results are presented in Tables 17 and 18, and Figure 13 below.

Table 17: Phosphorus Exceedances at Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange, Station # 01368900

Station	Date	Flow (cfs)	TP (mg/L)
01368900	12/4/2000	39	0.19
01368900	8/22/2001	5.33	0.49
01368900	11/8/2001	20.2	0.16
01368900	8/12/2002	2.58	0.365

Figure 13: Estimated Percent Reduction for the Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange Using a Regression Method

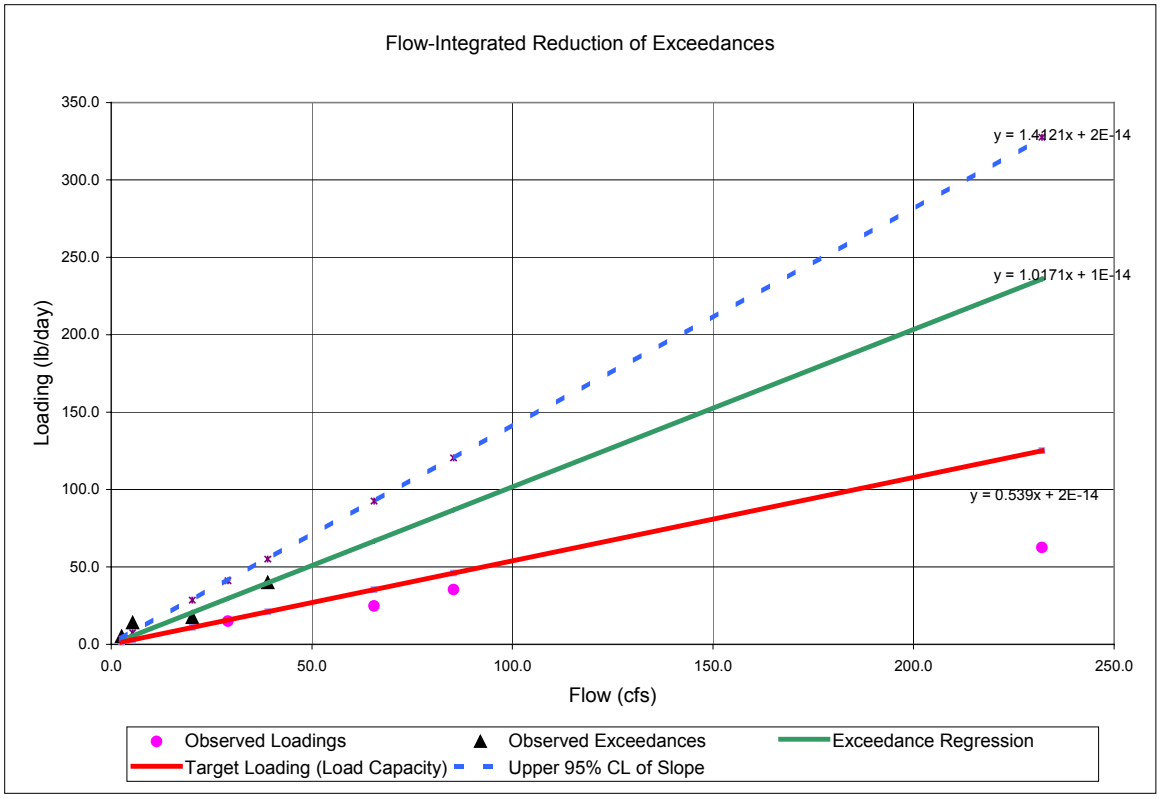


Table 18: Summary Output for Exceedances at Wawayanda/Pochuck River at Alt Rt. 517 in Vernon, Station # 01368900

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	1.0171
Upper 95% Confidence Limit of Slope	=	1.4121

To achieve SWQSs within the Wawayanda/Pochuck River at Alt Rt. 517 in Vernon, Station # 01368900 impaired segment, the required reductions are as follows:

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

$$\text{Target Load} = 0.1 \text{ mg/L} \times 5.39 \times \text{flow (cfs)}$$

Percent TP Loading Reduction:

$$(1 - \frac{0.539}{1.0171}) x 100\% = 0.470 x 100\% = 47.0\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1 - \frac{1.0171}{1.4121}) x 100\% = 0.279 x 100\% = 27.9\%$$

WMA 11:

For Lockatong Creek at Raven Rock, station 01460880/DRBC0013, four exceedences were recorded as shown in Tables 19 below. The regression results are presented in Table 20 and Figure 14 below.

Table 19: Phosphorus Exceedances at Lockatong Creek, station DRBC0013/01460880

Station	Date	Flow (cfs)	TP (mg/L)
DRBCNJ0013	05/22/01	18.75	0.17
DRBCNJ0013	06/19/01	14.41	0.11
DRBCNJ0013	7/22/2003	49.13	0.38
DRBCNJ0013	9/23/2003	180.30	0.49

Figure 14: Estimated Percent Reduction for the Lockatong Creek Using a Regression Method

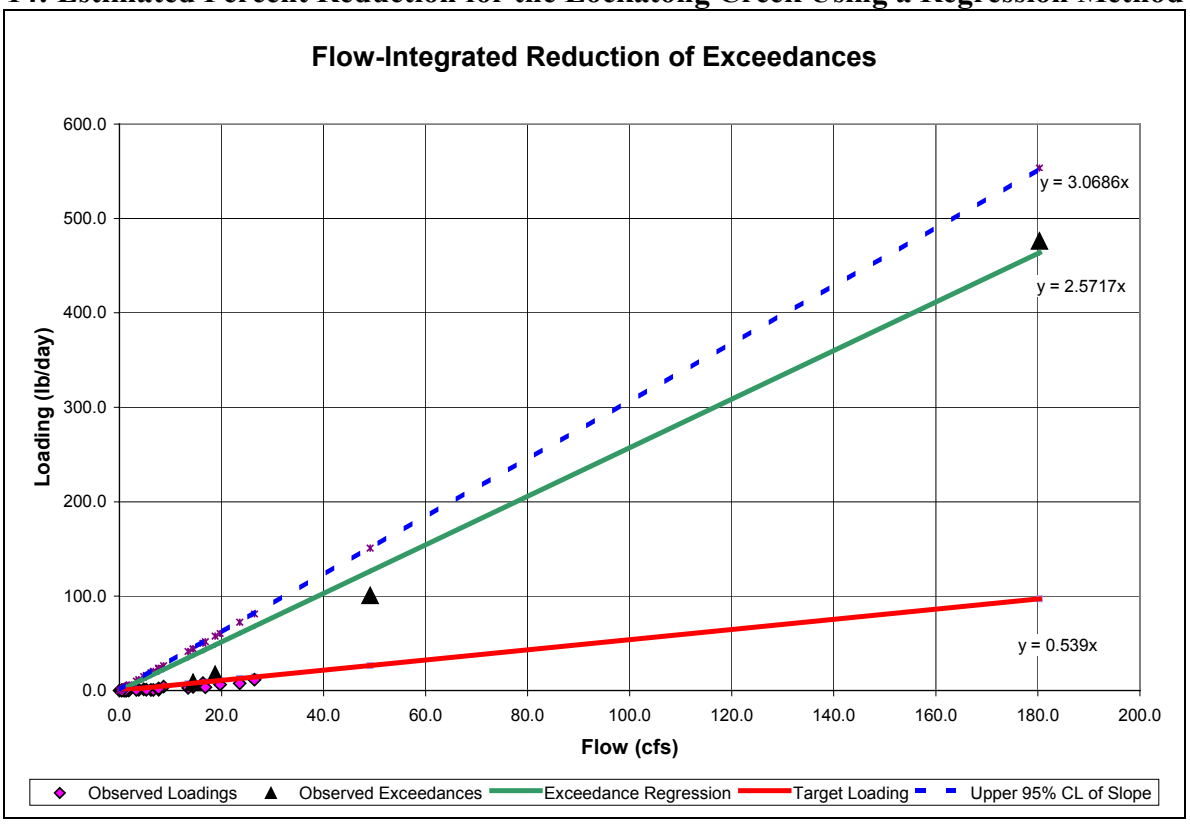


Table 20: Summary output for exceedances at Lockatong Creek, station DRBC0013

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	2.5717
Upper 95% Confidence Limit of Slope	=	3.0686

To achieve SWQSs within the Lockatong Creek at Raven Rock, station 1460880/DRBC0013 impaired segment, the required reductions are as follows:

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

Target Load = 0.1 mg/L x 5.39 x flow (cfs)

Percent TP Loading Reduction:

$$(1-\frac{0.539}{2.5717})x100\% = 0.790x100\% = 79.0\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{2.5717}{3.0686})x100\% = 0.1619x100\% = 16.2\%$$

For Wickecheoke Creek at Stockton, station 01461300/DRBC0012, ten exceedences were recorded as shown in Table 21 below. The regression results are presented in Table 22 and Figure 15 below.

Table 21: Phosphorus Exceedances at Wickecheoke Creek, station DRBC0012/01461300

Station #	Date	Flow (cfs)	TP (mg/L)
1461300	10/4/1977	61	0.11
1461300	10/13/1983	5.1	0.15
1461300	10/8/1986	0.87	0.28
1461300	5/18/1988	23	0.11
1461300	7/11/1988	1.2	0.108
DRBC0012	07/10/00	0.18	0.19
DRBC0012	08/21/00	2.04	0.13
DRBC0012	05/22/01	33.75	0.15
DRBC0012	7/22/2003	53.30	0.24
DRBC0012	9/23/2003	144.15	0.55

The highest TP result (0.55 mg/L) is an outlier and was eliminated from the regression method of determining reductions required in this watershed.

Figure 15: Estimated Percent Reduction for the Wickecheoke Creek Using a Regression Method

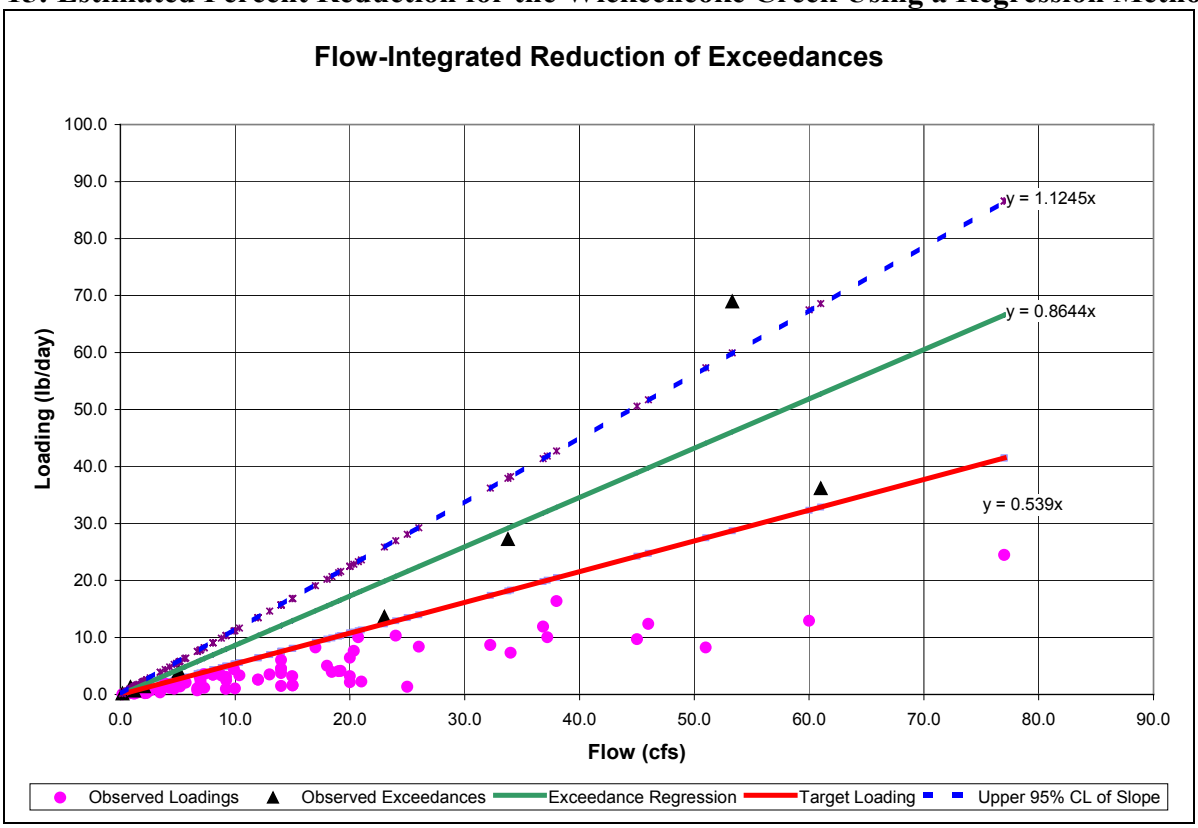


Table 22: Wickecheoke Creek at Stockton, station 01461300/DRBC0012

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.8644
Upper 95% Confidence Limit of Slope	=	1.1245

To achieve SWQSs within the Wickecheoke Creek at Stockton, station 01461300/DRBC0012 impaired segment, the required reductions are as follows:

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

Target Load = 0.1 mg/L x 5.39 x flow (cfs)

Percent TP Loading Reduction:

$$(1-\frac{0.539}{0.8644})x100\% = 0.3764x100\% = 37.6\%$$

The MOS portion of the reduction is calculated as follows:

$$\text{MOS} = (1-\frac{.8644}{1.1245})x100\% = 0.2313x100\% = 23.1\%$$

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. 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. The procedure to do this is described in more detail in Appendix E.

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." For point sources other than stormwater, individual WLAs are assigned. For stormwater point sources, both WLAs and LAs are expressed as percent reductions based on land use 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 23. 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 23: 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 (WLA) and load allocations (LA) for sources within the drainage area of the impaired segments in WMA 2 are presented in Tables 24 and 25, and shown in Figures 16 and 17. In the Black Creek watershed, the wasteload allocation for the Lounsberry Hollow Middle School and Legends Golf Discharge were calculated using full permitted flow and the final permit limit for phosphorus as it is identified in the existing NJPDES permit for each facility . The NJPDES permit for Lounsberry Hollow Middle School identifies the phosphorus limit to be 0.5 mg/l. The future allocation assigned to Lounsberry Hollow Middle School at the full permitted flow was calculated to be an annual load of 22.09 kg/yr of phosphorus. The permit for Legends Resort and Country Club (NJ0023949) allows for a permitted flow of 0.35 MGD, with a final phosphorus concentration of 0.211 mg/l, effective in June 2008. The future allocation for this facility at the TP permit limit of 0.211 mg/l and the permitted flow of 0.35 MGD is 42.18 kg/yr. No additional phosphorus reductions are directed as a result of the WLAs.

Table 24: TMDL calculations for the Black Creek Watershed (Black Creek at Vernon)

	Current Load	Load Capacity		% reduction
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	
Load allocation				
Point Sources other than Stormwater*				
Lounsberry Hollow MS	4.85 (10.67)	**22.09 (48.59)**	**1.2**	**0**
Legends Golf Discharge	7.71 (16.96)	**42.18 (92.79)**	**2.3**	**0**
Nonpoint and Stormwater Sources				
medium / high density residential	459.47 (1010.83)	229.45 (504.79)	12.8	50
low density / rural residential	419.41 (922.70)	209.44 (460.76)	11.7	50
commercial	199.43 (438.74)	99.58 (219.07)	5.5	50
industrial	26.80 (58.96)	13.38 (29.43)	.7	50
mixed urban / other urban	393.12 (864.86)	196.31 (431.88)	10.9	50
agricultural	850.97 (1872.13)	425.48 (934.89)	23.7	50
forest, wetland, water	472.00 (1038.4)	472.0 (1038.4)	26.3	0
barren land	22.13 (48.68)	11.05 (24.31)	.6	0
Margin of Safety	n/a	74.49 (163.87)	4.2	n/a
Total:	**2855.89 (628.93)**	**1794.92 (3948.78)**	**100**	

* Notes:

(1) From the NJPDES Permit NJ0023949, Lounsberry Hollow MS, the current effluent limit for phosphorus is 1.0 mg/l. After 4/1/2008 the monthly average will be 0.211 mg/l.

(2) Discharge from Legends Resort and Country Club (NJ0023949) to the Black Creek is allowed from November through March.

Figure 16: Phosphorus allocation for the Black Creek impaired watershed

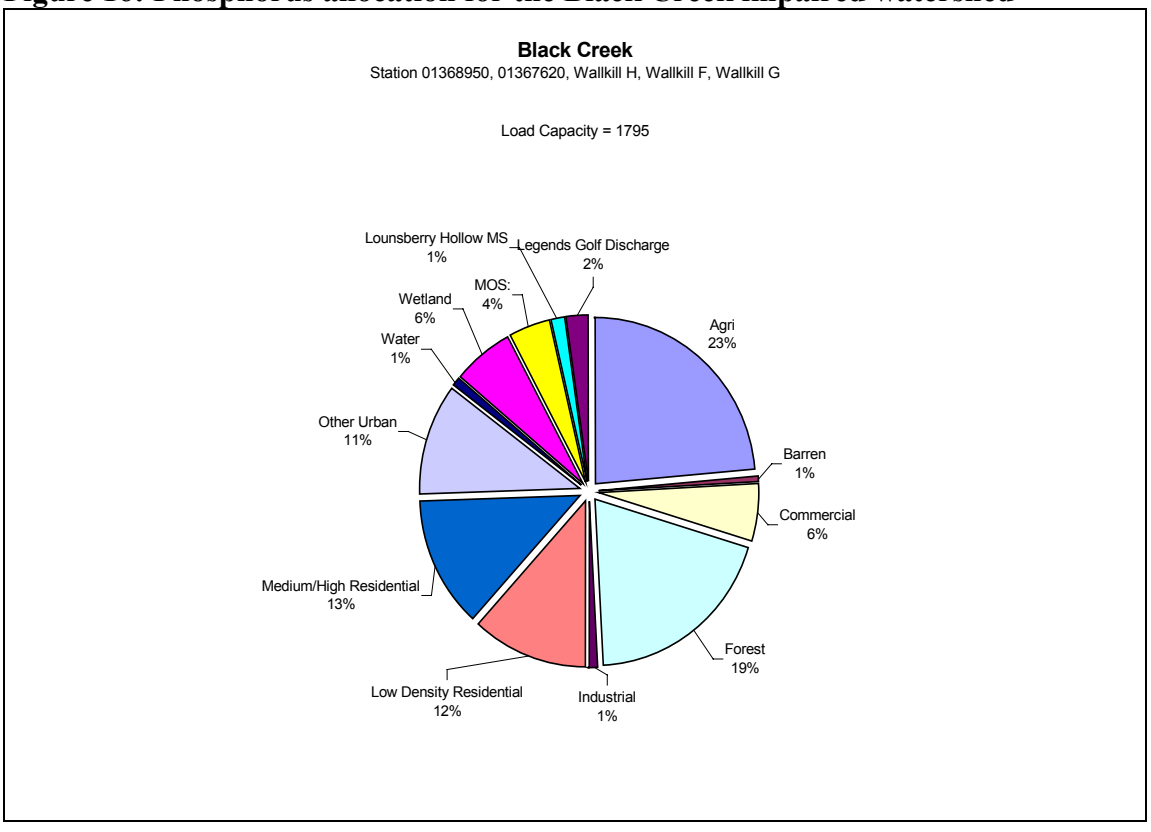
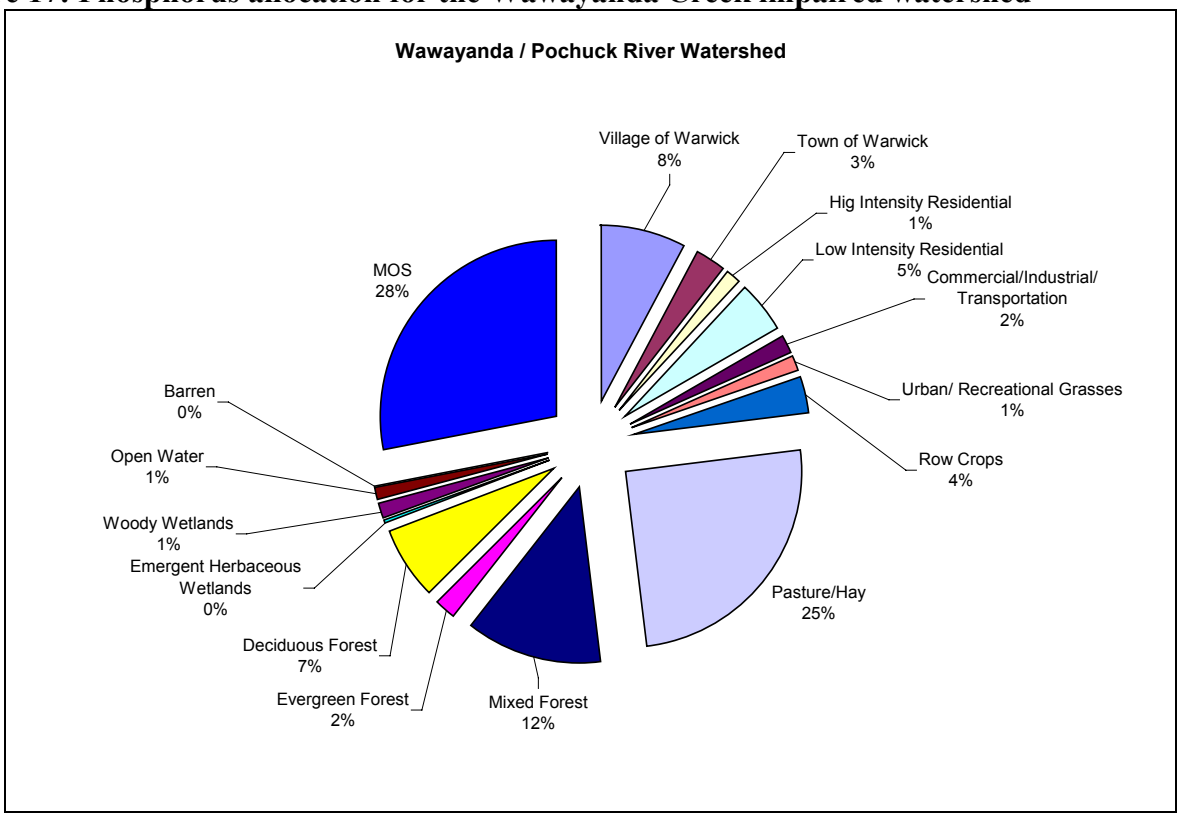


Table 25: TMDL calculations for the Wawayanda/Pochuck River Watershed

	Current	Loading capacity (LC)		% reduction
	Kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	
Load allocation				
Point Sources other than Stormwater*		(from New York portion of watershed)		
Village of Warwick	1,380.50	402.81	**7.8%**	**70.82**
Town of Warwick	497.00	145.02	**2.8%**	**70.82**
Nonpoint and Stormwater Sources				
high intensity residential	242.59	70.78	1.4%	70.82
low intensity residential	829.22	241.95	4.7%	70.82
commercial/industrial/transportation	282.77	82.51	1.6%	70.82
urban/recreational grasses	241.51	70.47	1.4%	70.82
row crops	632.88	184.67	3.6%	70.82
pasture/hay	4,411.99	1287.36	24.9%	70.82
mixed forest	643.02	643.02	12.4%	0
evergreen forest	104.81	104.81	2.0%	0
deciduous forest	349.71	349.71	6.8%	0
emergent herbaceous wetlands	7.20	7.20	0.1%	0
woody wetlands	71.68	71.68	1.4%	0
open water	61.01	61.01	1.2%	0
Barren	0.63	0.63	0.01%	0
Margin of Safety	**n/a**	1447		n/a
Total:		**5170**	100	

* the reductions for the New York point sources, other than stormwater point sources are illustrative only; New York will determine the actual allocation of loads to achieve the New Jersey SWQS at the border.

Figure 17: Phosphorus allocation for the Wawayanda Creek impaired watershed



WMA 11

Wasteload allocations (WLA) and load allocations (LA) for sources within the drainage area of the impaired segments in WMA 11 are presented in Tables 26 and 27, and shown in Figures 18 and 19. In the Wickecheoke Creek watershed, the wasteload allocation associated with Delaware Township Municipal Utility Authority (DTMUA) was assigned as follows. The overall reduction required of adjustable land use loads is 56 percent. Because the treatment facility contributes a relatively small proportion of the load, the approach was to reduce the effluent concentration limit by 50 percent at the full permitted capacity. The current DTMUA's phosphorus loading was calculated to be 20.20 kg/year based on average monthly loadings reported in the Discharge Monitoring Reports (DMR) for the period July 2000 through March 2005. However, because the facility is currently discharging less than the full permitted capacity, the WLA represents an increase in the existing load. Therefore, the effect of this WLA will be to require a modification of the existing effluent concentration limit for phosphorus in a phased manner so that the overall load does not exceed 44.96 kg/year.

Table 26: TMDL calculations for the Lockatong Creek watershed

	Current Load	Load capacity (LC)		% reduction
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	
Point Sources other than Stormwater	n/a			
Nonpoint and Stormwater Sources				
medium / high density residential	3.45 (7.60)	0.43 (0.94)	0.04	87.6
low density / rural residential	403.6 (887.9)	49.92 (109.8)	4.5	87.6
commercial	44.17 (97.16)	5.46 (12.02)	0.5	87.6
industrial	12.23 (26.90)	1.51 (3.33)	0.1	87.6
mixed urban / other urban	50.84 (111.84)	6.29 (13.83)	0.6	87.6
agricultural	4487.3 (9872)	555.02 (1221)	49.8	87.6
forest, wetland, water	307.76 (677.1)	307.76 (677.1)	27.6	0
barren land	7.51 (16.52)	7.51 (16.52)	0.7	0
Margin of Safety	n/a	180.5 (397.0)	16.2	n/a
TOTAL	**5316.84 (11697)**	**1114 (2451.6)**	**100.0**	**79.0**

Note: Current loadings were calculated using Unit Areal Loadings (UAL)

Figure 18: Phosphorus allocation for the Lockatong Creek impaired watershed

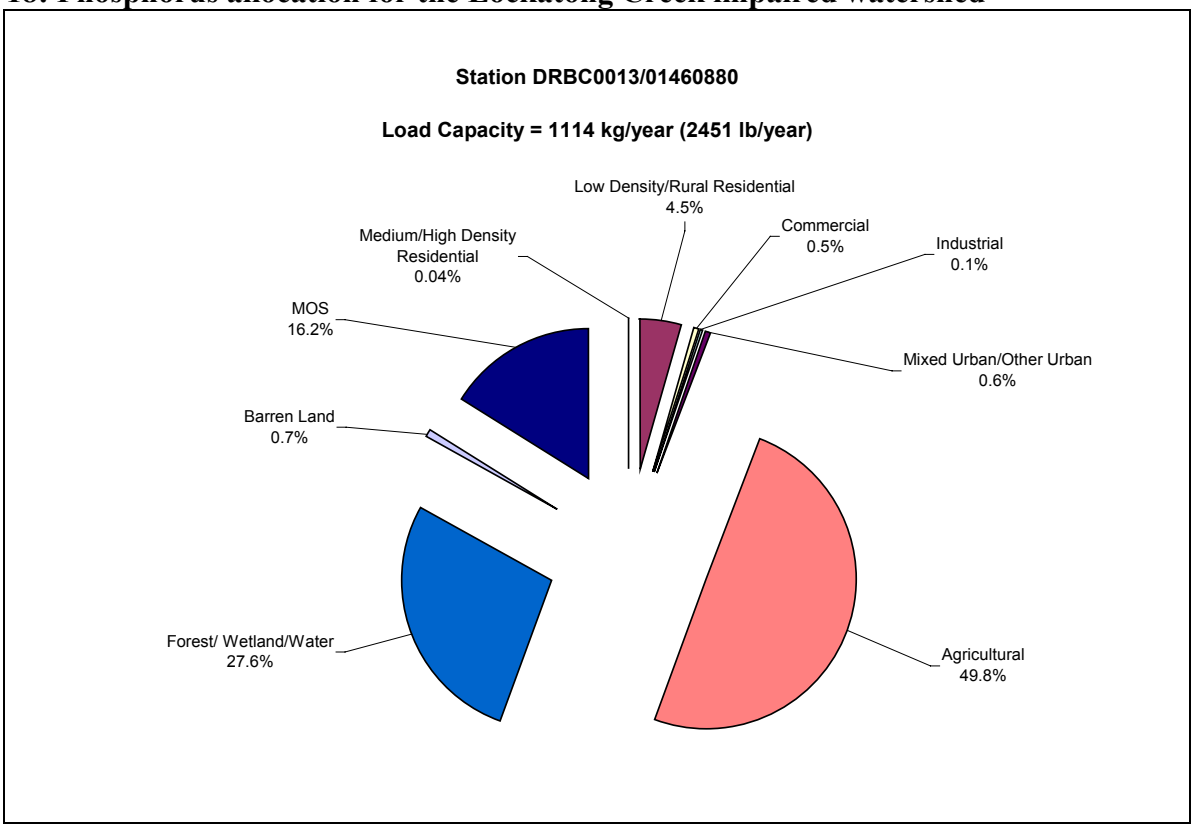
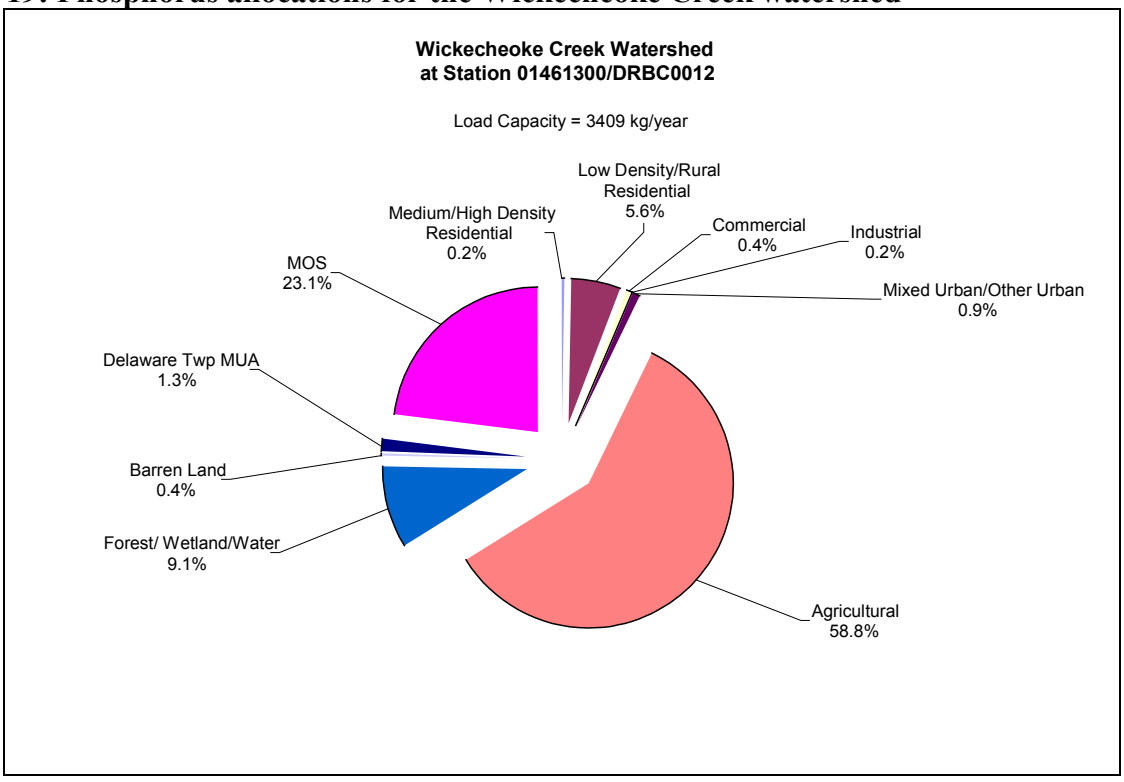


Table 27: TMDL calculations for the Wickecheoke Creek watershed

	Current Load (UAL)	Loading Capacity		% reduction
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	% of LC	
		Load allocation		
Point Sources other than Stormwater				
Delaware Twp MUA	20.20 (44.44)	44.96 (98.91)	1.3	n/a
Nonpoint and Stormwater Sources				
medium / high density residential	14.42 (31.72)	6.34 (13.96)	0.2	56
low density / rural residential	437.46 (962.42)	192.5 (423.5)	5.6	56
commercial	33.17 (72.98)	14.60 (32.11)	0.4	56
industrial	12.89 (28.36)	5.67 (12.48)	0.2	56
mixed urban / other urban	66.66 (146.65)	29.33 (64.53)	0.9	56
agricultural	4554.7 (10020.3)	2004 (4409)	58.8	56
forest, wetland, water	309.63 (681.19)	309.6 (681.2)	9.1	0
barren land	14.67 (32.28)	14.68 (32.29)	0.4	0
Margin of Safety	n/a	787.6 (1732.7)	23.1	n/a
TOTAL	**5463.8 (12020)**	**3409.4 (7501)**	**100**	**37.6**

Note: Current loadings were calculated using Unit Areal Loadings (UAL)

Figure 19: Phosphorus allocations for the Wickecheoke Creek watershed



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

For point sources other than stormwater located within New Jersey, effluent limits consistent with assigned WLAs will be incorporated into the applicable NJPDES permits. The only change required as a result of these TMDLs is for the DTMUA facility, as described above. New York will be responsible to determine the exact load reduction needed to attain SWQS at the border and for allocating that load between point and nonpoint sources.

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.

In these impaired watersheds wetlands and forest represent a significant portion of the land use. As discussed under source assessment, loads from these land uses are not adjustable. 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 Lockatong and Wickecheoke Creek Watershed, it was determined that the low phosphorus fertilizer ordinance was not required. However, in the Black Creek and Wawayanda Creek Watersheds, it was determined that the low phosphorus fertilizer ordinance was required based on the guidelines provided above.

Therefore, all municipalities with contributory drainage area into the impaired stream segments of the Black Creek and Wawayanda Creek 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:

All municipalities with contributory drainage area into the impaired stream segments 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 identified in Appendix C as needing a low phosphorus fertilizer ordinance 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 identified in Appendix C as needing a low phosphorus fertilizer ordinance shall certify annually that they have met the Low Phosphorus Fertilizer Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities identified in Appendix C as needing a low phosphorus fertilizer ordinance 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. Figures 20 and 21 show the category one (C1) waterways in the impaired watersheds. 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.

Figure 20: Category One Waterways in the Black Creek/ Wawayanda Creek Watersheds

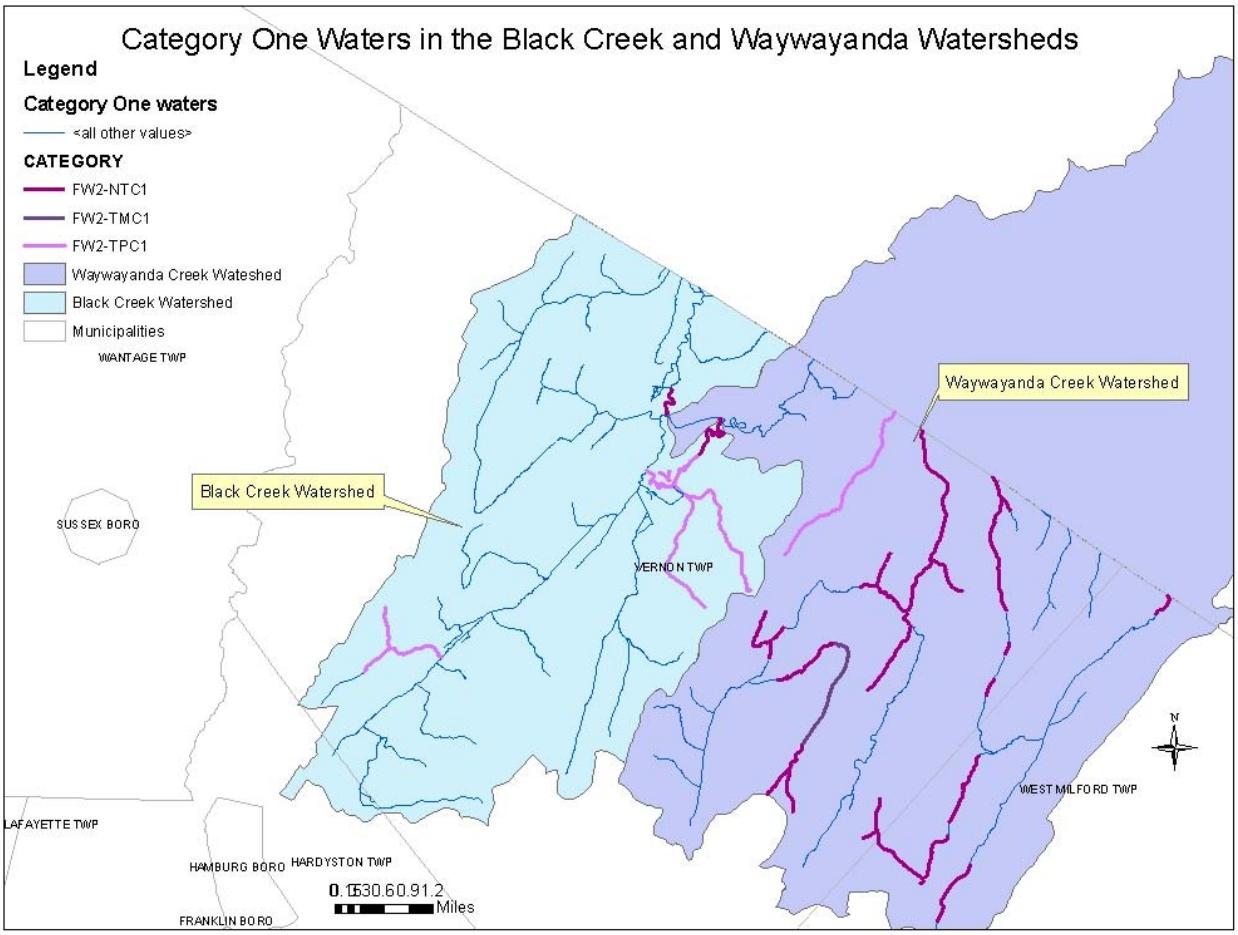
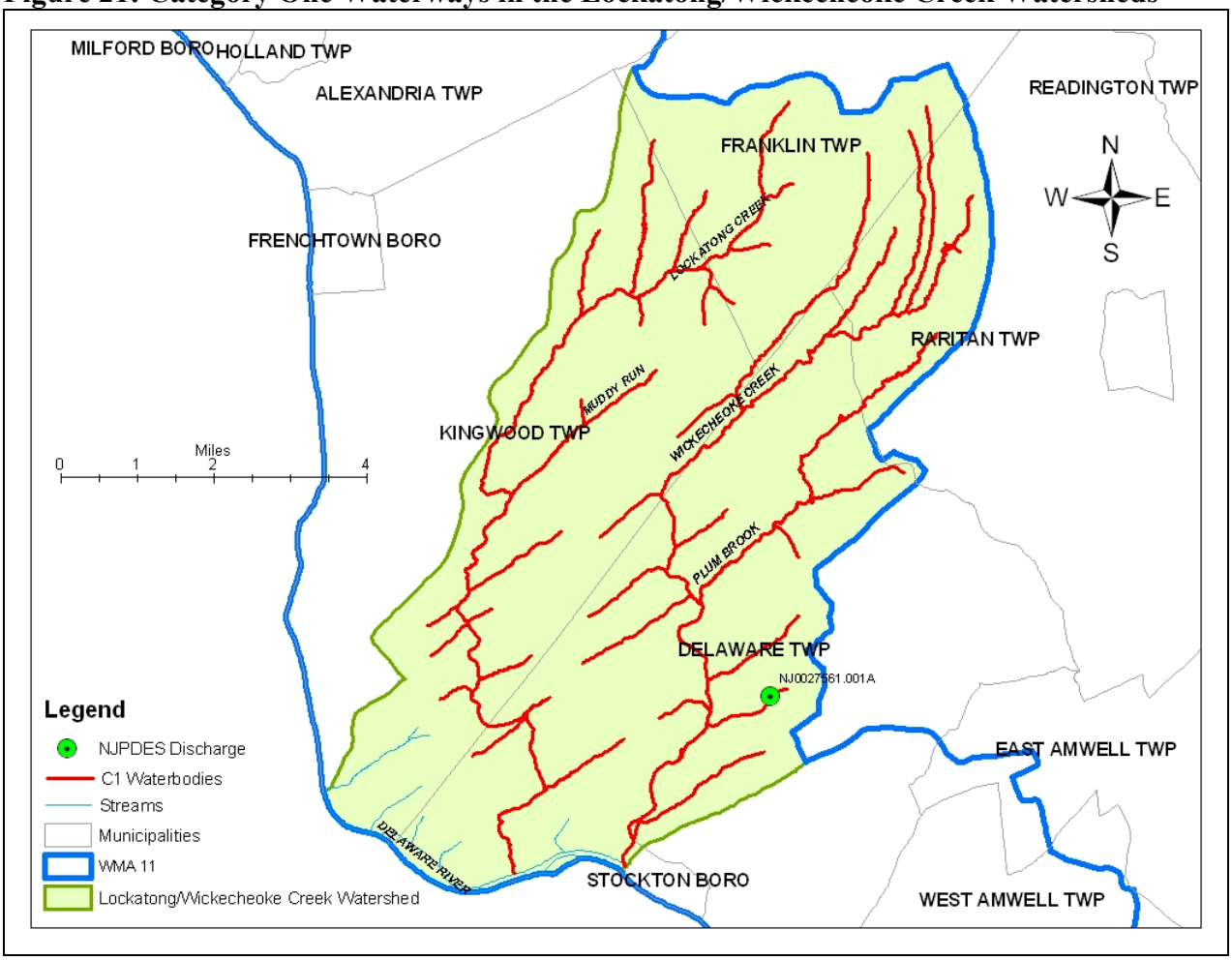


Figure 21: Category One Waterways in the Lockatong/Wickecheoke Creek Watersheds



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 28: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.

Current Implementation Projects

WMA 2:

The Highland Lakes Regional Nonpoint Source Pollution Control Project was a project funded in state fiscal year 2002 with the aim of producing a stormwater management plan for the 75-acre Upper Highland Lake community. The purpose of the project is to help manage the effects of cultural eutrophication that have been causing water quality problems in the 14-acre lake. The end goal is to have a full understanding of the nonpoint pollution sources responsible for the slow sedimentation and eutrophication of the lake in order for necessary roadway and drainage improvements to be undertaken with an environmental focus. The plan incorporates eight different stages, including a characterization and assessment, area-specific design and performance standards, storm event sampling, selection of best management practices (BMP), and development of a long-term management strategy among others. One of the primary parameters that will be tested for when developing the area specific BMP's is phosphorus, which is thought to be a contributor through septic problems, lawn maintenance, and stormwater. This project is due to be completed by the end of September 2005.

The Black Creek Watershed Restoration and Protection Plan project was recently funded in 2005. The plan will include a complete characterization and assessment of the Black Creek Watershed in addition to surface water quality sampling to achieve the recommended load reductions, and to address planning methods needed to improve stormwater quality. The main focus of this project is to address fecal coliform impairments, however the strategies identified in this plan will also be beneficial in the reduction of nonpoint sources of phosphorus.

WMA 11:

A Watershed Restoration and Protection Plan for the Lockatong and Wickecheoke Creek Watersheds is being developed by NJ Water Supply with 319 (h) 2005 funding. The plan covers about 54.4 square miles. There are many groups that are active in the protection and preservation of open space in the Lockatong and Wickecheoke watersheds. The Hunterdon Land Trust Alliance (HTLA) has been actively acquiring land for preservation and has made the Lockatong one of its priority target areas. Because of a generous donation by a local landowner the HTLA will receive donation credits for the New Jersey Green Acres program that can be used to match other land preservation grants for projects along the Lockatong Creek. Among the tracts of land the (HTLA) has facilitated the preservation of in the Lockatong Creek Watershed are 34 acres along the Locakatong Creek and Raven Rock - Rosemont Road in Delaware Township, 12-acres Milltown Road Preserve along Lockatong Creek in Kingwood Township and 14-acre conservation easement at Meadow Creek Farm in Delaware Township.

Hunterdon County has an open space acquisition program as does Kingwood Township. The Environmental Commissions of Delaware, Kingwood, Franklin, and Raritan Townships are active in protecting open space within their borders. Citizens groups such as the Delaware River Keeper also take an active interest in these watersheds.

Because the Wickecheoke Creek and Lockatong Creek watersheds consist largely of farmland and forested land, with a only small areas of residential development, implementation will need to be geared toward working with the agricultural community to employ best management practices to reduce phosphorus runoff.

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.

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). As part of the public participation process for the development and implementation of these TMDLs, the Department worked collaboratively with a series of stakeholder groups through the Department's ongoing watershed management efforts.

In June of 2005, GIS maps of the impaired stream segments and their associated streamsheds were made available on the Department's website for review and comment. Interested parties had the opportunity to supply the Department with information about each TMDL segment via e-mail. The Department specifically solicited information regarding potential sources and/or current non point sources of pollution reduction projects within the impaired streamsheds. In addition, an email notification of the web posting was sent to stakeholders involved in the Department's Watershed Management efforts.

Amendment Process

In accordance with N.J.A.C. 7:15–7.2(g), these TMDLs were proposed by the Department as an amendment to the Upper Delaware Water Quality Management Plan and Sussex County Water Quality Management Plan.

The notice proposing the TMDLs was published on July 5, 2005 in the New Jersey Register and the Star Ledger. The TMDL documents were made available at the Department, upon request by mail, and on the Department's website. The Department conducted two non-adversarial public hearings, on August 4, 2005 at Vernon Township, NJ and on August 8, 2005 at the Hunterdon County Complex. A presentation, describing the development of the TMDLs, preceded each hearing. The public comment period ended on August 19, 2005 for the public hearing at Vernon Township, NJ, and on August 23, 2005, for the public hearing at the Hunterdon County Complex. Notice of the proposal and the hearing was also provided to affected municipalities, DPAs and wastewater treatment plant authorities.

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".
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 depicting existing loads in tables presenting load allocations for each impaired segment.

Four comment letters were received on the proposed TMDLs. Six people attended the public hearings; four testified.

The following people submitted written and/or oral comments on the proposal:

1. Ernest Hofer, PE - Wallkill River Watershed Specialist (8/4/05 testimony and written)
   Sussex County Municipal Utilities Authority

Watershed Planning Division
34 South Route 94
Lafayette, NJ 07848

2. Nathaniel Sajdak - Wallkill River Watershed Coordinator (8/4/05 testimony and written)
   Sussex County Municipal Utilities Authority
   Watershed Planning Division
   34 South Route 94
   Lafayette, NJ 07848

3. Lance P. Salerno, QEP – Managing Engineer (written)
   Brown and Caldwell
   Allendale, New Jersey 07401

4. Andrew J. Higgins – Chief Engineer (8/8/05 testimony and written)
   Applied Water Management
   2 Clerico Lane
   Hillsborough, NJ 08844

5. Debbie Kratzer (8/8/05 testimony)
   Kingwood Township Environmental Commission

6. Thomas J. Fikslin - Head, Modeling and Monitoring Branch (written)
   Delaware River Basin Commission
   P.O. Box 7360
   West Trenton, NJ 08628-0360

7. Jeffery A. Myers, Director (written)
   New York State Department of Environmental Conservation
   Division of Water
   Bureau of Water Assessment and Management, 4th Floor
   625 Broadway, Albany, New York 12233-3502

A summary of comments to the proposal, and the Department's responses to those comments follow. The number(s) in brackets at the end of each comment corresponds to the commenter(s) listed above.

Comment 1: The commenter questioned how implementation will be accomplished, will it require an additional document a commitment or some other mechanism. The commenter also asked what the time frame would be for implementation, how effectiveness will be determined and on what time basis. (5)

Response 1: Some of the implementation measures, such as WLAs for point sources other than stormwater and the requirement to adopt low phosphorus fertilizer ordinances, will be effected through regulatory permit modifications following adoption of the TMDL. Other implementation measures will be effected through nonregulatory means through the watershed management process, including through wastewater management plans, and by working through the Department of Agriculture and the NRCS to target available funding and technical assistance to implement agricultural BMPs in accordance with conservation or resource management plans. More specific workplans identifying the

where/when/how of BMP implementation will be developed through priority stream segment plans and/or watershed restoration and protection plans developed using 319(h) grant funds and other available resources.

Comment 2: The commenter suggested that a historical flow duration curve for each creek be provided to properly evaluate the degree to which limited grab samples represent the curve. Flow rate when grab samples were taken should be marked. Grab sample data should cover full range of historical flow regimes to validate the use of this approach. (6)

Response 2: Limited data for these monitoring sites prevents the use of flow duration analyses. The method used for these TMDLs was designed to be applied with limited flow data. The loadings are associated with the flows at these sites at the time of sampling, no additional flows are required. Appendix D presents the stream flow and concentration data for the TMDLs.

Comment 3: The commenter suggested that on page 29 the percentage of the observed data that exceed the target loading curve for both streams is small: 9.8% for all sampling stations on Wickecheoke Creek and 10.9% for all sampling stations on Lockatong Creek. The commenter asked what level of exceedance is considered acceptable. (6)

Response 3: The Department's Methods Document sets forth that a 10% or greater exceedance rate will be assessed as an impairment, if there is a minimum of 8 data points within a spatial extent. Each spatial extent is considered a separate impairment and the data for each spatial extent is analyzed as such. Therefore, it is not appropriate to average the data for a stream when determining impairment status, if there are multiple spatial extents. The following separate spatial extents were assessed in this TMDL report: The Lockatong Creek at Rosemont-Raven Rock Road Bridge site has 12 percent of the data exceeding the SWQS. Lockatong Creek near Raven Rock has 12.5 percent of the data exceeding the SWQS. Wickecheoke Creek near Sergentsville and at Stockton have 12.5 and 10.5 percent of the data exceeding the SWQS, respectively.

Comment 4: The commenter suggested that on page 34 the slope of the exceedance curve is critical to the determination of the percent reduction needed to achieve the target loading curve. Therefore, this curve should not be based upon few data points and should not be influenced by extreme values. (6)

Response 4: Overall percent reduction is based on the target loading slope and the upper 95% confidence limit of the exceedance regression slope. Statistical uncertainty is represented by the range of the confidence interval, which is controlled by the number of samples and linearity of the data points. Outliers are removed prior to using the FIRE method, using the 99 percent confidence interval of the data.

Comment 5: The commenter suggested that on page 34, even though it is claimed that the FIRE method does not include the concept of a single target flow, the TMDL is eventually based upon a single flow condition as described in comments #10 and #11. The design flow for each Creek should be identified and provided. (6)

Response 5: The technical approach is designed to achieve a percent reduction of a pollutant over the range of flows measured during sampling, thus eliminating bias from a single, centralized (mean or median) target point. Load reductions are based on conservative estimates of land use loadings for the entire watershed. These loads can be reduced with site-specific BMPs which have expected load-reduction efficiencies over a range of flows.

Comment 6: The commenter suggested that on page 35 the basis for the margin of safety determination is flawed since the 95% confidence interval about the exceedance line occurs at the mean value for the flows corresponding to the exceedances. The 95% confidence interval will change over the range of X values (flow values) by the difference between the mean flow value and any flow value such that the confidence intervals at the extremes of the exceedance curve will be larger than that at the mean. (6)

Response 6: The confidence interval of the regression slope is used in the technical assessment, not the confidence interval of predicted loadings for selected flows. The upper and lower confidence limits of the regression slope are linear.

Comment 7: The commenter suggested that on page 42 in the approach to deriving the required percent reduction, the exceedance curve should be statistically compared to the target loading curve to ensure that the observed exceedances are statistically different from the target loadings. This can be accomplished by statistically comparing the slopes of the two curves using the standard error of the slope for the exceedance curve (the standard error for the target loading curve cannot be used since it has no variance). This analysis indicates that the exceedance curve for the Lockatong Creek is not statistically different than the target loading curve if the highest exceedance value is excluded. This indicates that this point is driving the exceedance curve. More data is needed to confirm the slope of the exceedance curve. (6)

Response 7: The Surface Water Quality Standard for total phosphorus in a stream is 0.1 mg/l. Additional data may show a somewhat different association between the exceedance loads and flow. However, the nearly perfect linearity of the exceedance loads with the range of flow suggests that additional data would present a very similar relationship. Delaying the TMDL to collect and analyze additional data may only delay water quality improvement.

Comment 8: The commenter stated that on page 42 and again on 44 the statement "Overall Percent TP Loading Reduction, including MOS" should read "Overall Percent TP Loading Reduction, *excluding* MOS". (6)

Response 8: The commenter is correct that the heading is mislabeled. The heading has been corrected to read "Percent TP Loading Reduction."

Comment 9: The commenter noted that on page 49, Table 26 shows the Loading Capacity (LC) for the Lockatong Creek as 1114 kg/yr of TP and suggests that dividing this loading with surface water quality standards (SWQS) of 0.10mg/L yields a flow rate of about 12.5 cfs. Thus, the TMDL is valid when the flow is higher than 12.5cfs with that loading. Since criteria have to be met at the MA7CD10 flow for this stream, is this the flow value corresponding to the design flow for this stream? (6)

Response 9: The LC represents an average annual target load that is used to determine loading reductions to apply to land use sources. The existing loads from land uses were calculated based on unit areal loads, which apply on an annual average basis. These reductions would be implemented with various BMPs to attain the SWQS. Since BMPs reduce the nonpoint source loadings, the actual in-stream concentration and flow will reflect the implementation measures. Therefore, a fixed target flow (such as an annual average) would not be appropriate for determining attainment or exceedances of the standard. Load reductions are applied across the range of measured flows.

Comment 10: The commenter suggested that on page 43 a similar analysis for the Wickecheoke Creek indicates that the exceedance curve is statistically different than the target loading curve. We agree that the highest exceedance appears to be an outlier, however the specified reduction will still not bring the exceedance observed on 7/22/03 below the target loading line. This suggests that more data is needed to confirm the slope of the exceedance curve. (6)

Response 10: Based on the statistical confidence for the technical approach, the loading reduction will achieve the SWQS. Implementation measures are required to assure the SWQS is attained. If follow up monitoring indicates the impairment continues to exist, then a revised reduction target and implementation plan will be developed.

Comment 11: The commenter noted that on page 50, from Table 27 the Loading Capacity (LC) for the Wickecheoke Creek is 3409 kg/yr of TP. Dividing this loading with surface water quality standards (SWQS) of 0.10 mg/L yields a flow rate of about 38.2cfs. Thus, TMDL is valid when the flow is higher than 38.2cfs. Since criteria have to be met at the MA&CD10 flow for this stream, is this the flow value corresponding to this design flow for this stream? (6)

Response 11: As previously addressed in Response 9, the LC represents an average annual target load that is used to determine loading reductions to apply to land use sources. The existing loads from land uses were calculated based on unit areal loads, which apply on an annual average basis. These reductions would be implemented with various BMPs to attain the SWQS. Since BMPs reduce the nonpoint source loadings, the actual in-stream concentration and flow will reflect the implementation measures. Therefore, a fixed target flow (such as an annual average) would not be appropriate for determining attainment or exceedances of the standard. Load reductions are applied across the range of measured flows.

Comment 12: The commenter suggested that the total phosphorus results that exceed the SWQS of 0.1 mg/L by a value, which when rounded to the tenths decimal place would equal 0.1 mg/L, not be counted as exceedances. The commenter cited the NJDEP Discharge Monitoring Report (DMR) Instruction Manual (Revised December 1993) rules regarding significant figures as the basis for this suggestion. The commenter requested that the Department revise its SWQS to 0.10 mg/L if it intended to assess data to the hundredths place when determining compliance with the SWQS. (3)

Response 12:
The Department's policy with regard to assessing waterbodies relative to attainment of the SWQS is to evaluate the data as it is recorded. Data that is recorded to two decimal places is valid to that degree of significance. The SWQS do not include rules for rounding; thus, if a value exceeds 0.1 mg/l, it is in exceedance of the criterion. The Department agrees that the SWQS for phosphorus bear revisiting and welcomes input in this regard. The commenter is invited to provide any additional views on what the phosphorus standards should be to protect water quality and designated uses in New Jersey. It should be noted that the Manual referenced does not suggest that effluent limits be restricted to the same number of significant figures as the SWQS and, in fact, permits are written (including that for Legends discussed in this TMDL report) with effluent limits for phosphorus to three decimal points and reporting will be required, in accordance with the cited manual, to be to that degree of significance, even though the SWQS are expressed with one decimal place.

Comment 13: The commenter wanted to know how the estimated annual phosphorus loading from the Delaware Township MUA facility of 44.96 kg TP/yr, 1.3% of the loading capacity, was calculated. Commenter noted that this relative contribution would appear to have a minimal effect. Since the facility has a very modest user base, it is essential that any change in effluent limits be based on regulatory requirements and sound science. (4)

Response 13: The DTMUA facility wasteload allocation (44.96 kg/year) was calculated assuming the full design flow of 0.065 MGD and the assigned phosphorus limit of 0.5 mg/L. The Department assigned a reduction from the existing limit of 1.0 mg/L to 0.5 mg/L TP, based on the overall reduction required for nonpoint phosphorus sources. However, this reduction of the effluent concentration will actually allow an increase in load at the full permitted capacity. The phosphorus loadings for the entire watershed were calculated on the annual basis and include a full range of flows. Therefore, the permit revision needed to be consistent with the WLA must require a phased reduction in phosphorus concentration in order to remain within the assigned load at full permitted capacity. The TMDL report has been revised to make this clear.

Comment 14: The commenter asked how the proposed limit of 0.5 mg/L TP, if adopted, will affect the Delaware Township MUA permit. (4)

Response 14: Upon adoption, the WLAs in the TMDLs will be incorporated into the NJPDES permit as a water quality based effluent limit, as described in the response above and in revisions to the TMDL report.

Comment 15: The commenter questioned if the set of 16 total phosphorus results at the Wickecheoke Creek near Sergeantsville station (01461282), of which two are exceeding SWQS, are sufficient to be statistically significant. (4)

Response 15: In accordance with the Department's Methods Document (http://www.state.nj.us/dep/wmm/sgwqt/wat/integratedlist/04%20Methods%20Doc.pdf), the Department considers a waterbody to be impaired for a parameter if 10% or more of samples taken exceed SWQS for the parameter and there is a minimum of 8 samples within the spatial extent. The Wickecheoke Creek near Sergeantsville station (01461282) was found to be impaired for phosphorus because 2 of 16 phosphorus results exceeded SWQS (12.5%). This fact allowed the Department to include the stream segment associated with this station in the calculated TMDL. However, the TMDL calculations for this segment were based on a data set from the Wickecheoke Creek at Stockton station (DRBCNJ0012/01461300), which is located downstream from the Wickecheoke at Sergeantsville station, and has a larger data set.

Comment 16: The commenter requested an explanation as to the basis for selecting a 50% reduction to be applied to the Delaware Township MUA STP. On page 44 the TMDL report shows that to achieve SWQS within the Wickecheoke Creek at Stockton impaired segment the required reduction in phosphorus was calculated as 37.6%, why is more expected of the STP? Commenter noted that the pre-hearing presentation indicated a reduction of 52% is required and requested an explanation of the apparent discrepancy and the significance of the adjustable load reduction requirement of 56%. (4)

Response 16: The calculations presented in the TMDL report lead the reader through the steps that result in the final reductions required in order to comply with SWQS. The 37.6% reduction referred to is the overall reduction required of the phosphorus loadings from all sources in the entire watershed. Because of the assumptions made and uncertainty of the methodology, it is required by EPA to set aside a portion of the total loading as a margin of safety (MOS). In addition, because loads from some land uses, specifically forest, water and wetlands, cannot be reduced, the overall reduction must be obtained by further reducing the loads from land uses (urban and agricultural) that can be reduced. After considering these factors, the reduction required from adjustable sources is 56%. The 50% reduction assigned to the DTMUA treatment facility is in line with the reduction required of nonpoint sources. This reduction is in terms of the effluent concentration at full capacity and the WLA actually allows an increase in load from the DTMUA treatment plant.

Comment 17:
The commenters suggest that there is an inconsistency in the numbering of the TMDL document in the New Jersey Register and the proposed TMDL amendment document. (1, 2)

Response 17:
The Department acknowledges that there is a difference in the numerical sequence of the New Jersey Register and the proposed TMDL amendment document. The phosphorus impaired stream segments were placed in a different order and in the future the numerical sequence will remain the same. However, this numbering is for reference only and is not intended for ranking.

Comment 18:
The commenters suggest that for readability and understanding, that Table 3, Table 4 and Table 5 show a summation of acres and percentages by land use / land cover. (1, 2)

Response 18: The Department has amended tables 3, 4 and 5 as recommended.

Comment 19: The commenters question why three significant figures are used in noting the proposed phosphorus limit of 0.211 mg/l for the Legend Resort and Country Club, NJ0023949. It is suggested that 0.22 be used in the permit. In addition, the commenters would like clarification on whether the 0.211 mg/l is a proposed permit limit or a not to exceed monthly limit. (1, 2)

Response 19: The TP effluent limit for Legends Resort and County Club, NJPDES permit number NJ0023949, was obtained directly from the NJPDES permit, and was not a calculation which was done as part of this TMDL. The existing permit states that the effluent limit for phosphorus will be lowered to 0.211 mg/l as of March 1, 2008. This limit represents the Water Quality Based Effluent Limit (WQBEL) as calculated bythe Department for the NJPDES permit. Therefore, the TMDL document included the permit limit in its entirely (3 significant figures) as it appeared in the permit. The permit states that 0.211 mg/ l of phosphorus is the monthly average, with 0.316 mg/l of phosphorus as the weekly average.

Comment 20: The commenters suggest that there may be a typing or calculation error in the average total phosphorus value of .933 mg/l noted for the Black Creek at Route 94 and Route 517 in Vernon (Wallkill Site “F”) in Table 10. The commenters believe the correct value may be closer to 0.10 to 0.11 with the inclusion of one or two possible data outliers in the estimation of the average value. (1, 2)

Response 20: The Department acknowledges this typing error and has made the necessary change from .933 to 0.0933.

Comment 21: The commenters question if during the application of the Flow-Integrated Reduction of Exceedances (FIRE) methodology, any consideration was given to the possible outliers in each data set or if all the sample values were used. The commenters believe that sample values corresponding to a flow rate below the 7Q10 stream value in a severe drought condition or one that is influenced by illegal sediment deposit activity at the sampling site location should be considered outliers that are not deemed appropriate for inclusion in the FIRE calculation. (1, 2)

Response 21: In almost every instance of the application of the Flow-Integrated Reduction of Exceedances methodology all data set sample values were included. However, in some extreme instances certain values could not be utilized because they inaccurately expressed and skewed final results, as determined by a statistical analysis. For instance, an outlier was removed from the Black Creek near Vernon (01368950) data set, due to a statistical analysis of a 99% confidence interval of the data set. However, low flow conditions are not considered to be a reason for removal of data points. Likewise, the knowledge of the reason for a particular exceedance, such as is noted in the comment, is useful in source identification, but does not provide reason for removal of that data point from the data set.

Comment 22: The commenters suggest the use of two distinctive and contrasting colors for the Exceedance Regression line and the Upper 95% Confidence line in graphing the results from the FIRE technique. The Upper 95% Confidence line is shown dashed in the Chart, but as a straight line in the Legend block (this may be due to a limitation in the plotting software). With some printers, both lines appear to have the same color in the Chart. This comment pertains to all FIRE Charts. (1, 2)

Response 22: The Department has expressed the Exceedance Regression line and the Upper 95% Confidence line through the use of two distinctive and contrasting colors. The Department has also modified the FIRE charts, so that a dashed line appears in both, the chart and the Legend blocks.

Comment 23: The commenters suggest that a footnote be used stating the load noted for the Legends and Country Club is based on the 2008 phosphorus discharge limit of 0.211 mg/l. The commenters inquired about the assumption made regarding the TP discharge limit for the Lounsberry Hollow Middle School. (1, 2)

Response 23: The Department has included notes stating that the Legends Resort and Country Club has a current phosphorus effluent limit of 1.0 mg/l and as of 4/1/08 the monthly average will be 0.211 mg/l. The NJPDES permit for Lounsberry Hollow Middle School identifies the phosphorus limit to be 0.5 mg/l. The future allocation assigned to Lounsberry Hollow Middle School was calculated assuming the maximum permitted flow of 0.032 MGD and the maximum permitted TP concentration of 0.5 mg/l, which resulted in an annual load of 22.1 kg/yr of phosphorus. A statement explaining this has been included in the text.

Comment 24: The commenters recommend that the implementation / adoption of a low phosphorus fertilizer ordinance within six months of the TMDLs adoption by NJDEP be extended to a minimum of 12 – 18 months due to the comprehensive effort required to obtain an ordinance. In order to adopt a low phosphate fertilizer, the municipalities of Vernon Township, Hardyston Township, and West Milford Township are required to 1.) draft the ordinance, 2.) gather local business support to supply

the products, 3.) communicate / guide lawn maintenance firms to use only low phosphate fertilizers including provisions for periodic field application monitoring, 4.) hold a public comment period, 5.) address enforcement of the ordinance, and 6.) defend the ordinance in the threat of a challenge. (1, 2)

Response 24: The Department recognizes the time and effort needed to draft and adopt a meaningful ordinance. Upon EPA approval of this TMDL document, the Department will begin the TMDL adoption process. During this time, the Division of Watershed Management will work with the affected municipalities to facilitate the process as much as possible. The municipalities will have six months from date of the actual adoption of the TMDL to enact the required ordinance, so it is suggested that the process of review and comment within the municipal government be started in advance of the adoption so as to make use of the time delay between EPA approval and the subsequent adoption of the TMDL as an amendment to the WQMP.

Comment 25: The commenters recommend that the spelling of the word "Category" be corrected in Figure 20. The commenters also suggest that the font size of the legend block in Figure 20 be increased to improve legibility, i.e., Figure 21. (1, 2)

Response 25: The Department acknowledges the misspelling of the word "Category" in Figure 20 and will make this correction. The Department will also increase the font size of the legend block to improve legibility.

Comment 26: The commenters feel that further guidance from NJDEP is warranted regarding a protocol for conducting septic surveys. The commenters feel that this protocol should include 1.) survey methodology, 2.) assessment approaches, 3.) funding sources, 4.) availability of field personnel, and 5.) legal implications. (1, 2)

Response 26: The Department recognizes the need for such guidance, and for assistance in performing surveys and implementing septic management programs. The Department intends to develop said guidance and to identify assistance that may be available in this regard.

Comment 27: The commenters believe that the noted completion date of September 2005 for the Highlands Lakes Regional Nonpoint Source Pollution Control Project may be optimistic. (1, 2)

Response 27: The Department has no reason to believe that the scheduled completion date of September 2005 for the Highlands Lakes Regional Nonpoint Source Pollution Control Project will not be met.

Comment 28: The commenters suggest the spelling of the word "donation" be corrected in WMA 11 – 6th line. (1, 2)

Response 28: The Department acknowledges the misspelling of the word "donation" and will make this correction.

Comment 29: The commenters expressed their appreciation for the amount of detail that was provided in the Appendices of pages 63 – 75. (1, 2)

Response 29: The Department aims to provide the public with as much detail as possible to aid in the understanding of the TMDL document. The Department would like to thank the commenters for their

support and constructive thoughts and suggestions over the years, all of which have helped the Department improve the quality of TMDLs.

Comment 30: The commenter concurs that in accordance with the NJDEP Surface Water Quality Standards, TP TMDLs for the two specified segments, Wallkill F and Wallkill H of the Black Creek, are warranted. (1, 2)

Response 30: The Department appreciates the support.

Comment 31: The commenter suggests the proposed TMDL represents a perfect example of how stakeholder-driven watershed projects can play a role in the development of TMDLs. For instance, the Wallkill River Management project, under the guidance of the DEP and being facilitated by the SCMUA, was responsible for contributing to the collection of a large portion of the data used in the development of this TMDL. These watershed projects have proven to serve as important functions in the state of New Jersey. The commenter requests that the Department of Environmental Protection continue to assist these watershed groups so that such work can continue and so that valuable data and information from people living within the watershed areas can be provided. (2)

Response 31: The Department concurs that watershed projects undertaken by stakeholders are important to development and implementation of plans, including TMDLs, to improve water quality. The Department acknowledges the efforts of the Wallkill River Watershed Management group and will continue to provide support to the extent resources allow.

Comment 32: The commenters declare their initial review of the four TMDLs affecting New York, which are nested within the multiple segments and watersheds addressed in the Departments Water Quality Management plans, has raised questions about the technical basis of the TMDLs. The commenters suggest there is an inadequacy of information presented on the New York sources of the phosphorus load, which prevent the accepting of the proposed allocations and required reductions in New York. The commenters request an extension of the comment period to complete the review of the TMDLs and supporting documents, and to gather necessary information on New York loads and ambient water quality tributary to these New Jersey waters. (7)

Response 32: The Department acknowledges that there are data gaps that bear further investigation as to the relative contribution of various sources of phosphorus within New York and that New York has ultimate responsibility and authority to determine how to address phosphorus loads originating in New York that are causing an exceedance of the SWQS at the New Jersey/New York border. The Department made certain assumptions that would allow calculation of a TMDL for the watershed, but intended to apply the WLAs and LAs only to the New Jersey portion of the watershed. Rather than extend the comment period, the Department commits to dialogue with New York with regard to the needed source reduction in New York.

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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 judgement 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.

Export Coefficient Database Reference List

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Appendix B: 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 22: Example of site where 0.1 mg/l criterion is applicable and exceeded

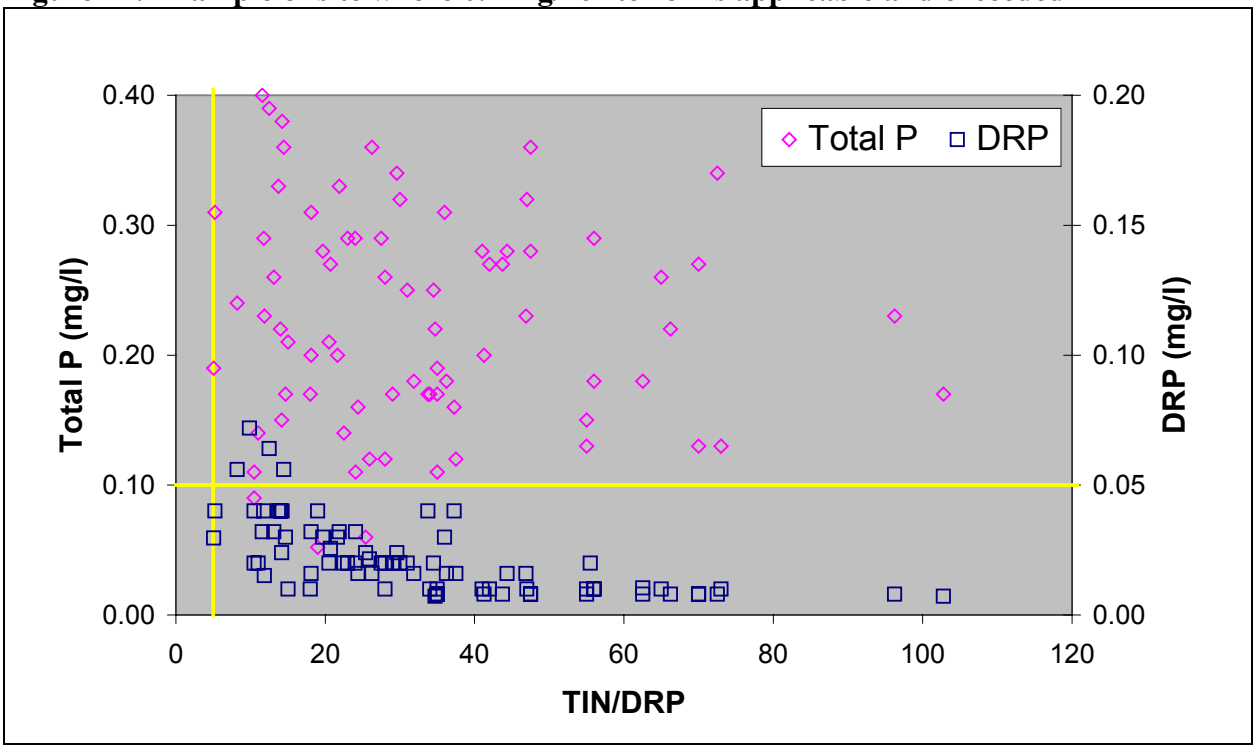
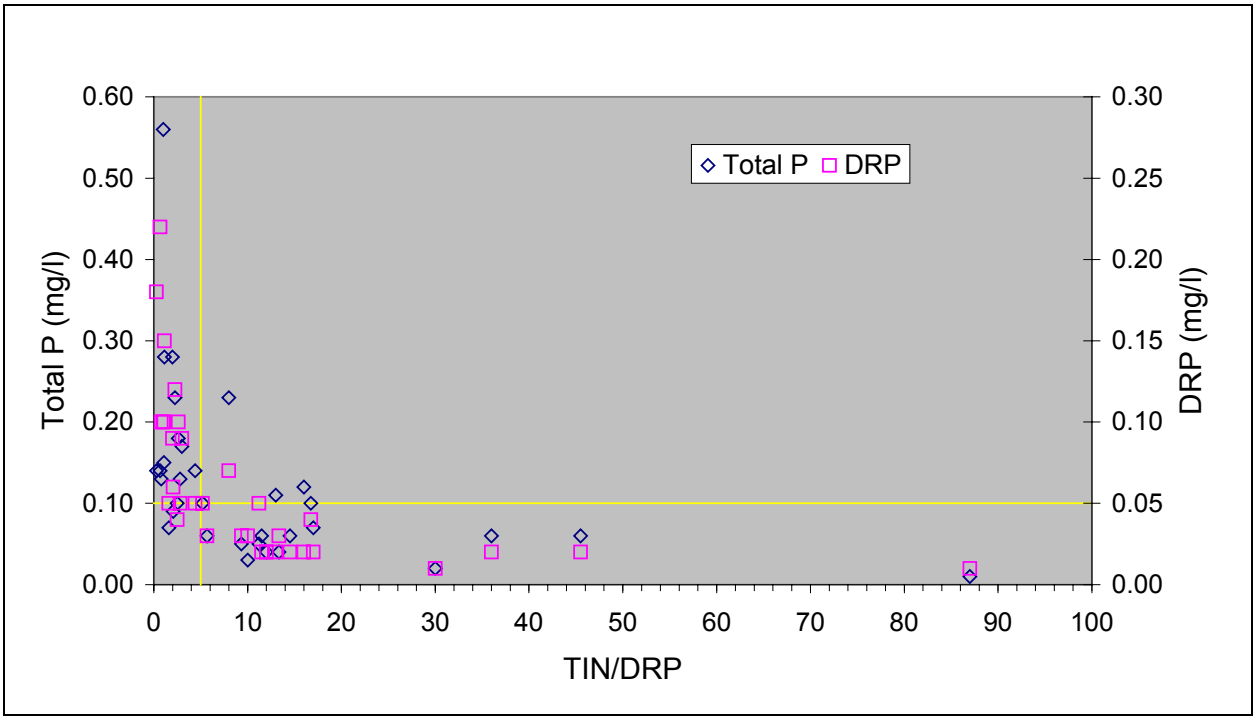


Figure 23: Example of site where phosphorus is not limiting algal growth when 0.1 mg/l threshold is exceeded



Appendix C: MS4 designations

Table 29: Municipal Stormwater Permits and Identification of Tier A or B Classification for the Black Creek and Wawayanda impaired streamsheds

NJPDES Permit Number	Municipality	Discharge Type	Additional Measures
NJG0149691	Vernon Twp	Tier B Municipal Stormwater General Permit	Low phosphorus ordinance
NJG0152269	Hardyston Twp	Tier B Municipal Stormwater General Permit	Low phosphorus ordinance
NJG0148806	West Milford Twp	Tier A Municipal Stormwater General Permit	Low phosphorus ordinance

Table 30: Municipal Stormwater Permits and Identification of Tier A or B Classification for the Lockatong and Wickecheoke impaired streamsheds

NJPDES Permit Number	Municipality	Discharge Type	Additional Measures
NJG0149241	Raritan Twp	Tier A Municipal Stormwater General Permit	none
NJG0152706	Kingwood Twp	Tier B Municipal Stormwater General Permit	none
NJG0149501	Franklin Twp	Tier B Municipal Stormwater General Permit	none
NJG0150673	Delaware Twp	Tier B Municipal Stormwater General Permit	none
	Stockton Borough		

Appendix D: Water Quality Data

Table 31: Water Quality Data for WMA 2

Black Creek near Vernon		
Sample Data	**Flow (cfs)**	**Conc (mg/l)**
1/18/1990	29	0.06
3/28/1990	33	0.04
5/16/1990	43	0.03
7/18/1990	16	0.06
8/8/1990	58	0.05
11/15/1990	66	0.03
1/28/1991	24	0.02
4/9/1991	20	0.02
6/11/1991	7.8	0.05
7/25/1991	3.9	0.07
10/10/1991	4.7	0.02
1/28/1992	36	0.02
4/2/1992	48	0.02
5/21/1992	25	0.03
7/16/1992	22	0.1
11/18/1992	22	0.03
2/1/1993	34	0.03
4/6/1993	70	0.02
5/19/1993	32	0.02
8/18/1993	12	0.05
10/27/1993	21	0.07
2/28/1994	40	0.03
4/13/1994	120	0.04
6/7/1994	23	0.08
8/17/1994	5.8	0.06
10/18/1994	10	0.07
1/17/1995	63	0.03
3/23/1995	39	0.03
5/23/1995	23	0.01
7/18/1995	19	0.16
10/17/1995	28	0.05
4/2/1996	80	0.03
6/4/1996	39	0.07
8/12/1996	11	0.02
10/21/1996	200	0.09
1/15/1997	28	0.01
4/16/1997	66	0.01
5/20/1997	30	0.03
7/23/1997	3.6	0.06
5/28/2002	18.4	0.08
6/25/2002	7.52	0.096
7/30/2002	1.63	0.12
8/27/2002	0.44	0.12
9/24/2002	0.5	0.25
10/29/2002	18.75	0.04
7/16/2003	12.67	0.07
5/24/2001	42.6	0.04

8/22/2001	2.79	0.13
11/8/2001	2.52	0.04
8/12/2002	0.5	0.145
10/21/1996	200	0.09
1/15/1997	28	0.01
4/16/1997	66	0.01
5/20/1997	30	0.03
7/23/1997	3.6	0.06
5/28/2002	18.4	0.08
6/25/2002	7.52	0.096
7/30/2002	1.63	0.12
8/27/2002	0.44	0.12
9/24/2002	0.5	0.25
10/29/2002	18.75	0.04
7/16/2003	12.67	0.07
5/24/2001	42.6	0.04
8/22/2001	2.79	0.13
11/8/2001	2.52	0.04
8/12/2002	0.5	0.145
8/12/2002	0.5	0.145

Black Creek at Rt. 94 and Rt. 517 in Vernon		
Sample Data	**Flow (cfs)**	**Conc (mg/l)**
4/30/2002	3.69	0.02
5/28/2002	2.53	0.12
6/25/2002	1.09	0.04
7/30/2002	0.4	0.07
8/27/2002	0.235	0.11
9/24/2002	0.062	0.46
10/29/2002	1.66	0.13
11/26/2002	3.48	0.03
12/17/2002	4.22	0.08
1/28/2003	2.6	0.1
2/25/2003	5.15	0.03
3/25/2003	10.42	0.04
7/16/2003	2.96	0.11
10/29/2003	1.91	0.02
9/29/2003	26.38	0.04

Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange		
Sample Data	**Flow (cfs)**	**Conc (mg/l)**
12/4/2000	39	0.19
3/14/2001	232	0.05
5/24/2001	65.5	0.07
8/22/2001	5.33	0.49
11/8/2001	20.2	0.16
2/6/2002	29.1	0.1
4/18/2002	85.3	0.08
8/12/2002	2.58	0.37

Black Creek at Sand Hill Road in Vernon		
Sample Data	**Flow (cfs)**	**Conc (mg/l)**
4/30/2002	16.49	0.02
5/28/2002	22.7	0.04
6/25/2002	3.08	0.04
7/30/2002	1.07	0.06
8/27/2002	0.124	0.1
9/24/2002	0.26	0.28
10/29/2002	5.67	0.07
11/26/2002	12.5	0.03
12/17/2002	18.32	0.02
1/28/2003	8.2	0.02
2/25/2003	18.02	0.03
3/25/2003	38.69	0.02
7/16/2003	6.32	0.03
10/29/2003	6.92	0.03

Table 32: Water Quality Monitoring Data for WMA 11 - Wickecheoke Creek at Stockton

Station	Date	Flow	TP
1461300	12/9/1976	12	0.04
1461300	4/18/1977	15	0.02
1461300	5/10/1977	20	0.02
1461300	6/8/1977	2.6	0.05
1461300	7/7/1977	1.3	0.08
1461300	8/18/1977	4.7	0.04
1461300	10/4/1977	61	0.11
1461300	11/2/1977	6.7	0.02
1461300	2/21/1978	12	0.04
1461300	4/12/1978	25	0.01
1461300	5/2/1978	9.2	0.02
1461300	6/21/1978	7	0.06
1461300	7/28/1983	0.84	0.06
1461300	8/24/1983	0.46	0.03
1461300	10/13/1983	5.1	0.15
1461300	1/18/1984	14	0.05
1461300	4/9/1984	60	0.04
1461300	5/21/1984	77	0.08
1461300	7/19/1984	38	0.08
1461300	8/8/1984	14	0.06
1461300	9/24/1984	1.9	0.05
1461300	2/7/1985	6.7	0.03
1461300	4/17/1985	5.2	0.05
1461300	6/13/1985	7.3	0.09
1461300	7/24/1985	1.6	0.08
1461300	8/15/1985	1.3	0.06
1461300	10/24/1985	4.3	0.05
1461300	2/4/1986	34	0.04
1461300	3/20/1986	45	0.04
1461300	5/20/1986	4.9	0.06
1461300	7/24/1986	0.85	0.06
1461300	8/7/1986	2.3	0.05
1461300	10/8/1986	0.87	0.28

1461300	1/29/1987	15	0.02
1461300	3/18/1987	14	0.02
1461300	5/21/1987	9.2	0.063
1461300	7/28/1987	9.9	0.083
1461300	8/17/1987	3.9	0.09
1461300	10/8/1987	5.7	0.068
1461300	2/18/1988	77	0.059
1461300	3/30/1988	18	0.052
1461300	5/18/1988	23	0.11
1461300	7/11/1988	1.2	0.108
1461300	8/22/1988	1.9	0.061
1461300	10/11/1988	1.2	0.02
1461300	2/8/1989	13	0.05
1461300	4/4/1989	46	0.05
1461300	5/22/1989	26	0.06
1461300	7/10/1989	14	0.08
1461300	8/2/1989	5.6	0.07
1461300	11/15/1989	24	0.08
1461300	3/1/1990	20	0.06
1461300	4/5/1990	51	0.03
1461300	6/26/1990	14	0.06
1461300	7/31/1990	2.3	0.03
1461300	8/16/1990	19	0.04
1461300	11/14/1990	20	0.03
1461300	2/4/1991	21	0.02
1461300	4/8/1991	17	0.09
1461300	5/20/1991	8.8	0.07
DRBC0012	06/05/00	2.29	0.02
DRBC0012	06/19/00	2.13	0.02
DRBC0012	07/10/00	0.18	0.19
DRBC0012	08/07/00	0.18	0.02
DRBC0012	08/21/00	2.04	0.13
DRBC0012	05/08/01	3.47	0.04
DRBC0012	05/22/01	33.75	0.15
DRBC0012	06/05/01	20.34	0.07
DRBC0012	06/19/01	20.72	0.09
DRBC0012	07/10/01	8.07	0.08
DRBC0012	07/10/01	8.07	0.08
DRBC0012	08/07/01	1.95	0.05
DRBC0012	08/21/01	2.03	0.06
DRBC0012	09/17/01	1.02	0.05
DRBC0012	09/25/01	6.92	0.08
DRBC0012	05/07/02	18.42	0.04
DRBC0012	05/21/02	1.18	0.05
DRBC0012	06/05/02	3.47	0.02
DRBC0012	06/18/02	9.22	0.05
DRBC0012	07/09/02	1.49	0.04
DRBC0012	07/23/02	1.41	0.05
DRBC0012	08/06/02	1.41	0.07
DRBC0012	08/20/02	0.63	0.07
DRBC0012	09/10/02	1.25	0.07
DRBC0012	09/24/02	0.86	0.06
DRBC0012	5/6/2003	9.99	0.02
DRBC0012	5/20/2003	7.31	0.03

DRBC0012	6/3/2003	36.82	0.06
DRBC0012	6/17/2003	32.22	0.05
DRBC0012	7/8/2003	14.97	0.04
DRBC0012	7/22/2003	53.30	0.24
DRBC0012	8/5/2003	37.20	0.05
DRBC0012	8/18/2003	19.19	0.04
DRBC0012	9/9/2003	10.37	0.06
DRBC0012	9/23/2003	144.15	0.55

Table 33: Water Quality Monitoring data for Lockatong Creek at Rosemont-Raven Rock Rd Bridge

Station DRBCNJ0013		
Date	**Flow**	**TP**
06/19/00	6.18	0.02
07/10/00	0.99	0.02
07/24/00	1.24	0.02
08/21/00	6.66	0.02
09/11/00	1.92	0.06
05/08/01	3.80	0.04
05/22/01	18.75	0.17
06/05/01	16.34	0.09
06/19/01	14.41	0.11
07/10/01	8.63	0.09
08/07/01	1.44	0.06
08/21/01	1.71	0.05
09/17/01	1.33	0.04
09/25/01	4.77	0.05
05/07/02	13.45	0.04
05/21/02	19.72	0.06
06/05/02	1.71	0.03
06/18/02	7.66	0.05
07/09/02	1.33	0.06
07/23/02	0.74	0.05
08/06/02	1.22	0.06
08/20/02	0.01	0.07
09/10/02	0.41	0.07
09/24/02	0.44	0.05
5/6/2003	7.66	0.02
5/20/2003	5.25	0.03
6/3/2003	23.58	0.06
6/17/2003	16.82	0.04
7/8/2003	3.32	0.04
7/22/2003	49.13	0.38
8/5/2003	26.47	0.08
8/18/2003	14.41	0.05
9/9/2003	7.66	0.05
9/23/2003	180.30	0.49

Appendix E: 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 %