Middle Gwynns Falls

Small Watershed Action Plan

Addendum A:

Sediment and Bacteria TMDLs Analysis and Actions

A.1 Introduction

Based on U.S. EPA – Region 3 review of the *Middle Gwynns Falls – Small Watershed Action Plan* a number of deficiencies were found in meeting the EPA a through i planning criteria. These deficiencies included:

- Addressing the sediment TMDL, and
- Addressing the bacteria TMDL

This addendum to the *Middle Gwynns Falls – Small Watershed Action Plan* has been prepared to address the stream based sediment TMDL that was discussed (*Middle Gwynns Falls – Watershed Characterization* – Section 3.2), but not addressed in the original document. Likewise the bacteria TMDL was discussed (*Middle Gwynns Falls – Watershed Characterization* – Section 3.2.2), but not addressed.

Baltimore County is in the process of developing TMDL Implementation Plans for each EPA approved TMDL in Baltimore County. These TMDL Implementation Plans will have a public participation component, and a public comment period, prior to submittal to Maryland Department of the Environment at the end of December 2014 to meet a component of our recently issued NPDES – MS4 Permit (11-DP-3317, MD0068314). The Small Watershed Action Plans that have been completed will be used to assist in identifying the implementation actions to be included in the TMDL Implementation Plan. Conversely, the TMDL Implementation Plans will be used to inform the SWAPs and possible result in a modification of the actions within the SWAP to assure the TMDL end points are met.

While the SWAP process is specifically designed to incorporate citizens in the plan preparation through the Steering Committee and the Stakeholder meetings; future SWAPs will be posted for a 30 day comment period prior to being finalized to ensure that citizens have the opportunity to express opinions and thoughts on each document. Based on the comments the plans may be modified, in any event a comment response document will be prepared, explaining why or why not the document was modified based on each comment.

A.2 Sediment TMDL

The sediment TMDL for Gwynns Falls is based on impairment of the aquatic community identified through the Maryland Biological Stream Survey monitoring. Subsequent evaluation using the methods detailed in the *Maryland Biological Stressor Identification Analysis Process* (MDE, 2009) indicated that the impairment of the aquatic community was due to a number of causes, including the following factors summarized in *Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland Biological Stressor Identification Analysis Results and Interpretation* (MDE, 2009) (See Appendix J in volume 2 of the *Middle Gwynns Falls Small Watershed Action Plan* for full report):

- Inorganic pollutants (chlorides and conductivity) were found in 76% of the Gwynns Falls stream miles with very poor or poor biological conditions. Degradation of the aquatic community due to these factors is related to prolonged exposure. The current lack of

state monitoring data for inorganic pollutants limits the ability of the state to more precisely determine the specific cause(s) of the impairment.

- The analysis also indicated that the aquatic community impairments are likely related to flow/sediment related stressors. The document states: "Specifically, altered hydrology and increased runoff from urban impervious surfaces have resulted in channel erosion and subsequent elevated suspended sediment transport through the watershed, which are in turn the probable causes of impacts to biological communities."
- The analysis also identified ammonia as a possible stressor resulting in degraded aquatic communities. The high ammonia was found a two of the twelve sites used in the analysis. It was concluded that more intensive analysis of the available data was needed to determine if there is ammonia toxicity impairment in the Gwynns Falls watershed.

The Gwynns Falls watershed was originally listed as sediment impaired in 1996. The Biological Stressor Identification Analysis confirmed the original listing. The sediment TMDL was developed to address the degradation of the aquatic community. Meeting the sediment TMDL reduction requirements may not result in improvement of the aquatic community to fair or good conditions due to the existence of additional impairing factors (inorganic pollutants and possibly ammonia) for which TMDLs have yet to be developed. However, improvement of aquatic habitat and reduction of sediment is necessary component to any aquatic community improvement.

A.2.1 Gwynns Falls Sediment TMDL

The *Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore County and Baltimore City* (MDE, 2009) document can be found in Volume 2, Appendix H of the *Gwynns Falls Small Watershed Action Plan*. A brief summary is provided in this section.

The framework for developing the TMDL was based on the Chesapeake Bay Program (CBP) Phase 5 Watershed Model. Based on the date of the publication, MDE did not use the final Phase 5 Watershed Model run from July 2011 for derivation of the land use loading rates. MDE used the edge-of-stream (EOS) loading rates in calculation of the baseline load for the TMDL. In the Watershed Model, the EOS loads represent not only the erosion from land, but also all of the intervening processes; hill slope/stream corridor deposition; and stream channel transport, erosion and deposition. This is due to the stream channel layer used in the CBP watershed model being representative of larger streams, typically fourth order. Thus the steam channel processes in the lower order streams are not taken specifically into account. The EOS represents not only the sediment load derived from upland erosion, but also the sediment contribution from low order streams. To remedy this situation, MDE developed a methodology to determine the percentage of the sediment load due to stream channel erosion. Based on the assumption that as impervious surfaces increase, upland sources decrease, flow increases, and change in sediment load is results from increased stream bank erosion, a model was developed. The following equation was used to estimate the percentage of sediment due to stream channel erosion:

$$\%E = \frac{I * L_I}{I * L_I + (1 - I)L_P}$$

where:

%E = percent erosional sediment resultant from stream channel erosion
I = percent impervious
L_I = Impervious urban land use EOF load
L_P = Pervious urban land use EOF load

This model was verified through two different methods used in modeling sediment in the Anacostia River Basin; an HSPF model with a Penn State developed stream channel erosion equation, and sediment rating curve model using data from USGS gage stations to estimate annual loads before and after increased development.

To determine the sediment threshold, a reference watershed approach was used. The basis for this approach is that sediment loads determined for reference watersheds that support aquatic life should serve as the basis for determining allowable sediment loads in sediment impaired watersheds.

The watershed was divided into two segments based on the location of two long-term Department of Natural Resources monitoring sites (see Table A-1).

Table A-1: DNR Core/Trend Sites in Gwynns Falls

Site Number	Latitude	Longitude	Current Water Quality Status	Trend Since 1970s
GWY0015	39.3140	-76.7280	Poor	No Change
GWY0115	39.3620	-76.7620	Fair/Good	Slight Improvement

Site GWY0015 is located in Baltimore City near the base of the Gwynns Falls watershed in Carroll Park. Site GWY0115 is located in Baltimore County on the mainstem of Gwynns Falls at Liberty Road. The Middle Gwynns Falls Planning area contains portions of both segments.

The resulting TMDL and associated reductions are displayed in Table A-2.

Table A-2: Baseline Loads, TMDL Load Reductions, and Percent Reductions for the Gwynns Falls Sediment TMDL

	Baseline Load (lbs/year)	TMDL (lbs/year)	Pounds Reduction	Reduction (%)
Segment 1	16,949,400	12,962,600	3,986,800	23.5
Segment 2	27,147,200	15,029,800	12,117,400	44.6
Total	**44,096,600**	**27,992,400**	**16,104,200**	**36.5**

While the Gwynns Falls Sediment TMDL did not break out the loads based on upland versus stream channel sources, based on the equation above, the document indicated that the entire Gwynns Falls with a 33% impervious cover would result in ~77% of the sediment load coming from stream channel erosion.

A.2.2 Sediment TMDL in Relation to the Middle Gwynns Falls Planning Area

To calculate the sediment load in the planning area, the Maryland Department of Planning (MDP) 2010 land use GIS coverage was used in conjunction with the land use per acre loading rates as determined by the October 2011 Maryland Assessment Scenario Tool (MAST) update. The MDP 2010 land use is based on 2007 aerial imagery and therefore represents the land use as of 2007. The impervious surface coverage was determined through the Baltimore County 2008 planimetric data for roads and buildings. Table A-3 presents per acre sediment loading by land

use classification and Table A-4 presents the results of the sediment calculations by subwatershed, along with the average per acre loading and the percentage of sediment attributable to stream channel erosion.

Table A-3: Land Use Sediment Loading Rates

Land Use	Lbs Sediment/Acre/Year
Impervious Urban	2,056.95
Pervious Urban	280.43
Cropland	1,422.32
Pasture	307.45
Forest	82.17

Table A-4: Subwatershed Land Use and Sediment Loading Results

Land Use	Gwynns Falls	Scotts Level Branch	Powder Mill Run	Dead Run	Maiden Choice Run	Total Middle Gwynns Falls
Impervious Urban	1,435	684	239	1,632	305	4,295
Pervious Urban	3,601	1,649	568	2,208	592	8,618
Cropland	4	1	0	0	0	5
Pasture	28	0	0	0	0	28
Forest	1,096	320	151	337	31	1,935
Total	**6,164**	**2,654**	**958**	**4,177**	**928**	**14,881**
Sediment Loads						
Impervious Urban	2,951,723	1,406,954	491,611	3,356,942	627,370	8,834,600
Pervious Urban	1,009,828	462,429	159,284	619,189	166,015	2,416,745
Cropland	5,689	1,422	0	0	0	7,111
Pasture	8,609	0	0	0	0	8,609
Forest	90,058	26,294	12,408	27,691	2,547	158,998
Total	**4,065,907**	**1,897,099**	**663,303**	**4,003,822**	**795,932**	**11,426,063**
Average #s/Acre	**660**	**715**	**692**	**959**	**858**	**768**
% Sediment From Stream Erosion	**69%**	**72%**	**71%**	**82%**	**78%**	**75%**

The target load reductions will vary depending on whether the subwatershed is in the segment 1 or segment 2 TMDL area or is split between the two. Table A-5 indicates the load reductions by subwatershed taking location into account.

Table A-5: Subwatershed Sediment Load Reductions

Subwatershed	Segment	Baseline Sediment Load	Target % Reduction	TMDL Load	Target Pounds Reduction
Gwynns Falls	1 & 2	4,065,907	36.5%	2,581,851	1,484,056
Scotts Level Branch	1	1,897,099	23.5%	1,452,281	445,818
Powder Mill Run	2	663,303	44.6%	367,197	295,833
Dead Run	2	4,003,822	44.6%	2,218,117	1,785,705
Maiden Choice Run	2	795,932	44.6%	450,036	345,896
Total Target Reduction		**11,426,063**	**38.1%**	**7,069,482**	**4,357,308**

A.2.3 Sediment Reduction Strategy

The reduction strategy to meet the Sediment TMDL target load reduction of 4,357,308 pounds is presented in Table A-6. This table is an adaptation of Table 3-24 of the Middle Gwynns Falls SWAP.

Table A-6: Implementation Actions and Expected TSS Reductions for the Middle Gwynns Falls

BMP	How Credited	TSS Efficiency	Units Available		Projected Participation	Projected 2025 TSS Load Reduction
Completed Measures						
Stream Restoration	NPDES Efficiency	Varies	7,775	feet	100%	2,007,250
Existing SWM	Efficiency	Varies	3,087	acres	100%	773,401
Proposed Measures						
SSO Reduction/Elimination	Direct Removal	N/A	223,390	gallons	100%	5,888
SWM Conversions	Efficiency	50%	335	acres	100%	145,837
SW Retrofits (NSA, ISI)	Efficiency	90%	30	acres	50%	27,686
NSA Stormwater Retrofit	Efficiency	90%	17	acres	50%	16,161
ISI Stormwater Retrofit	Efficiency	90%	12	acres	50%	11,526
ISI Impervious Cover Removal	LU Conversion	N/A	4	acres	75%	4,934
NSA Downspout Disconnection	Efficiency	90%	206	acres	43%	163,852
Reforest Stream Buffer	LU Conversion + Efficiency	50%	384	acres	33%	25,234
NSA Tree Plantings	LU Conversion	N/A	67	acres	43%	5,709
ISI Tree Plantings	LU Conversion	N/A	72	acres	65%	9,253
Street Sweeping	Efficiency	25%	76	miles	100%	142,348
WQMP Stream Restoration Projects	Lbs per Ln Ft	310	19,930	feet	85%	5,251,555
Stream Restoration	Lbs per Ln Ft	310	64,863	feet	50%	10,053,784
WQMP Wetland Creation Projects	Efficiency	60%	63	acres	100%	32,813
WQMP BMP Creation Projects	Efficiency	60%	357	acres	60%	112,106
Redevelopment of Urban Areas	Efficiency	60%	1,339	acres	67%	469,025
MS4 Retrofits	Efficiency	65%	12,913	acres	34%	2,486,296
Total TSS Reduction						**18,964,007**

As is evident from the total amount of expected reduction there is an apparent discrepancy between calculated load and the expected reductions due to implementation of the various actions. The expected load in the TMDL document stated that "the land use framework used to develop this TMDL was originally developed for the Chesapeake Bay Program Phase 5 (CBP P5) watershed model". Maryland Department of the Environment developed the model and the document in 2009 with the document being submitted to EPA September 28, 2009 with an EPA approval date of March 10, 2010. The data used to calculate the sediment loading for the Middle Gwynns Falls SWAP was based on the Chesapeake Bay Program Phase 5.2.3 watershed model which was run in July, 2011. During the interim of 2009 and July 2010, a number of changes in the watershed model were incorporated to improve the model. However, the loading rates used in the development of the Sediment TMDL for Gwynns Falls and the sediment loading rates used for the development of the Middle Gwynns Falls SWAP the result in discrepancy between the calculations of the baseline loads.

The Chesapeake Bay Program intends to conduct a mid-point assessment in 2017 of the progress made in meeting the Chesapeake Bay TMDL. As part of this assessment Phase 6 of the Watershed Model will be developed, calibrated and used to assess progress. Part of the development of the Phase 6 model is to reassess the land uses in the model and sediment loading related to the various land uses. Because the scale of the stream layer used in the model does not include most first and second order, and some third order streams, an urban riparian corridor land use is being considered. Inclusion of this land use could account for sediment contributed by stream channel erosion in urban settings, and provide a better mass balance that will allow a better assessment of progress in meeting the sediment TMDL in Gwynns Falls.

A second potential issue relates to load reductions calculated for the various restoration actions. For BMPs that treat runoff from the various land uses the more recent loading rates from CBP Watershed Model 5.2.3 were used to calculate both the load to the practice and then the reduction efficiency was applied. See: http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stormwater_Retrofits--_long.pdf for methods.

For practices, such as, stream restoration, the reduction is based on pounds removed due to prevented stream bank erosion and deposition on the reconnected floodplain. Stream restoration accounts for ~64% of the sediment reduction in the proposed actions. An interim planning level reduction rate was used for the calculation of the reduction expected. These rates will vary from project to project depending on the rate of stream channel erosion and degree of floodplain reconnection. The methods of calculations are detailed in the document titled "Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects" (Berg, et.al. 2013). The document is located on the web at: http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stream_Restoration_revised102813_LONG.pdf The recommendations for credit for stream restoration underwent a trial period and based on the trial period, the document is in the process of being revised. When the document is available, the revised credit rates will be used.

Based on the above, three programmatic actions are proposed:

- Continue to work with the Chesapeake Bay Program on land uses and/or stream networks for inclusion in the Chesapeake Bay Watershed Model to better model sediment at the local level.
- Continue to work with the Chesapeake Bay Program – Urban Stormwater Workgroup to improve assessment of various types of restoration projects for crediting purposes; including the crediting of stream restoration for sediment reduction.
- Develop better in-house calculation of sediment reduction for the various stream restoration projects to use in-lieu of the default values used in planning.

The sediment TMDL is based on impacts to the aquatic community. To assess progress in meeting the sediment reductions necessary to meet the TMDL, several monitoring programs will continue to be implemented.

- The Trend Monitoring Program collects grab samples on a fixed interval basis. Total Suspended Solids are part of the suite of constituents analyzed. There are two trend sites

located within the Middle Gwynns Falls planning area. The data from this program will be used to assess changes in TSS pollutant load over time.

- The Scotts Level Branch monitoring program includes storm event and baseflow chemical monitoring, including TSS; stream geomorphologic monitoring; and biological monitoring. There are two permanent storm event monitoring sites within Scotts Level Branch, 10 baseflow sites, and 20 geomorphological monitoring sites, and 10 biological monitoring sites. In addition, each restoration project within Scotts Level Branch is monitored to determine effectiveness, including sediment load reductions and biological community response. This is part of a paired watershed design study to determine the ability to detect changes on a small subwatershed scale that result from restoration activities within the subwatershed.
- The Probabilistic Biological Monitoring Program is conducted throughout the county with random sites selected in the Gwynns Falls watershed in odd years. These data allow an assessment of the trends in the aquatic biological community over time.

For greater detail on each of these monitoring programs, see Section 10 of the latest NPDES – MS4 Annual Report posted on the web page - http://www.baltimorecountymd.gov/Agencies/environment/npdes/

A.3 Bacteria TMDL

Volume 2, Appendix G of the Middle Gwynns Falls SWAP presents the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland* (MDE 2006) submitted by Maryland Department of the Environment to EPA – Region 3 for review and approval on September 9, 2006 and approved by EPA – Region 3 December 4, 2007. This TMDL is based on nonattainment of designated use of primary contact recreation. The Gwynns Falls watershed was listed on the state 303(d) list as impaired for bacteria (fecal coliform) in 2002. A brief summary of the Bacteria TMDL is presented in Volume 2, Appendix E – Characterization Report, Section 3.2.2. This summary is expand on below, along with actions that are anticipated in reducing bacteria sufficiently to meet the bacteria load reduction for the Gwynns Falls TMDL.

A.3.1 Gwynns Falls Bacteria TMDL

The Gwynns Falls Bacteria TMDL was developed on the basis of one long-term Core monitoring site, and one year of bacteria monitoring at four sites distributed longitudinally along the Gwynns Falls mainstem. Monitoring for *Escherichia coli* (*E.* coli) was conducted twice monthly from October 2002 through October 2003 at the four sites, in addition a monthly sample for the Bacteria Source Tracking (BST) analysis was collected. The water quality standard that was the basis for the TMDL load reduction analysis was an *E. coli* standard of a Geometric Mean of 126 MPN/100ml; where MPN stands for Most Probable Number, which is the estimate of the number of bacteria based on the number of *E. coli* bacterial colonies that develop as a result of testing the water quality sample. This is the standard for recreational waters - human contact based on minimizing human illness due to water contact.

The bacteria monitoring for *E. coli* established a baseline load using a flow duration approach where the data was stratified based on the high low and low flow conditions. Based on an analysis of the flow duration curves from gaged sites, it was determined that flows above the 25th

percentile represented high flows and below the 25th percentile represented mid/low flows. The results of the bimonthly sampling are presented in table A-7 based on an annual geometric mean and in Table A-8 for a seasonal geometric mean. The seasonal period is from May 1st through September 30th and represents the period during which recreational contact is most likely to occur.

Table A-7: Annual Steady State Geometric Mean by Monitoring Station (MPN/100 ml)

Station	Flow Stratum	Samples (#)	*E. Coli* Minimum Concentration	*E. coli* Maximum Concentration	Annual Steady State Geometric Mean	Annual Weighted Geometric Mean
GWN0015	**High**	7	15,530	86,600	40,086	32,470
	Low	19	5,800	77,000	30,267	
GWN0026	**High**	6	280	38,700	3,633	753
	Low	17	60	4,350	446	
GWN0115	**High**	7	320	16,700	1,009	321
	Low	19	20	5,790	219	
GWN0160	**High**	6	110	23,800	1,611	508
	Low	17	60	2,050	345	

Table A-8: Seasonal Steady State Geometric Mean by Monitoring Station (MPN/100 ml)

Station	Flow Stratum	Samples (#)	*E. Coli* Minimum Concentration	*E. coli* Maximum Concentration	Seasonal Steady State Geometric Mean	Seasonal Weighted Geometric Mean
GWN0015	**High**	3	43,500	86,600	65,529	40,716
	Low	9	5,800	77,000	35,290	
GWN0026	**High**	3	280	38,700	1,498	528
	Low	9	60	2,600	373	
GWN0115	**High**	3	620	16,700	1,954	842
	Low	9	310	5,790	636	
GWN0160	**High**	3	820	23,800	3,102	1,062
	Low	9	360	2,050	743	

Note that for each station the seasonal weighted geometric mean is greater than the annual weighted geometric mean. This is due to the greater die off of bacteria during colder temperatures than in warm temperatures; it does not indicate a reduction in the sources of bacteria during colder months.

One requirement for the development of a TMDL is to identify sources and partition the load among sources. Maryland Department of the Environment used a Bacteria Source Tracking (BST) method to fulfill this requirement. The rationale behind BST is that different types of organisms have differential responses to antibiotics based on their exposure to antibiotics. Four groups were identified; human, domestic pet, livestock, and wildlife. The methodology is to collect scat from various sources and measure the antibiotic resistance to create a library a reference. Water quality samples are then collected and the antibiotic resistance of the cultured samples is then compared to the library to determine the percent of the sample attributable to the four sources (see Appendix G, for more detail on the methodology). Table A-9 presents the results of the BST analysis on an annual basis for each station based on high flow, low flow and a weighted average, while Table A-10 presents the same data for the seasonal period.

Table A-9: Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Watershed for an Average Annual Period

Station	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	**High Flow**	10	73	0	4	13
	Low Flow	21	66	0	2	11

	Weighted	18	68	0	2	12
GWN0026	**High Flow**	14	66	0	12	8
	Low Flow	27	47	0	10	16
	Weighted	24	52	0	10	14
GWN0115	**High Flow**	11	48	0	16	25
	Low Flow	14	44	0	31	11
	Weighted	14	45	0	27	14
GWN0160	**High Flow**	10	65	0	15	10
	Low Flow	8	59	0	21	12
	Weighted	8	60	0	20	12

Table A-10: Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Watershed for the Seasonal Period (May 1st – September 30th)

Station	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	**High Flow**	10	61	0	4	25
	Low Flow	17	65	0	2	16
	Weighted	16	63	0	3	18
GWN0026	**High Flow**	3	55	0	26	16
	Low Flow	23	43	0	16	18
	Weighted	18	45	0	19	18
GWN0115	**High Flow**	2	48	0	14	39
	Low Flow	9	53	0	27	11
	Weighted	7	51	0	24	18
GWN0160	**High Flow**	12	54	0	22	12
	Low Flow	7	60	0	22	11
	Weighted	8	58	0	22	12

For each station human sources of bacteria account for the highest percentage of the load, domestic pet is somewhat variable by station, livestock sources in this highly urban watershed are not indicated as a source, and wildlife and unknowns account for an appreciable percentage of the bacteria.

Using the concentration factor (MPN/100 ml) and the flow MDE was able to calculate the baseline load at each station as billion *E. coli* MPN/100ml/day (for additional details see Appendix G, section 4.3, starting on page 30). The results are presented in Table A-11.

Table A-11: Baseline Load Calculation

	Station	**GWN 0160**	**GWN0115**	**GWN0026**	**GWN0015**
High Flow	Daily Average Flow (cfs)	74.9	52.3	96.7	15.5
	E. coli concentration (MPN/100ml)	1,611.3	302.3	8,109.8	740,277.0
Low Flow	Daily Average Flow (cfs)	14.0	9.8	18.1	2.9
	E. coli concentration (MPN/100ml)	345.4	65.2	1,271.1	156,243.6
Baseline Load (billion *E. coli* MPN/100ml/day		**2,539.6**	**314.8**	**17,990.7**	**90,620.3**

In order to meet the water quality standard of a geometric mean of 126 MPN/100ml for *E. coli* the percent reduction for each of the four source categories was calculated. The results are presented in Table A-12.

Table A-12: Required Reductions of Fecal Bacteria to Meet Water Quality Standards

Station	Time Period	Hydrologic Condition	Domestic Pet %	Human %	Livestock %	Wildlife %
GWN0160	Annual	Wet	98%	98%	0%	33%
		Dry	28%	98%	0%	0%
	Seasonal	Wet	98%	98%	0%	76%
		Dry	98%	98%	0%	47%
	Maximum Source Reduction		**98%**	**98%**	**0%**	**76%**
GWN0115	Annual	Wet	0%	32%	0%	0%
		Dry	0%	0%	0%	0%
	Seasonal	Wet	96%	98%	0%	2%
		Dry	0%	82%	0%	0%
	Maximum Source Reduction		**96%**	**98%**	**0%**	**2%**
GWN0026	Annual	Wet	98%	98%	0%	85%
		Dry	98%	98%	0%	45%
	Seasonal	Wet	98%	98%	0%	78%
		Dry	98%	98%	0%	45%
	Maximum Source Reduction		**98%**	**98%**	**0%**	**85%**
GWN0015	Annual	Wet	99.998%	99.9996%	0%	99.096%
		Dry	99.997%	99.9991%	0%	97.037%
	Seasonal	Wet	99.999%	99.9998%	0%	99.562%
		Dry	99.998%	99.9996%	0%	98.890%
	Maximum Source Reduction		**99.999%**	**99.9998%**	**0%**	**99.562%**

There is only one station located within the Middle Gwynns Falls Small Watershed Action Plan area and that is GWN0115. This station is on the mainstem of Gwynns Falls and is upstream of the Dead Run and Powdermill Run subwatersheds. Station GWN0160 is upstream and provides bacteria to the planning area, while GWN0026 and GWN0015 are located in the Baltimore City portion of the watershed downstream of the planning area. For this particular SWAP the bacteria reduction objective is the meet water quality standards at station GWN0115 and all of the subwatersheds within the planning area.

A.3.2 Middle Gwynns Falls Bacteria Reduction Strategy

The bacteria reduction strategy for the Middle Gwynns Falls includes the following components:

- Source reduction
  - Wastewater
  - Domestic Pet
  - Wildlife
- Monitoring
  - Bacteria Trend Monitoring
  - Subwatershed Bacteria Survey
  - Bacteria Source Tracking
  - Illicit Discharge Detection and Elimination
- Treatment Options

The source reduction strategy and the monitoring will occur concurrently, while the treatment options will be considered if the source reduction is insufficient to meet the bacteria load reduction targets.

A.3.2.1 Wastewater Source Reduction

Baltimore County entered into a consent decree (http://resources.baltimorecountymd.gov/Documents/Public_Works/consentdecreefinal.pdf) with the U.S Environmental Protection Agency and the Maryland Department of the Environment to address sanitary sewer overflows, September 21, 2005. The consent decree laid out a schedule of activities that are needed to address sanitary sewer overflows. The schedule is due for completion in 2020. The consent decree covers all of Baltimore County served by sanitary sewer, including the Middle Gwynns Falls. The Middle Gwynns Falls planning area has ~316 miles of force main and gravity sewer and potentially 381 on-site disposal systems (septic systems). It is anticipated that compliance with the consent decree requirements will eliminate the human source of bacteria. The specific implementation action is:

- Implement the requirements of the Baltimore County Consent Decree according to the schedule detailed in the decree, complete all requirements end date specified in the consent decree in 2020.

The Characterization Report for the Middle Gwynns Falls indicated that there are potentially 381 on-site disposal systems within the planning area. This information is based on the data base used to assess charges that result from the Bay Restoration Fund requirements. We have found that in some cases the database is not completely accurate in designating whether the household or commercial/industrial property is actually hooked up to the sanitary sewer or actually is served by an on-site disposal system. We are in the process of verifying the accuracy of the information in the database by conducting field inspections. In some cases the site is actually served by an on-site disposal system, in which case it is determined if the system is functioning properly. The specific implementation action is:

- Continue the process of inspecting sites indicated by the BRF database as being on an on-site disposal system when located within a sewer subshed. Make corrections to the database as necessary and determine the functioning of the on-site disposal system if the site is served by such a system.

A.3.2.2 Domestic Pet Source Reduction

While the TMDL analysis indicates that the domestic pet source for station GWN0115 only requires a reduction for one of the four conditions, seasonal wet weather source, it is likely that domestic pets provides a year round source, but due to cold temperatures during the winter months, the bacteria die off. This source will be addressed by developing a comprehensive pet waste education program. We currently have a door hanger program, where if pet waste is found to be a problem in a certain neighborhood, we will put out door hangers to alert the neighborhood residents to the problem; but we currently do not have a follow-up program to assess behavioral changes.

By the end of 2015 we will develop a comprehensive pet was program and begin a pilot test to determine effectiveness. The pilot will be conducted in 2016. Using what was learned regarding effectiveness of the comprehensive pet waste program, the program will be modified in 2017 and implemented throughout the county.

A.3.2.3 Wildlife Source Reduction

The designation of wildlife as a source is not specific enough to provide a mechanism for targeting programs to reduce bacteria sources from wildlife. The county will work with MDE to see if it is possible to make a finer distinction of the wildlife sources. If, for example, it is found that a major wildlife bacteria contribution has rats as the source, then better targeting of rat control programs can be effective in reducing this source. On the other hand, if song birds are found to be a major source of bacteria, then alternative methods for treatment will be need to be identified.

A.3.2.4 Bacteria Trend Monitoring

Baltimore County has been conducting bacteria trend monitoring since June 2010. This program was initiated to specifically assess progress in meeting bacteria TMDL reductions and standards. Only on site (GWY0115) is located within the Middle Gwynns Falls planning area. While this site is below the Scotts Level Branch subwatershed and in the Middle Gwynns Falls subwatershed; it is above the confluences of Powdermill Run, Dead Run, and Maidens Choice Run; and therefore results at this station do not reflect the condition bacteria conditions within these subwatersheds. Section 10.3.1.5, Table 10-16 (http://www.baltimorecountymd.gov/Agencies/environment/npdes/) of the 2013 Annual NPDES – MS4 Permit Report indicates that from the time period of 7/1/12 – 6/30/13 only one sample exceeded the *E. coli* standard of 126 MPN/100ml and the geometric mean of 12 samples was 109. This would seem to indicate that we have achieved the bacteria TMDL reduction for the site within this planning area, but the analysis has not stratified the data into the four conditions of annual, seasonal, wet, dry. That data is available and will be included in future analyses.

The next downstream monitoring site (GWY0026), which is below the confluence of the three subwatersheds indicated above, is also reported. This site had only 3 of twelve samples exceed the 126 MPN/100ml standard and had a geometric mean for twelve samples of 195 MNP/100ml. This exceeds the standard, but is a considerable improvement over the initial 17,990.7 MPN/100ml that was determined to be the baseline load in the TMDL.

A.3.2.5 Bacteria Subwatershed Monitoring

Since the monitoring sites used to develop the Gwynns Falls bacteria TMDL all fall along the mainstem, we lack sufficient data to determine if the each individual subwatershed is meeting the bacterial standard. To address this deficiency, the county will conduct a one-year assessment of the subwatersheds within the Middle Gwynns Falls planning area. Results from this on-year assessment will be used to target efforts for bacteria reductions, if needed. All of these subwatersheds are part of the Consent Decree and will undergoing sanitary sewer remediation between now and 2020.

A.3.2.6 Bacteria Source Tracking

Baltimore County is in the process of developing a Bacteria Source Tracking Program to further refine locations of high bacteria and narrow the area that needs to be assessed for bacteria sources. This should not be confused with the State BST Program used to develop the bacteria TMDLs. This program is currently in its pilot stages, where successive samples are taken in an upstream direction and the results used to refine the reaches of stream where the bacteria seem to be entering. The program has been used to locate and lead to the remediation of a sanitary sewer leak in the Powdermill Run subwatershed.

A.3.2.7 Illicit Discharge Detection and Elimination Program

This program, mandated by the NPDES – MS4 Permit, assesses water quality at storm drain outfalls. Some of the illicit discharges detected and eliminated include sanitary sewer cross connections, wash water discharges, on-site disposal system failures and groundwater connections that are contaminated by sanitary sewer leaks. This program will continue and address bacterial contamination by correction and elimination of the source.

A.3.2.8 Treatment Options

Treatment options will be explored, if by 2020 the bacteria water quality standards have not been met. For bacteria, the options are those that either infiltrate water or detain water for a long enough period of time for ultraviolet light to kill off the bacteria. Increasing additional options are appearing in the market, such as, ferrate technology, which can be used for the reduction of bacteria concentrations, although at a relatively high cost. By 2020 Baltimore County will explore and select a suite of treatment options based on the effectiveness of bacterial removal and a cost/benefit analysis.

A.4 Summary

A series of programmatic, implementation, and monitoring actions have been laid out in the above sections of this Addendum. Adherence to fulfilling those actions is expected to result in meeting both sediment and bacteria TMDL reductions for the Middle Gwynns Falls. Baltimore County and the Middle Gwynns Falls Implementation Committee will continue to assess progress in meeting the TMDLs as restoration goes forward and use an adaptive management approach to refine the actions going forward.