Table C8.6 below presents TMDL results for the West Branch Sub-basin #4..

Table C8.6. Summary of TMDL for West Branch Sub-basin #4 (lbs/yr)

Pollutant	TMDL	MOS	WLA	LA	LNR	ALA
Sediment	5,998,845	599,885	-	5,398,990	570,350	4,828,640

The ALA computed above is the portion of the load that is available to allocate among contributing sources (Hay/Pasture, Cropland, and streambank erosion) as described in the next step. Not all land use/source categories were included in the allocation because they are difficult to control, or provide an insignificant portion of the total load (e.g., forested areas). The following section shows the allocation process in detail for the entire watershed.

C8.2.5 Load Reduction Procedures

Sediment loads obtained in the previous step were allocated among the remaining land use/sources of the impaired watershed according to the Equal Marginal Percent Reduction (EMPR) method. EMPR is carried out using an Excel Worksheet in the following manner:

1) Each land use/source load is compared with the total allocable load to determine if any contributor would exceed the allocable load by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load to the receiving waterbody. If the contributor exceeds the allocable load, that contributor would be reduced to the allocable load. This is the baseline portion of EMPR.

2) After any necessary reductions have been made in the baseline the multiple analysis is run. The multiple analysis will sum all of the baseline loads and compare them to the total allocable load. If the allocable load is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analysis, the final reduction percentage for each contributor can be computed.

The load allocation and EMPR procedures were performed using an Excel Worksheet, and results are presented in Appendix G. Table C8.7 provides load allocation by considering all land uses in the watershed. In this case, land uses/sources that were not part of the allocation are carried through at their existing loading values.

The total allowable sediment load in West Branch Sub-basin #4 and its tributaries when all sources are considered (and including the 10% MOS) is 5,398,990 pounds per year. In order for all stream segments to attain their specific uses, the total sediment load should be reduced from 9,859,400 pounds per year by a factor of 45%.

Table C8.7 Load Allocation by Each Land Use/Source					
		Sediment			
Source	*Area (acres)*	*Unit Area Loading Rate (lbs/ac/yr)*	*Annual average load (lbs/yr)*	*ALA (lbs/yr)*	*Reduction (%)*
Hay/Pasture	840	54.7	45,980	23,913	48
Cropland	2,938	1320.2	3,938,020	2,047,498	48
Coniferous For	489	5.5	2,700	2,700	0
Mixed Forest	408	5.2	2,120	2,120	0
Deciduous For	912	7.2	6,540	6,540	0
Unpaved Roads	3	353.3	1,060	1,060	0
Transitional	457	1032.1	471,680	471,680	0
Lo Intensity Dev	2,474	27.3	67,560	67,560	0
Hi Intensity Dev	882	18.6	16,460	16,460	0
Stream Bank			5,307,280	2,759,459	48
Groundwater					
Point Source					
Septic Systems					
Total	9,447	1043.7	9,859,400	5,398,990	**45**

C8.3 CONSIDERATION OF CRITICAL CONDITIONS

The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment and nutrients to a waterbody and the resulting impact on beneficial uses, establishing these TMDLs using average annual conditions is protective of the waterbody.

C8.4 CONSIDERATION OF SEASONAL VARIATIONS

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season, and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

C8.5 REASONABLE ASSURANCE OF IMPLEMENTATION

Sediment reductions in the TMDL are allocated to agricultural areas and sources of stream bank erosion in the watershed. Implementation of agricultural best management practices (BMPs) in the affected areas to increase infiltration and sediment control measures should achieve the loading reduction goals established in the TMDL. Substantial reductions in the amount of sediment reaching the streams can be made through the planting of riparian buffer zones, contour strips, and cover crops, and conservation tillage. These BMPs range in efficiency from 20% to 70% for sediment reduction. Implementation of BMPs aimed at sediment reduction will also assist in the reduction of phosphorus, which is contributing to algal growth in the streams. Other possibilities for attaining the desired reductions in sediment include streambank stabilization and fencing. Further field verification will be performed in order to assess both the extent of existing BMPs, and to determine the most cost-effective and environmentally protective combination of BMPs required to meet the sediment reductions outlined in this section.

C8.6 PUBLIC PARTICIPATION

Notice of the draft TMDLs will be published in the *PA Bulletin* and local newspapers with a 30-day comment period provided. A public meeting with watershed residents will be held to discuss the TMDLs. Notice of final TMDL approval will be posted on the Department website.

C9.0. Total Maximum Daily Load (TMDL) Development Plan for Neshaminy Creek Tributary #1 Watershed

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EXECUTIVE SUMMARY

The Neshaminy Creek Tributary #1 watershed in Bucks County is about 2.1 square miles in size. This watershed contains a stream segment that is a tributary of Neshaminy Creek. The protected uses of the watershed are water supply, recreation, and aquatic life. Its aquatic use is warm water fishes and migratory fishes.

The Total Maximum Daily Load (TMDL) applies to about 4.6 miles of stream (Stream Segment Id # 980427-0945-GLW). It was developed to address the impairments noted on Pennsylvania's 2002 Clean Water Act Section 303(d) List. The impairments are primarily caused by sediment loads from land development in the watershed. The TMDL focuses on control of sediments. Pennsylvania does not currently have water quality criteria for sediment. For this reason, a modeling approach was developed to identify the TMDL endpoints or water quality objectives for sediments in the impaired segments of this watershed. The approach is based on the comparison of simulated sediment loads at two time periods: Year 1992 when the stream was still attaining and Year 2000 when it was found to be impaired. Siltation, the cause of impairment in Neshaminy Creek Tributary #1, resulted from the accumulation of sediments originating from construction and newly developed land over several years. It was estimated that the amounts of sediment loading that will meet the water quality objectives for this tributary were 232,830 pounds per year. It is assumed that this tributary will support its aquatic life uses when this value is met. The sediment TMDL for Neshaminy Creek Tributary #1 is allocated as shown in the table below.

Summary of TMDLs for Neshaminy Creek Tributary #1 Watershed (lbs/yr)

Pollutant	Source	TMDL	MOS	WLA	LA	LNR	ALA
Sediment	Upland and stream bank erosion	232,830	23,283	209,543	-	-	-

The TMDL for sediments is allocated primarily to non-point source loads from transitional (i.e., "developing") land and stream bank erosion, with 10% of the TMDL total load reserved as a margin of safety (MOS). In this case, all sediment loads were assigned to the waste load allocation (WLA) category. The sediment TMDL covers a total of 4.6 miles, and establishes a reduction for total sediment loading of 71% from the current annual loading of 721,215 pounds. This reduction also accounts for the 10% MOS.

C9.0 INTRODUCTION

C9.0.1 Watershed Description

The following discussion provides information on the physical characteristics of Neshaminy Creek Tributary #1 and its watershed including location, land use distributions, and geology. This particular watershed is located in the Piedmont Physiographic Province, and is entirely situated in Bucks County. It covers an area of approximately 2.1 square miles. This tributary drains into the main stem of Neshaminy Creek from the west. The watershed is located south of the town of St Leonard and north of Holland. It can be reached via Pennsylvania Route 522 from the east. Figure C9.1 shows the watershed boundary, its location, and water quality status of stream segments as reported on the 2002 303(d) List. The designated uses of the watershed include water supply, recreation and aquatic life. As listed in the Title 25 PA Code Department of Environmental Protection Chapter 93, Section 93.o (Commonwealth of PA, 1999), the designated aquatic life use for Neshaminy Creek Tributary #1 is warm water fishes and migratory fishes.

The current land use distribution in the watershed was developed by updating the National Land Cover Data (NLCD) layer described by Vogelmann et al. (1998) using a recent 10-m colorized panchromatic SPOT (System Probatoire pour l'Observation de la Terre) satellite image. The NLCD layer was based primarily on 1992-vintage Landsat Thematic Mapper (TM) imagery. SPOT imagery was acquired in 2000 and is available for the entire Commonwealth of Pennsylvania at the Pennsylvania Spatial Data Access (PASDA) site (http://spot.pasda.psu.edu) at no charge. The primary land uses in the Neshaminy Creek Tributary #1 watershed are developed land (43%) followed by agriculture (36%). It is important to note that development in the watershed changed from 346 to 567 acres, or a 64% increase, from 1992 to 2000.

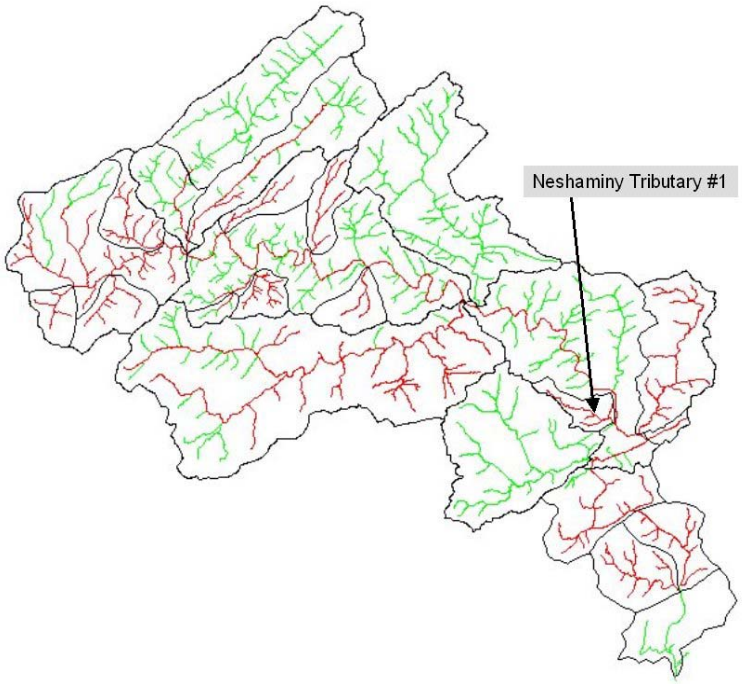

Figure C9.1. Neshaminy Creek Tributary #1 Watershed.

The surficial geology of the Neshaminy Tributary #1 watershed consists of sandstone. The bedrock geology affects primarily surface runoff and background nutrient loads through its influences on soils and landscape as well as fracture density and directional permeability. Soils are mostly sandy and very erodible, as indicated by a high average K factor (0.37). Watershed characteristics are summarized in Table C9.1.

C9.0.2 Surface Water Quality

The Total Maximum Daily Load or TMDL was developed for stream segments in this watershed to address the impairments noted on Pennsylvania's 2002 Clean Water Act Section 303(d) List (see Table A1 in section A1.0). It was first determined that Neshaminy Creek Tributary #1 was not meeting its designated water quality uses for protection of aquatic life in 2001 based on an aquatic biological survey. As a consequence, Pennsylvania listed this tributary on the 2002 Section 303(d) List of Impaired Waters.

Table C9.1. Physical Characteristics of Neshaminy Creek Tributary #1 Watershed

Physiographic Province	Piedmont
Area (square miles)	5.3
Predominant Land Use	- Developed land (43%) - Agriculture (36%)
Predominant Geology	Sandstone (100%)
Soils	
Dominant HSGs	C
Average K Factor	0.37
20-Year Average Rainfall (in)	41.5
20-Year Average Runoff (in)	4.6

The 2002 303 (d) List reported 4.6 miles of stream (Stream Segment Id# 980427-0945-GLW) to be impaired by siltation from land development. These stream segments are impacted by siltation as a result of "new land development" in the watershed. New land development is defined here as disturbed land at construction sites/new development. It appeared from our reconnaissance surveys and contacts in the watershed that siltation presently observed in this watershed is the result of years of build-up of sediments in the channel bottom that started in the early 1990's. These sediments originated from disturbed and unprotected soils at construction sites and increased channel bank erosion during periods of intense storm events. As indicated above, land development has increased by approximately 64% between 1992 and 2000.

Sediments, which are often the cause of stream impairment in urban and suburban areas, are primarily from two sources: disturbed land and unprotected soils at construction sites, and stream channel erosion. Transitional land uses, mainly new construction sites, are one of the main sources of sediments in streams draining newly developed areas. Sediment production and

sedimentation in streams are typically important during the construction phase because soils are disturbed and exposed to detachment by raindrops and transported during storm events. Construction also renders landscapes unstable and cause soil to move in "sheets" and localized landslides during storm events.

Channel erosion and scour that occur in waterways and receiving waters located in urban and suburban areas may also be an important source of sediments. Channel erosion is primarily the result of elevated storm water runoff during storm events caused by increased impervious surfaces from residential, commercial and industrial areas; construction sites; roads; highways; and bridges in the watershed (Horner, 1994). Basically, impervious areas and disturbed land restrict water infiltration thus converting more rainfall into runoff during storm events. The visible impact of elevated storm runoff includes fallen trees, eroded and exposed stream banks, siltation, floating litter and debris, and turbid conditions in streams. All these events were observed during a reconnaissance survey of the Neshaminy Creek Tributary #1 watershed. In conclusion, addressing storm water runoff and sediment production at new construction sites through the use of management practices will assure that aquatic life use is achieved and maintained in this watershed. Without effective storm water management practices and sediment traps, build-up of sediments will continue in the stream.

C9.1 APPROACH TO TMDL DEVELOPMENT

The present TMDL addresses impairment by sediment in Neshaminy Creek Tributary #1 stream segments as reported on the 2002 303(d) Lists. This TMDL was derived as follows:

C9.1.1 Siltation Caused by Land Development

The 2001 survey showed that sediment produced by newly developed land in the watershed was the cause of impairment of stream segments in this watershed. Sediments deposited in large quantities on the streambed were degrading the habitat of bottom-dwelling macroinvertebrates. The TMDL for the Neshaminy Creek Tributary #1 watershed addresses sediment from construction sites or "transitional" land uses, and from stream bank erosion. Because neither Pennsylvania nor EPA have water quality criteria for sediment, we had to develop a method to determine water quality objectives for this parameter that would result in the impaired stream segments attaining their designated uses. The approach consists of:

> Comparing simulated annual sediment loads for Year 1992 and Year 2000 land use conditions in the watershed. It appeared from several field visits in the watershed that most of the siltation and turbidity observed in the stream have accumulated during several years. This assumption is supported by the fact that siltation was not found as a cause of impairment during the 1994 survey and 1997 assessments. Year 1992 is considered here as the benchmark because (as indicated earlier) the analysis of classified satellite images showed that development in the watershed increased by about 64% between 1992 and 2000.

C9.1.2 Watershed Assessment and Modeling

The AVGWLF model was run for this watershed to establish sediment loadings under differing land use/cover conditions (see section B for model-specific details). First, the model was run using the 1992 land use distributions provided by the National Land Cover Data (NLCD) set. As indicated earlier, NLCD land uses were developed by the MRLC Consortium using primarily 1992-vintage Landsat TM imagery. Second, the model was performed for the Year 2000 land use conditions using an updated version of this earlier land use data set. SPOT imagery that was acquired in the summer of 2000 was used for the land use update. In this model, land in transition (transitional land use) was considered to be new development (built after 1992) or construction sites.

Prior to running the model for the two land use conditions as described, historical stream water quality data for the period 4/89 to 3/96 were first used to calibrate various key parameters within the GWLF model. Such data sets are typically not available in AVGWLF-based TMDL assessments done elsewhere in Pennsylvania. In this case, however, it was felt that model calibration would provide for better simulation of localized watershed processes and conditions. A description of the calibration procedure used can be found in Section B1.4 of this document.

Using the refined parameter estimates based on the calibration results, AVGWLF was re-run for the Neshaminy Creek Tributary #1 watershed. Based on the use of 20 years of historical weather data, the mean annual loads for sediment for the 1992 and 2000 land use/cover conditions are shown in Tables C9.2 and C9.3, respectively. The Unit Area Load for sediment was estimated by dividing the mean annual loading (lbs/yr) by the total area (acres) resulting in an approximate loading per unit area for the watershed. Table C9.4 presents an explanation of the header information contained in Tables C9.2 and C9.3. Modeling output for this watershed for 1992 and 2000 land use conditions are presented in Appendix F.

Table C9.2. Loading Values for Neshaminy Creek Tributary #1 Watershed, Year 1992 Land Use Conditions

Land Use Category	*Area (acres)*	*Sediment Load (lbs/year)*	*Unit Area Sediment Load (lbs/acre/yr)*
Hay/Pasture	318	19,028	59.84
Cropland	353	128,262	363.35
Coniferous Forest	5	0	0
Mixed Forest	94	221	2.35
Deciduous Forest	215	750	3.49
Transitional	0	0	0
Low Intensity Developed	304	17,571	57.80
High Intensity Developed	42	1,214	28.90
Stream Bank		65,784	
Groundwater			
Point Source			
Septic Systems			
Total	1,331	232,830	174.93

Table C9.3. Loading Values for Neshaminy Creek Tributary #1 Watershed, Year 2000 Land Use Conditions

Land Use Category	*Area (acres)*	*Sediment Load (lbs/year)*	*Unit Area Sediment Load (lbs/acre/yr)*
Hay/Pasture	199	10,331	51.91
Cropland	286	96,424	337.15
Coniferous Forest	5	0	0
Mixed Forest	86	199	2.31
Deciduous Forest	188	662	3.52
Transition	261	524,901	2011.11
Low Intensity Developed	264	15,497	58.70
High Intensity Developed	42	1,236	29.43
Stream Bank		71,965	
Groundwater			
Point Source			
Septic Systems			
Total	1,331	721,215	541.86

Table C9.4. Header Information for Tables C9.2 and C9.3.

Land Use Category	The land cover classification that was obtained by from the MRLC database
Area (acres)	The area of the specific land cover/land use category found in the watershed.
Sediment Load	The estimated total sediment loading that reaches the outlet point of the watershed that is being modeled. Expressed in lbs/year.
Unit Area Sediment Load	The estimated loading rate for sediment for a specific land cover/land use category. Loading rate is expressed in lbs/acre/year

C9.2 LOAD ALLOCATION PROCEDURE FOR SEDIMENT TMDL

The load allocation and reduction procedures were applied to the entire Neshaminy Creek Tributary #1 watershed. The load reduction calculations are based on sediment loads that were obtained using 1992 land use conditions. This assumes that the watershed was attaining its designated uses prior to 1992. As indicated earlier, land development, which is the source of stream impairment in the watershed, has increased considerably since 1992. These loads were then used as the basis for establishing the TMDL for this watershed.

The basic equation defining the TMDL for sediment is as follows:

$$TMDL = MOS + LA + WLA \quad (1)$$

TMDL is the TMDL total load. The LA (load allocation) is the portion of Equation (1) that is typically assigned to non-point sources. The MOS (margin of safety) is the portion of loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The WLA (Waste Load Allocation) is the portion of this equation that is typically assigned to point sources. However, as described below, this category was used to reflect sediment loads from all sources in this particular watershed. This was done for two primary reasons: 1) because "land development" was listed as the primary source of sediment to impaired streams in this sub-watershed, and 2) to be consistent with EPA guidance on how to handle sediment loads in urbanized watersheds to which MS4 regulations apply. Details of how specific components of the overall TMDL calculation were derived are presented below.

C9.2.1 Sediment TMDL Total Load

As noted earlier, the TMDL total target loads for the Neshaminy Creek Tributary #1 watershed are based on the sediment loads obtained using the 1992 land use conditions, and are equal to 232,830 lbs/year (see Table C9.2).

C9.2.2 Margin of Safety

The Margin of Safety (MOS) for this analysis is explicit. Ten percent of the TMDL was reserved as the MOS.

$$MOS\ (Sediments) \quad 232{,}830\ lbs/yr \times 0.1 = 23{,}283\ lbs/yr \quad (2)$$

C9.2.3 Waste Load Allocation

For the purposes of this TMDL assessment, sediment loads from all sources have been assigned to the waste load allocation (WLA) category to be consistent with EPA guidance on how to handle sediment loads in urbanized watersheds. Therefore, the load allocation (LA) in this case is equal to zero. Allowing for an explicit 10% MOS, the target WLA is re-computed as:

$$WLA\ (Sediment) \quad 232{,}830\ lbs/yr - 23{,}283\ lbs/yr = 209{,}547\ lbs/yr \quad (3)$$

Tables that can be used to cross-reference sub-areas with municipalities in the Neshaminy Creek basin, as well as a summary of sediment-related WLAs, can be found in Appendix E. A map showing the overlap between sub-basin and municipal boundaries within the entire Neshaminy Creek basin is also included in this same appendix.

C9.2.4 Load Reduction Procedures

The allocation of the sediment load among contributing sources in this watershed was done by reducing each source equally on a percentage basis. Based on the target WLA of 209,547 lbs/year described above, the computed load allocations are as shown in Table C9.5.

Table C9.5. Sediment Load Allocation by Each Land Use/Source

Land Use Category	*Area (acres)*	*Unit Area Load (lbs/acre/yr)*	*Avg.Load (lbs/year)*	*WLA (lbs/year)*	*Reduction (%)*
Hay/Pasture	199	51.91	10,331	3,002	71
Cropland	286	337.15	96,424	28,015	71
Conifer Forest	5	0	0	0	71
Mixed Forest	86	2.31	199	58	71
Deciduous Forest	188	3.52	662	192	71
Transitional	261	2011.11	524,901	152,499	71
Low Intensity Dev	264	58.70	15,497	4,503	71
High Intensity Dev	42	29.43	1,236	360	71
Stream Bank			71,965	20,914	71
Groundwater					
Point Source					
Septic Systems					
Total	1,331	541.86	721,215	209,543	71

The total allowable sediment load in this watershed when all sources are considered (as well as the 10% MOS) is 209,543 pounds per year. In order for all stream segments to attain their specific uses, total sediment load should be reduced from 721,215 pounds per year by a factor of 71%.

C9.3 CONSIDERATION OF CRITICAL CONDITIONS

The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment and nutrients to a waterbody and the resulting impact on beneficial uses, establishing this TMDL using average annual conditions is protective of the waterbody.

C9.4 CONSIDERATION OF SEASONAL VARIATIONS

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance

calculations. The model requires specification of the growing season, and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

C9.5 REASONABLE ASSURANCE OF IMPLEMENTATION

Proposed sediment reductions are allocated primarily to developed land, transitional land uses and stream bank erosion in the watershed. Implementation of best urban best management practices (BMPs) in the affected areas to increase infiltration and sediment control measures should achieve the loading reduction goals established in the TMDL. Substantial reductions in the amount of sediment reaching the streams can be made through the installation of drainage controls such as detention ponds, sediment ponds, infiltration pits, dikes and ditches. These BMPs range in efficiency from **20% to 70%** for sediment reduction. The implementation of such BMPs will likely occur in the watershed as a result of PaDEP's Proposed Comprehensive Stormwater Management Policy. When approved, this new policy will require affected communities to implement BMPs to address stormwater control that will "reduce pollutant loadings to streams, recharge groundwater tables, enhance stream base flow during times of drought and reduce the threat of flooding and stream bank erosion resulting from storm events." Over the next year and one-half, PaDEP will be developing a "Phase II" program for NPDES discharges from small construction sites, additional industrial activities, and for the 700 municipalities subject to the requirements for separate storm sewer systems (MS4). All of the municipalities located within the Neshaminy Creek Tributary #1 watershed will be affected by this policy, which has been included in Appendix E. Tables that can be used to cross-reference sub-areas with municipalities in the Neshaminy Creek basin, as well as a summary of sediment-related WLAs, can be found in Appendix E. A map showing the overlap between sub-basin and municipal boundaries within the entire Neshaminy Creek basin is also included in this same appendix. Implementation of BMPs aimed at sediment reduction will also assist in the reduction of phosphorus originating from transitional land uses and stream bank erosion.

C9.6 PUBLIC PARTICIPATION

Notice of the draft TMDLs will be published in the *PA Bulletin* and local newspapers with a 30-day comment period provided. A public meeting with watershed residents will be held to discuss the TMDLs. Notice of final TMDL approval will be posted on the Department website.

C10.0 Total Maximum Daily Load (TMDL) Development Plan for Neshaminy Creek Tributary #2 Watershed

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EXECUTIVE SUMMARY

The Neshaminy Creek Tributary #2 watershed in Bucks County is about 1 square mile in size. This watershed contains a stream that is a tributary of the main stem of Neshaminy Creek. The protected uses of the watershed are water supply, recreation, and aquatic life. Its aquatic use is warm water fishes and migratory fishes.

The Total Maximum Daily Load (TMDL) applies to about 1.5 stream miles in the watershed (Stream Segment Id # 980514-1004-GLW). It was developed to address the impairments noted on Pennsylvania's 2002 Clean Water act Section 303(d) List. The impairments are primarily caused by sediment loads and water/flow variability due to urban runoff/storm sewers in the watershed. The TMDL focuses on control of sediments. Water/flow variability was not explicitly addressed because it was believed that the implementation of BMPs in the urban land use areas (both developed and developing) to reduce sediment would also decrease water flow and volume to the stream and therefore stabilize stream flow.

Pennsylvania does not currently have water quality criteria for sediment. For this reason, a modeling approach was developed to identify the TMDL endpoints or water quality objectives for sediments in the impaired segments of the this watershed. The approach is based on the comparison of simulated sediment loads at two time periods: Year 1992 when the stream was still attaining and Year 2000 when it was found to be impaired. Siltation, the cause of impairment to this tributary, resulted from the accumulation of sediments originating from construction and newly developed land over several years. It was estimated that the amount of sediment loading that will meet the water quality objectives for the Neshaminy Creek Tributary #2 watershed was 62,382 pounds per year. It is assumed that the affected stream will support its aquatic life uses when this value is met. The sediment TMDL for this watershed is allocated as shown in the table below.

Summary of TMDL for Neshaminy Creek Tributary #2 Watershed (lbs/yr)

Pollutant	Source	TMDL	MOS	WLA	LA	LNR	ALA
Sediment	Upland and stream bank erosion	62,382	6,238	56,144	-	-	-

The TMDL for sediment is primarily allocated to non-point source loads from transitional (i.e., "developing") land and stream bank erosion, with 10% of the TMDL total load reserved as a margin of safety (MOS). In this case, all sediment loads were assigned to the waste load allocation (WLA) category. The sediment TMDL covers a total of 1.5 stream miles, and establishes a reduction for total sediment loading of 66% from the current annual loading of 165,561 pounds.

C10.0 INTRODUCTION

C10.0.1 Watershed Description

The following discussion provides information on the physical characteristics of the Neshaminy Creek Tributary #2 watershed including location, land use distributions, and geology. This watershed is located in the Piedmont Physiographic Province and is situated in Bucks County. It covers an area of approximately 1 square mile. Tributary #2 drains into the main stem of Neshaminy Creek from the east. The watershed is located north of the town of Langhorne in eastern Pennsylvania. It can be reached via Pennsylvania Route 432 from the east and Route 413 from the west. Figure C10.1 shows the watershed boundary, its location, and water quality status of stream segments as reported on the 2002 303(d) List. The designated uses of the watershed include water supply, recreation and aquatic life. As listed in the Title 25 PA Code Department of Environmental Protection Chapter 93, Section 93.o (Commonwealth of PA, 1999), the designated aquatic life use for the Neshaminy Creek Tributary #2 is warm water fishes and migratory fishes.

The current land use distribution in the watershed was developed by updating the National Land Cover Data (NLCD) layer described by Vogelmann et al. (1998) using a recent 10-m colorized panchromatic SPOT (System Probatoire pour l'Observation de la Terre) satellite image. The NLCD layer was based primarily on 1992-vintage Landsat Thematic Mapper (TM) imagery. SPOT imagery was acquired in 2000 and is available for the entire Commonwealth of Pennsylvania at the Pennsylvania Spatial Data Access (PASDA) site (http://spot.pasda.psu.edu) at no charge. The primary land uses in the Neshaminy Creek Tributary #2 watershed are developed land (47%). It is important to note that development in the watershed changed from 168 to 216 acres, for a 29% increase from 1992 to 2000.

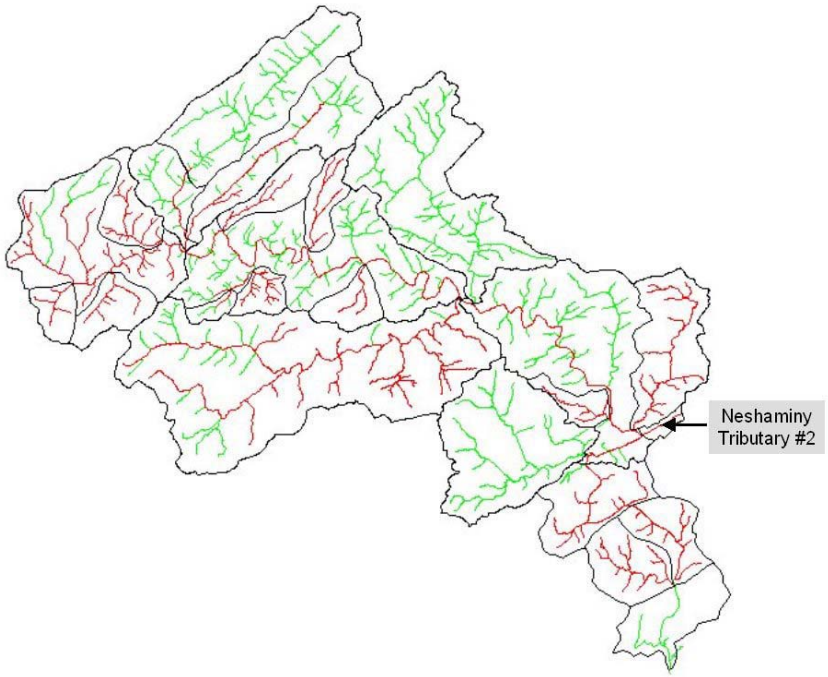

Figure C10.1. Neshaminy Creek Tributary #2 Watershed.