Technical Appendix:

Section 3. BMP Effectiveness

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TA-3.1 2010 BMP Monitoring Status

SPA projects and BMP monitoring requirements

A list of all properties with SPA BMP monitoring is provided in Table TA-3.1. The first part of the table provides structural monitoring requirements; the second part of the table provides monitoring requirements for other parameters. Any modifications or updates to monitoring requirements are located in Table TA-3.2.

Table TA-3.1. 2010 SPA project status with monitoring requirements.

If structural monitoring was required, the type of sampling – grab or automated – is specified. "Automated" denotes that flow-weighted composite samples were collected using automated sampling equipment.

SPA	No.	Project Name	Monitoring Phase (during 2011)	Structural Monitoring		ESD Monitoring
				S&EC Structure	SWM Structure	
Clarksburg	1	All Souls Cemetery	Complete (2008)	No	No	No
	2	Cabin Branch	Pre-construction; construction anticipated 2011	Yes - Automated	Yes - Automated	No
	3	Catawba Manor	Complete (2008)	No	No	No
	4	Clarksburg Detention Center (Jail)	Complete (2003)	Yes - Grab	No - Requirement dropped	No
	5	**Clarksburg Ridge**	**Complete (2010)**	Yes - Grab	Yes - Automated	No
	6	Clarksburg Town Center	During Construction; nearing post construction in some areas	Yes - Automated	Yes - Automated	No
	7	Clarksburg Village (w/Greenway Trail)	During Construction; nearing post construction for Phase I	Yes - Grab	Yes - Automated; 3 structures	No
	8	Gallery Park [a]	During Construction	Yes - Automated	Yes - Automated	No
	9	Garnkirk Farms	Pre-construction; on hold	Yes - Automated	Yes - Automated	No
	10	Gateway 270	Complete (2003)	No	No	No
	11	Gateway 270 Lot 7	Complete (2005)	No	No	No
	12	Gateway 270 West	Complete (2004)	No	Yes - Automated; existing pond outfall	No
	13	Gateway Commons	During Construction	Yes - Automated	Yes - Automated	No
	14	Glen and Meadows at Hurley Ridge [b]	During Construction; Approaching post construction	Yes - Grab	Yes	No
	15	Goddard School - Clarksburg	Pre-construction - baseline	TBD	Yes - ESD	Turf Filter - method TBD
		Greenway Village - Phases I-II	Post Construction (year 1 of 5)	Yes - Grab&Auto *	Yes - Automated; 3 structures	No
	16	Greenway Village - Phases III-V	During Construction	Yes - Grab&Auto *	Yes - Automated; 2 linked systems	No
	17	Highlands at Clarksburg	During Construction; Approaching post construction	Yes - Grab	Yes - Automated; 1 linked system	No
	18	Parkside	Post Construction (year 2 of 3)°	Yes - Grab	No - Not required; Temperature only	No
	19	Running Brook Acres	Complete **	Yes - Grab	Yes - Automated *	No
	20	Stringtown Road Extension	During Construction - awaiting basin conversion	Yes - Automated	Yes - Automated	No
	21	Summerfield Crossing [c]	Post Construction (year 1 of 5)	No - Required but not sampled	Yes - Automated; 2 structures	No
	22	Tapestry	Pre-construction; on hold	Yes - Automated	Yes - Automated	No
	23	Timbercreek	Completed (2008)	No	No	No
	24	Woodcrest	During Construction	Yes-Grab&Auto *	Yes - Automated	No

Paint Branch	25	Anselmo Property	Pre-construction - Baseline anticipated	Yes - Automated	Yes - ESD	TBD
	26	Briarcliff Manor West	Complete (2006)	No	No	No
	27	Briarcliff Meadows North & South	Post Construction (year 2)	No	Yes - Automated; 2 structures	No
	28	Briggs Chaney Rd. / US 29 Interchange	Complete (2008)	Yes - Grab; outfall only	Yes - Grab; outfall only	No
	29	Cloverly Safeway	Complete (2008)	No	Yes - Automated	No
	30	Edgewood Inn	Pre-construction - baseline	TBD	Yes - ESD	Porous Pavement - Method TBD
	31	Fairland Community Center	Complete (2003)	No	No	No
	32	Fairland Gardens	Complete (2000)	No	No	No
	33	**Forest Ridge** [d]	**Complete (2010)**	Yes - Grab	No	No
	34	Hunt Lions Den	Complete (2009)	No	No	No
	35	Maydale Stream Restoration	Post Restoration (year 1 of 5)	No	No - n/a	No - n/a
	36	Paint Branch High School	During Construction	Yes	Yes - 1 structure	No
	37	Parr's Ridge [e]	Complete (2005)	No	No	No
	38	Snider's Estates	Complete (2008)	Yes - Grab	Yes - Flow only	No
Piney Branch	39	Boverman	Complete (2004)	No	No	No
	40	Bruck	Complete (2003)	No	No	No
	41	Cavanaugh	Complete (2003)	No	No	No
	42	Peters Property	Complete (2004)	No	No	No
	43	Shady Grove Rd.	Complete (2002)	No	No	No
	44	Snider Property	Complete (2005)	No – stream chem. below outfall	No – stream chem. below outfall	No
	45	Travilah Fire Station	No pre-construction requirement; awaiting groundbreak	TBD	Yes - ESD	Yes - TBD
	46	Traville	Post Construction (Year 1 of 5)	Yes - Grab	Yes - Automated; 2 structures	No
	47	Traville - Human Genome Sciences	Post Construction (Year 1)	Yes - Grab	Yes - Infiltration only	No
	47	Willow Oaks	Complete (2008)	No - Requirement dropped	Yes - Automated	No
Upper Rock Creek	48	Laytonia Recreational Park	Pre-construction - baseline	Yes - Automated	Yes - ESD	Artificial Turf Athletic Field - Method TBD
	49	Montgomery County Animal Shelter	No pre-construction requirement; awaiting groundbreak	Yes - Automated	Yes - ESD	Yes - TBD
	50	Preserve at Rock Creek [f]	Pre-construction; groundbreak anticipated in 2011	No	Yes - Automated; 2 structures	No
	51	Reserve at Fair Hill [g]	During Construction	No	Yes - Automated; 3 structures	No

[a] Gallery Park was formerly known as Eastside.
[b] Martens Property is divided into two phases, which are now called Glen at Hurley Ridge (Phase I) and the Meadows at Hurley Ridge (Phase II).
[c] Summerfield Crossing is also referred to as Lithicum Property.
[d] Forest Ridge is also known as Hunt Miles Tract or Fairland Farms
[e] Parr's Ridge was previously known as Drayton Farms
[f] The Preserve at Rock Creek was previously known as the Casey Property @ Bowie Mill.
[g] The Reserve at Fair Hill was previously known as the Freeman Property.
* Automated (flow-weighted composite) sampling required, but some grab samples have been obtained instead.
** The permits for Running Brook were closed before montioring requirements were fulfilled. No useable SWM BMP sampling data were produced.
° Some additional sample collection required due incomplete montioring requirements.
† Final year of post-construction monitoring pending submission of data, final report, and DEP/DPS approval.

Table TA-3.1. (continued). 2010 SPA projects with monitoring requirements. Numbers beneath headings indicate the number of stations monitored for the specified parameter.

SPA	No.	Project Name	Other Monitoring Requirements												
			GW[a] Lvl.	GW Chem	Stream WQ[b]	Cont-inuous Flow	Discrete Stream Flow	Peak Stream Flow	Cross-Sections	Embedded-ness	Stream Profile	Temperature	Photo	Rain	Wetland Assess-ment
Clarksburg	1	All Souls Cemetery							2			1			
	2	Cabin Branch	5	5	1				10			2			
	3	Catawba Manor	1												
	4	Clarksburg Detention Center (Jail)	3	3		1						1		1	
	5	**Clarksburg Ridge**													
	6	Clarksburg Town Center			3	1						3		1	
	7	Clarksburg Village (w/Greenway Trail)	18	6	1	1	6		10	6		7		1	
	8	Gallery Park	1						3		1		1	1	
	9	Garnkirk Farms	2												
	10	Gateway 270										4			
	11	Gateway 270 Lot 7											1		
	12	Gateway 270 West													
	13	Gateway Commons	3			1			3					1	
	14	Glen and Meadows at Hurley Ridge	4									2			
	15	Goddard School	2	2											
	16	Greenway Village - Phases I-II	7		1	1	4		4	4		1			
		Greenway Village - Phases III-V													
	17	Highlands at Clarksburg	5							1		2	1		
	18	Parkside	3									1	1		
	19	Running Brook Acres								1					
	20	Stringtown Road Extension													
	21	Summerfield Crossing	5		1		1			2		5			
	22	Tapestry	2						3						
	23	Timbercreek	2									2			
	24	Woodcrest	4	4											

Upper Paint Branch	25	Anselmo Property	4	4				1	3	3	1	4	1	1	1
	26	Briarcliff Manor West	1			1			1	2		3			
	27	Briarcliff Meadows North & South	4	4											
	28	Briggs Chaney Rd. / US 29 Interchange													
	29	Cloverly Safeway										1			
	30	Edgewood Inn	1	1										1	
	31	Fairland Community Center	2									3	1		
	32	Fairland Gardens				1									
	33	Forest Ridge	4						3	1		5	1	1	
	34	Hunt Lions Den	3						5	1		2			
	35	Maydale Stream Restoration													2
	36	Paint Branch High School	~~1~~	~~1~~										1	
	37	Parr's Ridge	1												
	38	Snider's Estates													
Piney Branch	39	Boverman	1	1						1		1			
	40	Bruck								1		2			
	41	Cavanaugh	2							1		3			
	42	Peters Property				1				2		2	1		
	43	Shady Grove Rd.								4					
	44	Snider Property			1								1		
	45	Travilah Fire Station													
	46	Traville	3		1	1			4	1		2			
	47	Traville - Human Genome Sciences													
	48	Willow Oaks													
Upper Rock Creek	49	Laytonia Recreational Park	5	5									1	1	
	50	Montgomery County Animal Shelter													
	51	Preserve at Rock Creek	4	4					3		3				
	52	Reserve at Fair Hill	4	4				1	2		2			1	

[a] GW = Groundwater
[b] WQ = Water Quality; also known as "instream chemistry" or "surface water chemistry". Generally monitored baseline and post construction.

Table TA-3.2. Updates and modifications to SPA BMP project monitoring requirements.

SPA	Project	Parameter	Reason	Comment
Clarksburg	Catawba Manor	GW Level	Sampling not completed as specified	
Clarksburg	Clarksburg Detention Center	SWM BMP sampling	Discontinued	Requirement dropped
Clarksburg	Clarksburg Town Center	GW Level	Wells were never installed	To pick up additional post-construction monitoring of SWM BMPs
Clarksburg	Summerfield Crossing	S&EC grab sampling	Sampling not completed as specified	To pick up additional post-construction monitoring of SWM BMPs
Clarksburg	Summerfield Crossing	GW Level	Reduction from 5 wells to 3	2 wells abandoned
Paint Branch	Briarcliff Manor West	Continuous flow	Staff plate causing stream bank erosion	Monitoring discontinued; Requirement dropped
Paint Branch	Fairland Elementary School	SWM BMP sampling	SWM configuration change	Monitoring discontinued; Requirement dropped
Paint Branch	Fairland Gardens	Continuous flow	Equipment failure and lack of data	Monitoring discontinued
Paint Branch	Paint Branch High School	GW Level & Chemistry	Did not meet pre-construction requirements	Earth disturbance prior to baseline monitoring completion; S&EC and SWM BMP efficiency sampling in lieu of GW
Piney Branch	Traville	Stream WQ	Sampling not completed as specified	
Piney Branch	Willow Oaks	S&EC grab sampling	Structure deemed unsampleable	Requirement dropped; small property & no alternates available
Upper Rock	Reserve at Fair Hill	Precipitation	Rain gage not installed	Rain gage to be installed; Brookville Weather Station in use temporarily

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TA-3.2 Water Quality Monitoring

Completed projects and monitoring dates

Monitoring dates and requirements for completed projects are provided in Table TA-3.3. Table TA-3.3 is also split into two parts: the first part displays years of monitoring and structural monitoring requirements; the second part lists number of stations monitored for other parameters.

Table TA-3.3. Years of monitoring and data collected for completed SPA projects.

				Structural Monitoring	
SPA	**Project Name**	**Year Monitoring Began**	**Year Monitoring Completed**	**S&EC Structure**	**SWM Structure**
Clarksburg	All Souls Cemetery	2001	2008	No	No
Clarksburg	Catawba Manor	1998	2008	No	No
Clarksburg	Clarksburg Detention Center (Jail)	1997	2003	Yes - Grab	No-requirement dropped
Clarksburg	Clarksburg Ridge	2004	**2010**	Yes - Grab	Yes - Automated
Clarksburg	Gateway 270	1999	2003	No	No
Clarksburg	Gateway 270 Lot 7	2003	2005	No	No
Clarksburg	Gateway 270 West	1999	2003	No	Yes - grab; existing pond outfall
Clarksburg	Timbercreek	2001	2008	No	No
Paint Branch	Briarcliff Manor West /Baldi	1998	2006	No	No
Paint Branch	Briggs Chaney Rd. / US 29 Interchange	2004*	2008	Yes - Grab; outfall only	Yes - Grab; outfall only
Paint Branch	Cloverly Safeway	1998	2008	No	Yes - Automated
Paint Branch	Fairland Community Center	1998	2003	No	No
Paint Branch	Fairland Gardens	1997	2000	No	No
Paint Branch	Forest Ridge	2002	**2010**	Yes - Grab	No
Paint Branch	Hunt Lions Den	2001	2009	No	No

Paint Branch	Parr's Ridge (Drayton Farms)	1997	2005	No	No
Paint Branch	Snider's Estates	2004*	2008	Yes - Grab	Yes - flow only
Piney Branch	Boverman	1998	2004	No	No
Piney Branch	Bruck	1998	2003	No	No
Piney Branch	Cavanaugh	1998	2003	No	No
Piney Branch	Peters Property	1998	2004	No	No
Piney Branch	Shady Grove Rd.	1997	2002	No	No
Piney Branch	Snider Property	2000	2005	Yes - Grab; outfall only	Yes - Grab; outfall only
Piney Branch	Willow Oaks	2005**	2008	No - Requirement Dropped	Yes - Automated

* - Preconstruction monitoring was not required as part of the monitoring plan. The first sample was collected in 2004 as part of during construction monitoring.
** - Preconstruction monitoring was not required as part of the monitoring plan. The requirement to sample TSS during construction was also dropped. The first sample was collected in 2005 as part of post construction monitoring.

Table 3.3. (continued). Years of monitoring and data collected for completed SPA projects. Numbers beneath headings indicate the number of stations monitored for the specified parameter.

		Other Monitoring Requirements										
SPA	**Project Name**	**GW[a] Lvl.**	**GW[a] Chem**	**Stream WQ[b]**	**Discrete Stream Flow**	**Cont-inuous Stream Flow**	**Cross Section**	**Embedded-ness**	**Stream Profile**	**Temp-erature**	**Photo**	**Rain**
Clarksburg	All Souls Cemetery						**2**			**1**		
Clarksburg	Catawba Manor	**1**										
Clarksburg	Clarksburg Detention Center (Jail)	**3**	**3**			**1**				**1**		**1**
Clarksburg	**Clarksburg Ridge**											
Clarksburg	Gateway 270									**4**		
Clarksburg	Gateway 270 Lot 7										**1**	
Clarksburg	Gateway 270 West											
Clarksburg	Timbercreek	**2**								**2**		
Paint Branch	Briarcliff Manor West /Baldi	**1**				**1**	**1**	**2**		**3**		
Paint Branch	Briggs Chaney Rd / US 29 Interchange											
Paint Branch	Cloverly Safeway									**1**		
Paint Branch	Fairland Community Center	**2**								**3**	**1**	
Paint Branch	Fairland Gardens					**1**						

Paint Branch	**Forest Ridge**	**4**					**3**	**1**		**5**	**1**	**1**
Paint Branch	Hunt Lions Den	**3**					**5**	**1**		**2**		
Paint Branch	Parr's Ridge (Drayton Farms)	**1**										
Paint Branch	Snider's Estates											
Piney Branch	Boverman	**1**	**1**					**1**		**1**		
Piney Branch	Bruck							**1**		**2**		
Piney Branch	Cavanaugh	**2**						**1**		**3**		
Piney Branch	Peters Property					**1**		**2**		**2**	**1**	
Piney Branch	Shady Grove Rd.							**4**				
Piney Branch	Snider Property			**1**							**1**	
Piney Branch	Willow Oaks											

[a] GW = Groundwater; [b] WQ = Water Quality; also known as "instream chemistry".

Forest Ridge (Upper Paint Branch SPA)

Forest Ridge is a 48.2 acre residential neighborhood in Burtonsville, Maryland (Upper Paint Branch SPA). The 44 unit single-family home development is located on the southwest side of the intersection of Miles Road and Old Columbia Pike. The site was developed using the cluster method from pasture and contains a tributary of the Right Fork of Paint Branch. Surrounding land use of Forest Ridge includes parkland, forested stream buffer, commercial, and low- and high-density residential subdivisions.

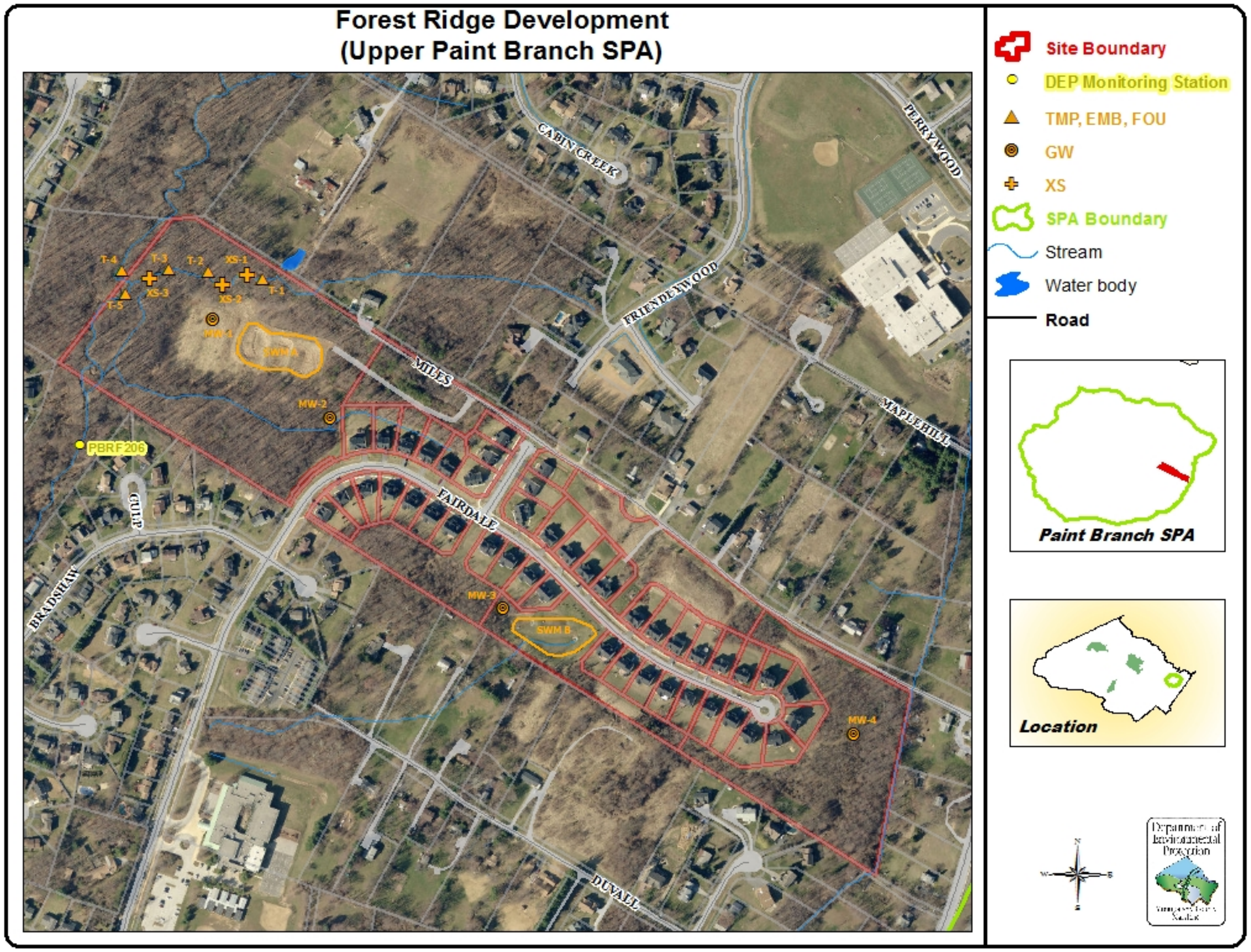
Seven performance goals were established for the development:

1. Protect the streams and aquatic habitat;
2. Minimize storm flow runoff increases;
3. Minimize increases to ambient water temperatures;
4. Minimize sediment loading;
5. Maintain stream base flows;
6. Protect springs and seeps;
7. Minimize pollutant loading (nutrient and toxic substances).

Monitoring of stream temperature, cross sections, embeddedness, and groundwater elevations, as well as photographic documentation, were used to demonstrate achievement of performance goals. Data collection on preconstruction conditions (baseline monitoring) occurred from June 2002 through March 2003. Monitoring of during construction conditions initiated with groundbreak in May 2003 and continued through completion of construction in November 2005. Data on post construction conditions were collected for five years post construction (2006 to 2010). In 2009 and 2010 only cross-section and precipitation data were collected.

A 2010 aerial image of the Forest Ridge development with approximate locations of monitoring stations is provided (Figure TA-3.1). Information on monitoring data and results are discussed in Sections TA-3.2.1 (Temperature), TA-3.2.2 (Embeddedness), TA-3.2.3.(Groundwater Levels) and TA-3.2.7 (cross sections).

Figure TA-3.1. Forest Ridge 2010 aerial and monitoring locations.



TA-3.2.1 Stream Temperature

Stream water temperature is a very important factor in maintaining the biological health of streams. SPA BMP design features that help minimize temperature impacts include: 1) requiring enhanced stream buffers and reforestation, 2) minimizing imperviousness, 3) using dry ponds for runoff quantity control to avoid standing pools that soak up excessive heat, 4) promoting infiltration using roadside swales and other infiltration structures, and 5) using sand filters and biofiltration cells which cool warm water as it filters through sand and soil.

Stream temperature is logged continuously from June 1 through September 30 at a minimum of 24-minute intervals (although smaller intervals may be required at individual projects). Temperature is monitored before development and through the construction and post construction periods to evaluate if BMPs meet performance goals by mitigating thermal impacts (MCDEP 1998).

Monitoring of stream temperature at five stations in Forest Ridge was completed in 2008. Temperature was monitored continuously, in 15 minute intervals, from 2002 to 2008 in the mainstem of the Right Fork of Paint Branch and in an unnamed tributary to the Right Fork of Paint Branch. Data loggers were placed upstream and downstream of a SWM BMP outfall (Fig. TA-3.1; T-1 and T-2, respectively) for a paired study design to evaluate if the BMP was mitigating instream impacts. Another data logger (T-3) was placed downstream of the outfall near the confluence with Right Fork of Paint Branch. Two data loggers were placed in the Right Fork of Paint Branch, one upstream (T-4) and one downstream (T-5) of the confluence with the unnamed tributary. Results of temperature monitoring at Forest Ridge suggest that there were no thermal impacts to the stream associated with the BMP. Temperature data are summarized in Table TA-3.4.

Table TA-3.4. Instream temperature data (15 minute intervals) summary table for Forest Ridge monitoring.

Stream Temperature Statistics 2002 to 2008 June 21 - September 30* (°F)		
Station	**Maximum**	**Median**
T #1 2002 (baseline)	72.22	64.85
T #1 2003	75.16	66.04
T #1 2004	76.16	65.53
T #1 2005	75.03	67.37
T #1 2006	76.72	67.46
T #1 2007	74.55	67.24
T #1 2008	77.20	67.67

T #2 2002 (baseline)	72.35	66.60
T #2 2003**	75.77**	66.86
T #2 2004	74.64	66.47
T #2 2005	81.86	68.27
T #2 2006****	---	---
T #2 2007	76.03	68.44
T #2 2008	75.25	68.01
T #3 2002 (baseline)	72.70	65.92
T #3 2003	72.78	65.79
T #3 2004***	76.90	65.53
T #3 2005	79.79	67.97
T #3 2006	74.81	67.84
T #3 2007	71.88	66.69
T #3 2008	72.46	67.65
T #4 2002 (baseline)	75.07	68.49
T #4 2003	74.55	66.43
T #4 2004	76.20	66.64
T #4 2005	73.91	68.10
T #4 2006	76.69	68.49
T #4 2007	76.16	68.18
T #4 2008	73.60	67.37
T #5 2002 (baseline)	74.12	67.71
T #5 2003	---	---
T #5 2004	76.33	66.73
T #5 2005	75.85	68.31
T #5 2006	76.99	68.79
T #5 2007	71.53	67.20
T #5 2008	73.84	67.65

*Data collected from June 1-20 were excluded from this comparison because the baseline study did not begin until June 20, 2002.

** Data points from September 19-30, 2003 were excluded from this value because the logger was out of the water.
***Logger was buried in sediments from about July 28, 2004 through September 30, 2004; therefore, temperatures recorded by the logger were artificially low.
**** Logger data points from June 28, 2006 to September 30, 2006 were excluded from analysis because the logger was out of the water.

TA-3.2.2 Embeddedness

Embeddedness is monitored to evaluate the amount of sediment covering the stream bottom. SPA BMP monitoring of embeddedness documents existing instream fine sediment loads in riffle habitats and records changes in these fine sediment loads before, during, and after BMP installation. Quarterly data collection is most often required. Monitoring is in accordance with Montgomery County Department of Environmental Protection Protocols (1998).

Fouling, a related parameter, may be monitored concurrently with embeddedness. Fouling is the amount of biological/organic matter covering the area throughout the riffle and resulting in loss of habitat and loss of aquatic life. Fouling was not assessed at the Forest Ridge property.

Embeddedness was monitored quarterly at one station for the Forest Ridge Property, downstream of a BMP outfall (Fig. TA-3.1; T-2). Data were collected from 2001 to 2008. Embeddedness and fouling data are summarized in Tables TA-3.5 and TA-3.6.

Table TA-3.5. Embeddedness Summary Table for Forest Ridge.

Forest Ridge Embeddedness				
Monitoring Period	Date	Percent Embeddedness	Average Embeddedness	Median
Baseline (2002-2003)			75	80
	Jul-02	90		
	Oct-02	80		
	Dec-02	80		
	Mar-03	50		
Construction Year 1 (2003)			64	60
	Apr-03	50		
	Jun-03	50		
	Sep-03	85		
	Dec-03	70		
Construction Year 2 (2004)			53	60
	Apr-04	60		
	Jun-04	60		
	Oct-04	40		
Construction Year 3 (2004-2005)			63	60
	Dec-04	60		
	Mar-05	60		
	Jun-05	70		
	Sep-05	60		

Post Construction Year 1 (2005-2006)			61	60
	Dec-05	60		
	Mar-06	60		
	Jun-06	55		
	Sep-06	70		
Post Construction Year 2 (2006-2007)			69	68
	Dec-06	80		
	Mar-07	60		
	Jun-07	60		
	Sep-07	75		
Post Construction Year 3			55	60
	Dec-07	40		
	Mar-08	60		
	Jun-08	65		
	Sep-08	25		

Table TA-3.6. Embeddedness Statistics for Forest Ridge by Monitoring Period.

Stream Percent Embeddedness Statistics Baseline (2002), Construction (2003-2005) , and Post Construction (2006-2008) Monitoring				
Monitoring Period	**Average**	**Minimum**	**Maximum**	**Median**
Baseline (2002)	75	50	90	80
Construction (2003-2005)	60	40	85	60
Post Construction (2006-2008)	60	25	80	60

TA-3.2.3 Groundwater Levels

Groundwater levels are monitored to determine if there are impacts to groundwater elevations and stream baseflow as a result of the development process. Furthermore, many SPA BMPs are designed to promote infiltration, so groundwater levels are often monitored upstream and downstream of the SWM facility. Discrete or continuous groundwater levels (using a data logger) can be required.

Four groundwater wells were monitored at Forest Ridge. Wells were installed on or before July 9, 2002 to a depth sufficient to observe groundwater. Well #1 is 18 feet deep, Well #2 is 20 feet deep, Well #3 is 40 feet deep, and Well #4 is 28 feet deep. Well #1 and #2 are associated with SWM A, which is located in the northwest portion of the property; Well #1 is downgradient of the outfall, and Well #2 is located upslope. Well #3 is located downgradient of SWM B, in the south central portion of the site. Well #4 is in a forested area in the eastern portion of a property and is not associated with a SWM structure (Fig. TA-3.1; MW-1 thru MW-4).

Groundwater elevations were monitored quarterly from 2002 to 2008 to document seasonal variations in the local groundwater table. Table TA-3.7 provides a summary of groundwater elevation data collected at Forest Ridge from 2002 through 2008.

Table TA-3.7. Groundwater elevation data summary for two monitoring wells at Forest Ridge.

Monitoring Phase	Year	Annual Statistic	Well #1 Elevation (ft)	Well #2 Elevation (ft)	Well #3 Elevation (ft)	Well #4 Elevation (ft)
Baseline	2002	**Mean**	**374.79**	**389.04**	**423.15**	**445.37**
		Maximum	375.50	390.14	423.68	446.07
		Minimum	371.23	388.46	dry	445.25
Construction*	2003	**Mean**	**375.72**	**394.43**	**431.26**	**450.16**
		Maximum	378.20	399.52	439.29	452.13
		Minimum	371.23	390.14	422.62	446.07
	2004	**Mean**	**375.75**	**393.76**	**435.89**	**449.93**
		Maximum	377.78	396.62	437.49	450.90
		Minimum	374.78	393.57	431.54	448.22
	2005	**Mean**	**375.70**	**395.36**	**432.68**	**448.97**
		Maximum	378.08	397.46	434.88	450.29
		Minimum	371.05	394.66	431.39	447.89
Post-Construction**	2006	**Mean**	**373.56**	**396.83**	**430.49**	**448.38**
		Maximum	380.19	397.24	433.90	449.58
		Minimum	370.66	391.62	428.84	447.22
	2007	**Mean**	**375.02**	**393.50**	**430.64**	**448.35**
		Maximum	375.84	398.08	432.90	450.14
		Minimum	373.72	390.43	425.18	445.75
	2008	**Mean**	**375.71**	**392.21**	**428.43**	**447.69**
		Maximum	376.54	394.41	432.13	449.42
		Minimum	374.70	390.74	427.44	447.02

*Mass Grading and basin installation began in May of 2003.
**S&EC converted in October 2005.

TA-3.2.4 Groundwater Chemistry

In addition to affecting surface water, stormwater discharges may affect groundwater quality. The value of stormwater monitoring alone can be limited when assessing compliance with groundwater quality standards since stormwater quality is likely to change substantially while percolating through soils (Geosyntec Consultants and UWRRC 2002). Monitoring of groundwater chemistry in SPAs is often performed quarterly. Values are compared to Maryland water quality standards where values exist.

Two projects completed monitoring prior to 2010; there are no technical appendix materials for this section.

TA-3.2.5 Instream Chemistry

There are no technical appendix materials for this section.

TA-3.2.6 Continuous Stream Flow

There are no technical appendix materials for this section.

TA-3.2.7 Cross Sections

Cross sections are used to document changes to the shape and area of the stream channel. Cross sections are installed and measured in accordance with Montgomery County Department of Environmental Protection BMP Monitoring Protocols (1998).

Three cross sections along the unnamed tributary to Right Fork of the Paint Branch (PBRF) were monitored annually at Forest Ridge each spring. The monitored reach of the tributary is located to the northwest of SWM A and flows approximately west. Three cross sections (identified as Cross-sections 1 through 3, moving downstream (west)) were monitored from 2002 through 2010 (Fig. TA-3.2 to Fig. TA-3.4).

Cross-Section #1

Facing Upstream (March 18, 2010)

Facing Downstream (March 18, 2010)

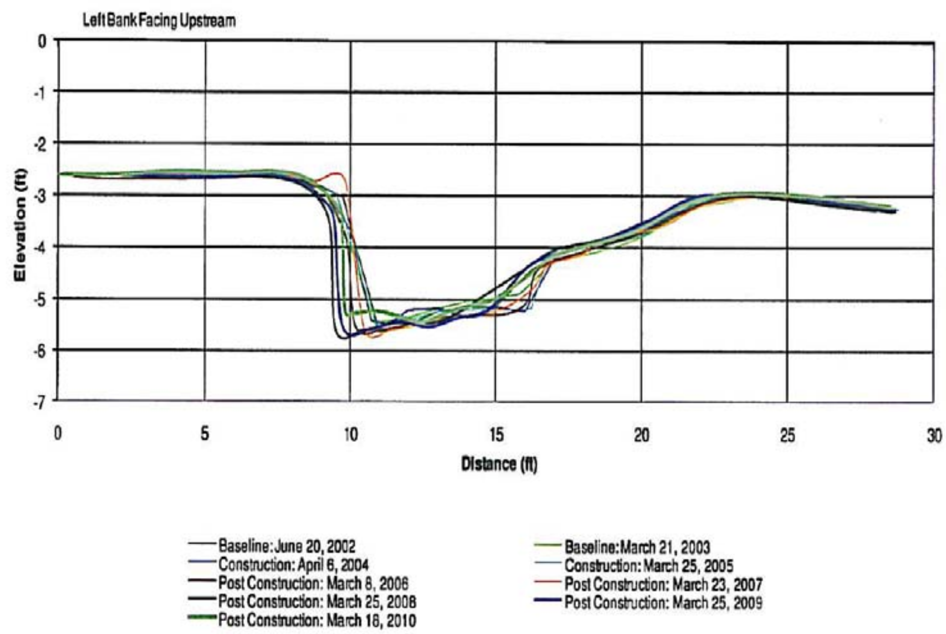


Figure TA-3.2. Forest Ridge Cross Section #1 (ESA 2010). This cross section is the farthest upstream.

Cross-Section #2

Facing Upstream (March 18, 2010)

Facing Downstream (March 18,2010)

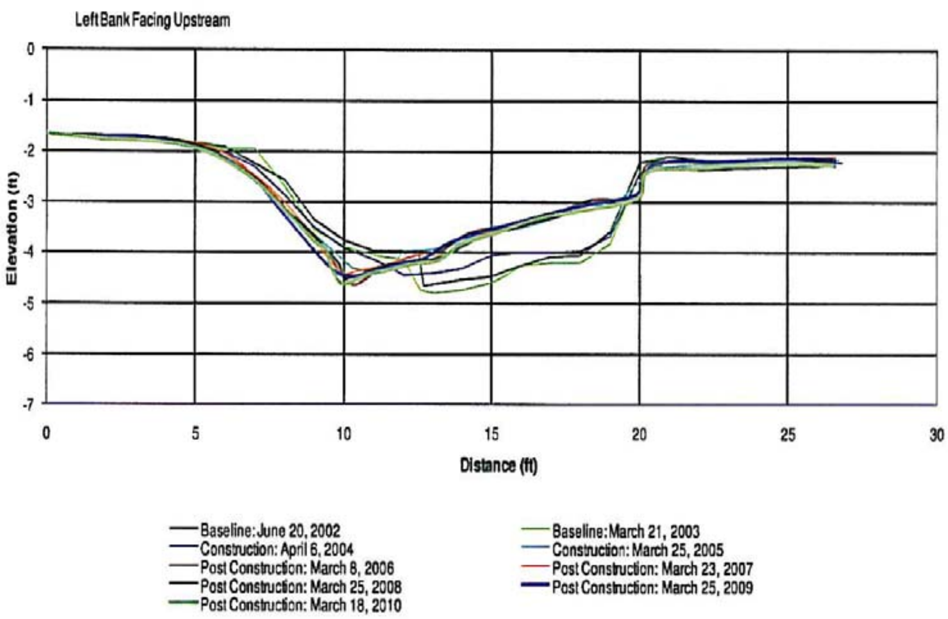


Figure TA-3.3. Forest Ridge Cross Section #2 (ESA 2010).

Cross-Section #3

Facing Upstream (March 18, 2010)

Facing Downstream (March 18, 2010)

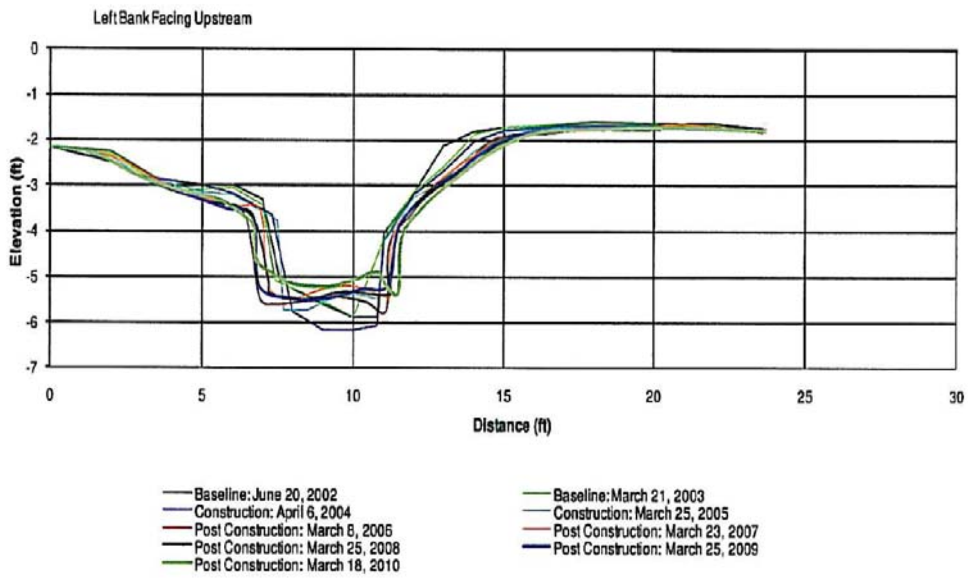


Figure TA-3.4. Forest Ridge Cross Section #3 (ESA 2010).

TA-3.3. Sediment and Erosion Control (S&EC) BMP Monitoring

Evaluation of BMP Efficiency Using Percent Removal

Using percent removal to evaluate BMP efficiency is a controversial topic. Two articles are most helpful regarding the topic: one that presents BMP efficiency in terms of percent removal (CWP 2007) and one that contests its use (Geosyntec Consultants and Wright Water Engineers 2007).

Copies of these documents are available online:

www.stormwater.net – Center for Watershed Protection. 2007. National pollutant removal performance database: version 3. (CWP 2007)

www.bmpdatabase.org – Frequently Asked Questions: Why does the International Stormwater BMP Database Project omit percent removal as a measure of BMP performance? (Geosyntec Consultants and Wright Water Engineers, Inc. 2007.)

Another document consulted when selecting the appropriate method to evaluate BMP efficiency can be located here:

http://www.bmpdatabase.org/docs/Urban%20Stormwater%20BMP%20Performance%20Monitoring.pdf – Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the NationalStormwater BMP Database Requirements (Geosyntec Consultants and UWRRC 2002).

Full citations are provided in the Literature Cited section at the end of this document.

TA-3.3.1. Grab Samples

A total of 129 total suspended solids (TSS) grab samples were collected and considered in efficiency analysis (Table TA-3.8). % Removal Efficiency = ([influent] - [effluent]) / [influent]).

Table TA-3.8. 2010 Total suspended solid (TSS) grab sample data used to calculate median removal efficiency.

SPA	Project and Structure	Project Phase	TSS Sampling Ongoing?	Sample Date	Inlet Conc. (average; (mg/L))	Outfall TSS Conc. (mg/L)	TSS removal efficiency (%)	Rain (in.)	Rainfall Duration (hours)
Clarksburg	Clarksburg Ridge Sed. Trap C	Post	No	4/12/2004	369	81.8	77.83%	1.26	
				7/7/2004	236	23.2	90.17%	1.16	
				8/2/2004	102	30	70.59%	0.04	
	Clarksburg Village - basin 'A'	During	No	4/1/2004	406.67	53.33	86.89%	1.45	
				7/8/2004	72		100.00%	0.61	
				9/9/2004	125		100.00%	0.52	
				9/18/2004	96.67	213.33	-120.68%	1.34	
				2/15/2005	53.33	27.33	48.75%	0.49	
				3/23/2005	357	284.67	20.26%	1.29	
				7/6/2005	95	78.33	17.54%	0.77	
				10/7/2005	25.33	146.67	-479.02%	0.99	
				10/25/2005	2	10	-400.00%	1.09	
				5/11/2006	20	33.33	-66.67%	0.91	
				6/26/2006	2.23	5.8	-160.09%	2.03	
				9/1/2006	3.27	3.17	3.16%	1.41	
				9/5/2006	7.73	18	-132.86%	1.24	
	Clarksburg Village - basin 'B'	During	No	4/1/2004	243	33.33	86.28%	1.45	
				7/8/2004	176	6	96.59%	0.61	
				9/9/2004	21.5	1.5	93.02%	0.52	
				9/18/2004	131.3333	12.67	90.36%	1.34	
				2/15/2005	28.66667	8.67	69.77%	0.49	
				3/23/2005	58.66667	29.33	50.00%	1.29	
				7/6/2005	222.5	6.67	97.00%	0.77	
				10/7/2005	315.3333			0.99	
				10/25/2005	30.66667	42.67	-39.13%	1.09	
				5/11/2006	93.33333	0	100.00%	0.91	
				6/26/2006	33.78333	3.1	90.82%	2.03	
				9/1/2006	46.91667	0.17	99.64%	1.41	
				9/5/2006	29.88333	8.67	71.00%	1.24	
	Clarksburg Village Basin D	During	Yes	8/21/2007	10.08	7.83	22.35%	0.93	0.95
				9/11/2007	4.34			0.36	1.98
				9/28/2007	3.13	4	-27.80%	0.6	5.08
				11/27/2007	5.87	7.9	-34.66%	0.56	6

				4/22/2008	32.25	43.33	-34.37%	0.41	5.25
				4/29/2008	5.00	32	-540.19%	0.47	10
				5/9/2008	2.45	1.67	31.96%	0.82	16
				5/16/2008	15.17	12.33	18.69%	0.69	15.75
				4/15/2009	1.95	15.93	-716.92%	0.19	
				4/21/2009	2.73	4.17	-52.64%	1.21	
				6/4/2009	11.37	10.81	4.88%	0.73	
				10/15/2009		NS		0.7	
				7/14/2010	135.5	72.67	46.37%	0.93	
				8/12/2010	256.25	330.67	-29.00%	1.66	
				8/16/2010	35.72	70.33	-93.88%	0.45	
				9/28/2010	119.08	225.8333	-89.65%	0.42	
	Clarksburg Village Basin F	During	Yes	8/21/2007	68.94	3.00	95.65%	0.93	0.95
				9/11/2007	10.22	6.67	34.78%	0.35	1.98
				9/28/2007	9.69	3.77	61.12%	0.6	5.08
				10/26/2007	184.59	18.23	90.12%	0.83	2
				4/22/2008	178.33	489.67	-174.58%	0.41	5.25
				4/29/2008	291.00	54.67	81.21%	0.47	5
				5/9/2008	179.44	22.33	87.55%	0.82	16
				5/16/2008	139.44	136.00	2.47%	0.69	15.75
				4/15/2009	27.73	11.50	58.52%	0.19	
				4/21/2009	37.15	24.00	35.40%	1.21	
				6/4/2009	33.58	6.90	79.45%	0.73	
				10/15/2009	117.05	13.57	88.45%	0.7	
				7/14/2010	59.83333	23.83333	60.17%	0.93	
				8/12/2010	68.16667	286	-319.60%	1.66	
				8/16/2010	106.9333	25.83333	75.84%	0.45	
				9/28/2010	NS			0.42	
	Glen at Hurley Ridge Basins 1 & 3	During	No	3/18/2004	12.6	4.6	63.49%	0.16	
				6/14/2004	15	4	73.33%	0.83	
				9/29/2004	47.25	156	-230.16%	2.05	
				12/10/2004	10.7	80	-647.66%	0.98	
				2/15/2005	8.4	41	-388.10%	0.47	
				6/23/2005	11.35	4.8	57.71%	0.35	
	Glen at Hurley Ridge Traps B1 & B2	During	No	10/25/2005	207	118	43.00%		
				4/4/2006	1020	NS			
				5/12/2006	94	73	22.34%		
				9/6/2006	54	38.4	28.89%		
				10/18/2006	14.8	8.4	43.24%		
				2/26/2007	274	18.2	93.36%	0.72	
				6/4/2007		27		0.54	
				8/21/2007	6	83	-1283.33%	0.59	
	Greenway Village Sed. Trap #5	During	No	6/29/2005	46.2	30	35.06%	0.57	
				7/8/2005	109.3333 333	150	-37.20%	2.5	

				7/15/2005	30	60	-100.00%	0.68	
				10/8/2005	17.33333	12	30.77%	1.95	
				9/5/2006	8.8	7.8	11.36%	1.4	
				9/14/2006	3.333333	5	-50.00%	0.74	
				10/17/2006	23.83333	46.7	-95.94%	0.88	
	Greenway Village Sed. Trap #7/7A	During	Yes*	8/20/2007	99.5	9	90.95%	1.11	
				10/26/2007	192.6667	46	76.12%	1.57	
	Highlands at Clarksburg - Basin 3	During	No	9/29/2004	104.7	264	-152.23%		
				12/10/2004	203.7	266	-30.61%		
				2/15/2005	32.7	30	8.16%		
				6/23/2005	49.2	11.8	76.02%		
				9/15/2005	65				
				10/25/2005	68.7	83	-20.76%		
				4/4/2006	134	139	-3.73%	0.39	
				5/12/2006	205	106	48.29%	0.91	
				9/6/2006	17.8	96	-439.33%	1.23	
				10/18/2006	9.5	25.2	-164.34%	0.71	
				2/26/2007	27.2	34.2	-25.74%	0.69	
				6/4/2007	3	4	-33.33%	0.54	
				8/21/2007	12.7	4	68.42%	0.59	
				11/16/2007	10.7	1	90.63%	0.57	
				3/5/2008	133.3	28	79.00%		
				4/29/2008	24.3	10	58.90%		
	Parkside Cell #1 & Cell #2	Post	No	9/17/2004	250	330	-32.00%	1.34	
				9/28/2004	170	120	29.41%	1.83	
				6/30/2005	5	5	0.00%	0.58	
				7/15/2005	8	4	50.00%	0.75	
	Running Brook	Post	No	3/26/2002	23	18	21.74%	0.56	
				6/7/2002	58	12	79.31%	0.27	
				10/11/2002	100	104	-4.00%	1.6	
				2/4/2003	520	226	56.54%	0.4	
				5/16/2003	53	410	-673.58%	0.85	
				9/3/2003	8.5	8	5.88%	0.31	
	Woodcrest	During	No	9/5/2006	598	922	-54.18%	1.57	
				9/14/2006	154	254	-64.94%	0.8	
				10/17/2006	222	384	-72.97%	1.1	
				8/20/2007	138	90	34.78%	1.04	
Paint Branch	Forest Ridge Cells #1 & #2	Post	No	9/3/2003	120			0.12	
				9/4/2003	400			0.37	
				9/23/2003	356	80	77.53%	2.14	
				4/1/2004	140	5	96.43%	1.45	
				4/13/2004	60	82	-36.67%	1.37	
				7/8/2004	132	8	93.94%	0.76	
				9/9/2004	136	25.3	81.40%	0.4	
				9/18/2004	230			1.21	

				2/15/2005	6	16	-166.67%	0.5	
				3/23/2005	32	158	-393.75%	2.1	
				7/8/2005	12	102	-750.00%	2.92	
Piney Branch	Snider Estates	Complete	No	4/12/2004	100	46	54.00%	1.25	22.75
				4/23/2004	53	13	75.47%	0.71	1.25
				5/18/2004	21	9	57.14%	1	0.75
				7/22/2004	31	7	77.42%	1.43	1.43

* Greenway Village Sediment Traps 5 and 7/7A were required to using flow-weighted composite sampling but grabs were collected instead.
Neg. A negative removal efficiency indicates that more of a pollutant is leaving the system than is entering.

TA-3.3.2. Flow-weighted Composite TSS Sampling

Automated Sampling Results

The characteristics of the basins sampled are provided in Table TA-3.9. All sampling data produced from those basins and used in preparation of Figure 3.10 (in the main document) are provided in Table TA-3.9. Data in Table TA-3.10 are updated in Table TA-3.11 to account for a calculation error made by the monitoring consultant. Incorrect data in Table TA-3.10 are denoted in red.

Table TA-3.9. Sediment and Erosion Control structure information for four sediment basins monitored in Clarksburg and one in Paint Branch.

Project	Structure	Structure Type	Drainage Area (acres)	Capacity (CF)	Oversized?
Clarksburg Town Center	Basin 3	Two forebays & Main Cell	44.5	89,280	
	Forebay F		10.6	45,036	
	Forebay G		16.7	276,085	N/A *
Gateway Commons	Basin 2	Dual Cell	4.6	21,068	Yes
Stringtown Road Extension	Basin 3	Single Bay/Cell	12.9	58,071	Yes
Greenway Village	Basin 7/7A	Forebay + Main Bay (Dual Cell)	32.5	44,447 106,888	N/A *
Paint Branch High School	Basin B-1	Single Bay/Cell	2.4	8,640	N/A *

* - Information not provided

Table TA-3.10. TSS sampling data for three Sediment and Erosion Control structures in Clarksburg (automated sampling) as reported in 2008. Data points affected by a calculation error are denoted in red.

Project and Structure	Structure Type	Sampling locations	Date of Event	Rainfall			TSS loadings (lbs)		TSS Load Removal Efficiency	Discharge (cfs)	
				Amount (in.)	Duration (hrs)	Return interval	Entering (Sum of Inlets)	Out		Inflow (combined inlets)	Outfall
Clarksburg Town Center - Basin 3 *	Two forebays & Main Cell	4 – 2 in East, 1 in West, 1 Out	4/30/2005	0.82	22.25	< 1 yr	520.7	29.4	94%	65488.4	57292.9
			5/19/2005	1.04	14.15	< 1 yr	366	43.2	88%	43992.0	35813.4
			5/23/2005	0.84	29.25	< 1 yr	146	17.5	88%	57025.0	38853
			5/11/2006	1.76	13	< 1 yr	342.1	196.7	43%	24563.4	66577.8
			6/1/2006	0.45	9	< 1 yr	1180	37.1	97%	64989.2	78096.6
			9/1/2006	1.95	31.58	< 1 yr	3.1	4.4	-44%	114413.1	114048.6
			12/22/2006	1.3	15.67	< 1 yr	108.4	14.3	87%	32710.9	16393.2
			3/15/2007	2.09	47	< 1 yr	87.2	4.3	95%	127003.4	83313.6
Gateway Commons - Basin 2	Dual Cell	3 – 1 inflow, 1 mid, 1 out	4/21/2006	1.11	40.67	< 1 yr	18	n.a **.	100%	127,646.40	n.a **.
			5/11/2006	1.76	13	< 1 yr	10.6	n.a **..	100%	37,628.40	n.a **..
			9/1/2006	1.95	31.58	< 1 yr	0.3	n.a **..	100%	21,450.60	n.a **..
			9/28/2006	0.79	5.5	< 1 yr	2.4	n.a **.	100%	6,084.60	n.a **.
			9/25/2008	1.88	62.25	< 1 yr	38.3	0.5	99%	48,152.40	492.6
			12/16/2008	0.64	19.1	< 1 yr	9.9	0.5	95%	43,015.40	1,002.70
			1/6/2009	1.5	24.92	< 1 yr	42	0.4	99%	83,768.20	906
Stringtown Rd Extension - Basin 3	Single Bay/Cell	2 – 1 in, 1 out	9/1/2006	1.95	31.58	< 1 yr	1.51	N.S.[(b)]	100%	7,852	1,402
			9/28/2006	0.79	5.5	< 1 yr	7.87	N.S.[(b)]	100%	1,612	414
			3/15/2007	2.09	47	< 1 yr	(a)	2.09	(a)	(a)	10,872
			4/11/2007	0.84	7.42	< 1 yr	1.05	0.12	88.80%	2,917	655
			6/28/2007	0.79	0.67	< 1 yr	75.48	0.03	99.96%	3,457	269
			12/2/2007	0.57	8.33	< 1 yr	0.38	0.02	94.50%	1,843	811

* Twelve storms total; only storms with valid flows & calculated loadings considered.
** No outflow
(a) Not calculated due to backwater in Station #1 pipe.
(b) N.S. denotes no samples taken due to low water levels in Station #2 pipe.

Table TA-3.11. TSS sampling data for four Sediment and Erosion Control structures in Clarksburg and one in Paint Branch (automated sampling) sampled through 2010 (with corrected loadings).

Project and Structure	Structure Type	Sampling locations	Date of Event	Rainfall			TSS loadings (lbs) CORRECTED		TSS Load Removal Efficiency	Discharge (cfs)	
				Amount (in.)	Duration (hrs)	Return interval	Entering (Sum of Inlets)	Out		Inflow (combined inlets)	Outfall
Clarksburg Town Center - Basin 3 *	Two forebays & Main Cell	4 – 2 in East, 1 in West, 1Out	4/30/2005	0.82	22.25	< 1 yr	2530.9	143.1	94%	65488.4	57292.9
			5/19/2005	1.04	14.15	< 1 yr	1176.2	210.2	88%	43992	35813.4
			5/23/2005	0.84	29.25	< 1 yr	709.8	84.9	88%	57025	38853
			5/11/2006	1.76	13	< 1 yr	1662.8	956	43%	24563.4	66577.8
			6/1/2006	0.45	9	< 1 yr	5734.1	180.4	97%	64989.2	78096.6
			9/1/2006	1.95	31.58	< 1 yr	14.8	21.4	-44%	114413.1	114048.6
			12/22/2006	1.3	15.67	< 1 yr	526.8	69.6	87%	32710.9	16393.2
			3/15/2007	2.09	47	< 1 yr	424	20.8	95%	127003.4	83313.6
Gateway Commons - Basin 2	Dual Cell	3 – 1 inflow, 1 mid, 1 out	4/21/2006	1.11	40.67	< 1 yr	87.7	n.a **	100%	127,646.40	781.1
			5/11/2006	1.76	13	< 1 yr	51.7	n.a **	100%	37,628.40	115.2
			9/1/2006	1.95	31.58	< 1 yr	1.3	n.a **	100%	21,450.60	3.6
			9/28/2006	0.79	5.5	< 1 yr	11.8	n.a **	100%	6,084.60	56.4
			9/25/2008	1.88	62.25	< 1 yr	128.2	2.5	99%	48,152.40	492.6
			12/16/2008	0.64	19.1	< 1 yr	48.3	2.4	95%	43,015.40	1,002.70
			1/6/2009	1.5	24.92	< 1 yr	69.1	2.1	99%	83,768.20	913.1
			4/14/2009	0.52	48.42	< 1 yr	3.2	n.a **	100%	2869.5	28.4
			5/28/2009	1.12	30.25	< 1 yr	17.7	4.5	75%	12910.2	1233.9
			9/26/2009	1.24	16.5	< 1 yr	8.4	n.a **	100%	9647.6	4.9
			10/14/2009	2.9	88	< 1 yr	33.5	5.7	83%	38336.6	7583.7
			12/2/2009	0.62	21.92	< 1 yr	90.2	12.3	86%	7602.4	1156.5
Stringtown Rd Extension - Basin 3	Single Bay/Cell	2 – 1 in, 1 out	9/1/2006	1.95	31.58	< 1 yr	7.35	N.S.[b]	100%	7,852	1,402
			9/28/2006	0.79	5.5	< 1 yr	38.25	N.S.[b]	100%	1,612	414
			3/15/2007	2.09	47	< 1 yr	N.S.[a]	10.18	(a)	(a)	10,872

			4/11/2007	0.84	7.42	< 1 yr	5.1	0.57	88.80%	2,917	655
			6/28/2007	0.79	0.67	< 1 yr	366.88	0.15	99.96%	3,457	269
			12/2/2007	0.57	8.33	< 1 yr	1.84	0.1	94.50%	1,843	811
Greenway Village – Basin 7/7A	Forebay + Main Bay (Dual Cell)	4 – 2 in, 1 bypass, 1 out	11/15/2007	0.8	8.02	< 1 yr	39.89	11.34	71.57%		
			10/27/2009	1.18	12.75	< 1 yr	423.66	238.08	43.80%		
			9/28/2010	0.93	26	< 1 yr	3.26	9.81	-200.9%		
			10/14/2010	0.86	5.08	< 1 yr	62.78	26.14	58.4%		
Paint Branch High School	Single Bay/Cell	3 – 2 in, 1 out	**9/28/2010**	3.92	43.75	3yr	23.14	7.23	68.8%	1,445	1511
			10/14/2010	3.89	25.16	3yr	5.92	1.46	75.3%	126	651

* Twelve storms total; only storms with valid flows & calculated loadings considered; ** No outflow;
(a) Not calculated due to backwater in Station #1 pipe.; (b) N.S. denotes no samples taken due to low water levels in Station #2 pipe.

Sediment Basin #3 Clarksburg Town Center (Clarksburg SPA)

Monitoring requirements and the dates of monitoring for Clarksburg Town Center are provided in Table TA-3.12. The locations of monitoring stations in Clarksburg Town Center are provided in Fig. TA-3.5.

Table TA-3.12. Clarksburg Town Center monitoring.

Monitoring Requirement	Dates of Construction Monitoring		
	Pre	**During**	**Post** [(a)]
Annual stream water chemistry (baseflow and flow-weighted stormwater samples)	April 1997 – May 1998	5/2/2001 - present	n/a
Continuous flow data and stream stage		10/5/2000 - present	n/a
Instream temperature		9/28/2000 - present	n/a
Embeddedness			n/a
Cross sections		4/2005 - present	n/a
S&EC Basin (TSS)	Not required	1/2005 to present	Not required
SWM BMP Efficiency	Not required	Not required	n/a

(a) - Clarksburg Town Center is still in the construction phase and post-construction monitoring will not begin until S&EC structures are converted, as-builts are approved, and a post-construction stream monitoring bond has been posted.

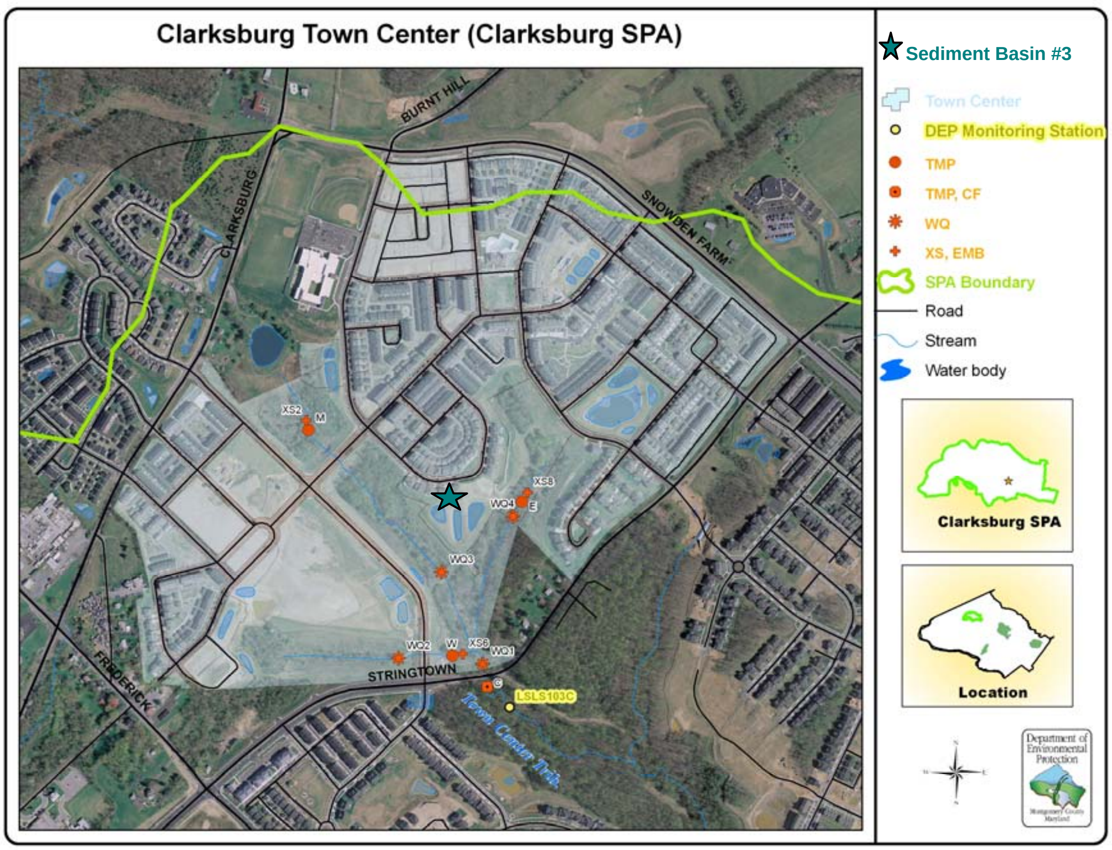


Figure TA-3.5. Clarksburg Town Center 2008 aerial and monitoring locations.

Approximate consultant monitoring stations denoted in orange: TMP = Temperature; TMP, CF = Temperature & Continuous Flow; WQ = Surface Water Quality (stream chemistry); XS, EMB = Cross Section and Embeddedness.

Sediment Basin #3 (Figs. TA-3.6 and TA-3.7) on Burdett Avenue is monitored quarterly for TSS using flow-weighted composite sampling. Complete TSS concentrations (Table TA-3.13) are provided. As stated in the main document, calculated loadings were under-represented due to a calculation error by the monitoring consultant.

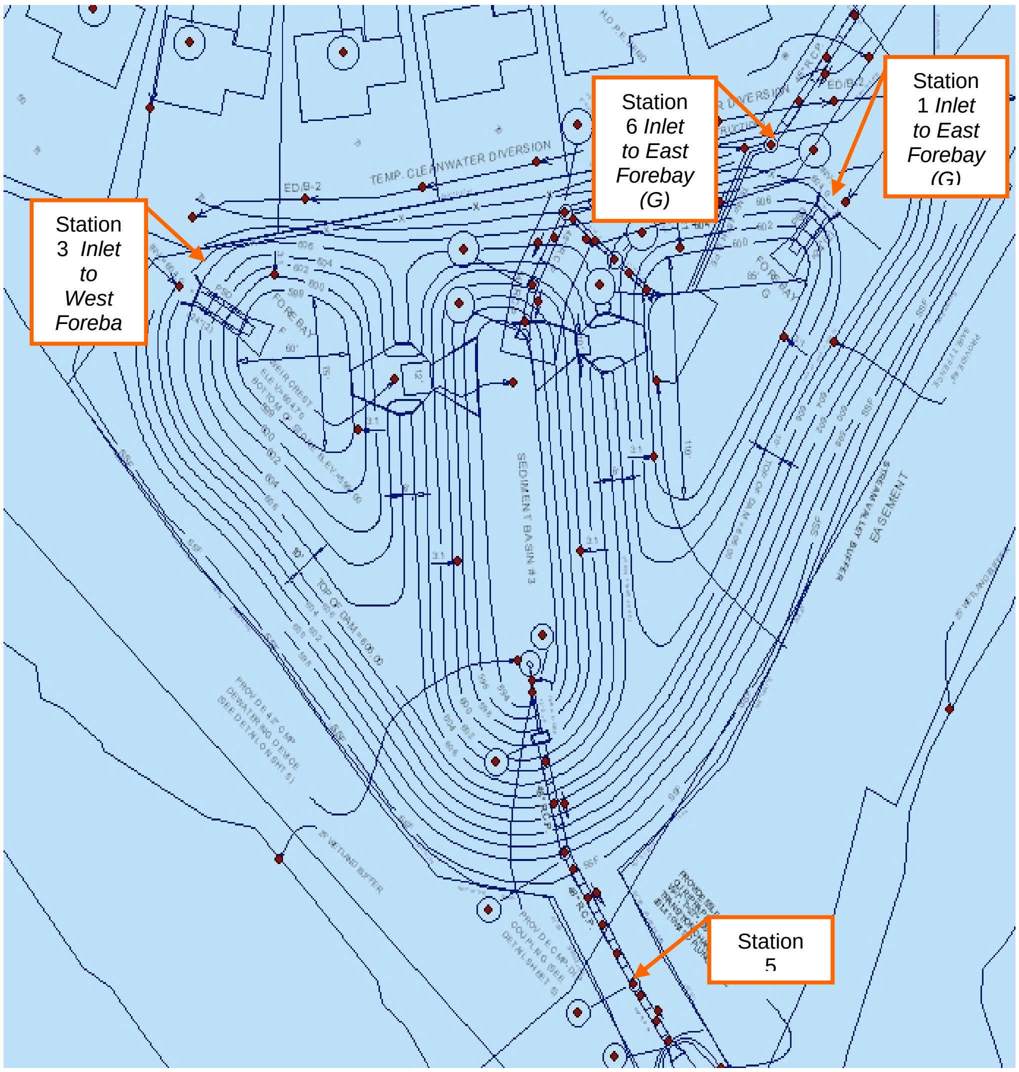


Figure TA-3.6. Plan view of Clarksburg Town Center Sediment Basin #3 (Jones 2007). Final monitoring stations (4) are indicated.

Table TA-3.13. TSS concentration results (mg/L) for flow-weighted composite sampling of Sediment Basin #3 at Clarksburg Town Center.

					TSS Concentration (mg/L)			
					Station 1	Station 3	Station 5	Station 6
Storm Number	Date of Rainfall	Rainfall (inches)	Rainfall Duration (hours)	Rainfall Return Interval	Inlet to East Forebay (Forebay G)	Inlet to West Forebay (Forebay F)	Outfall (initial round of sampling)	48” Concrete Inlet to East Forebay (G)
1	3/23/2005	2.11	14.75	< 1 yr	590	1300	420	*
2	3/27/2005	1.37	26.25	< 1 yr	1600	850	500	*
3	4/1/2005	1.93	26.00	< 1 yr	4,200	4,400	1,100	*
4	4/30/2005	0.82	22.25	< 1 yr	230	140	40	630
5	5/19/2005	1.04	14.15	< 1 yr	240	N.S	94	670
6	5/23/2005	0.84	29.25	< 1 yr	160	N.S.	35	200
7	4/21/2006	1.11	40.67	< 1 yr	200	N.S.	28	40
8	5/11/2006	1.76	13.00	< 1 yr	1800	370	230	610
9	6/1/2006	0.45	9.00	< 1 yr	3000	N.S.	37	1400
10	9/1/2006	1.95	31.58	< 1 yr	12	N.S.	3	2
11	12/22/2006	1.30	15.67	< 1 yr	120	3700	68	74
12	3/15/2007	2.09	47.00	< 1 yr	17	N.S.	4	54

* - An additional inlet to the east forebay (Forebay G) was discovered after the third monitored storm (April 1, 2005)

N.S. denotes no samples taken due to low water levels in pipe.

Clarksburg Town Center: 2009 Additional TSS Study

A station map for the 2009 developer-funded sediment study at Clarksburg Town Center is provided (Fig TA-3.7). This study included two stream sampling points (Route 27 Station and Stringtown Road Station) and three BMP outfall locations (Ponds 1-3).

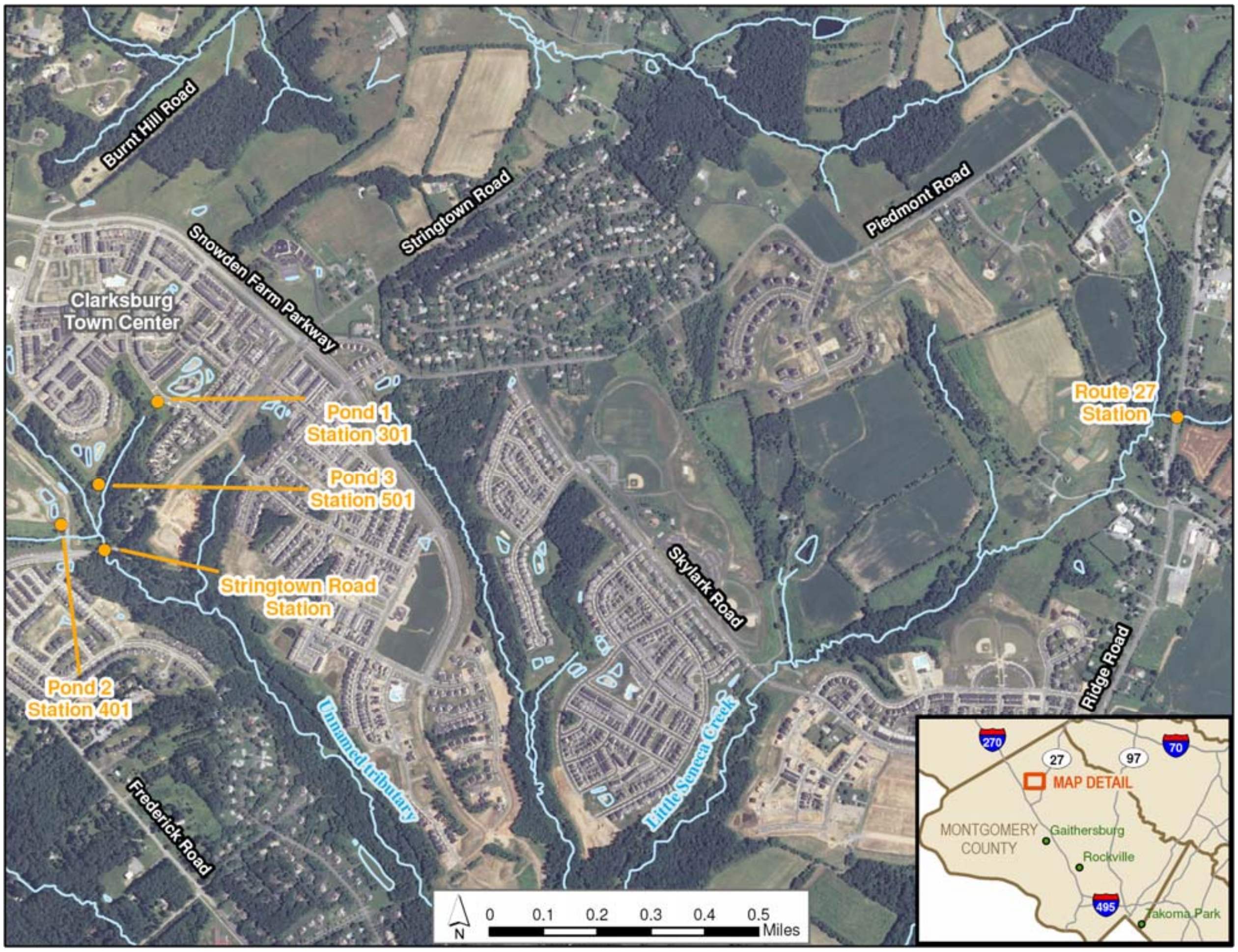


Figure TA-3.7. Clarksburg Town Center 2009 TSS study locations.
(Jones 2010b). Two stream monitoring stations and three pond outfall stations are indicated.

Clarksburg Town Center 2009 Instream TSS Study

Baseflow and storm flow samples were collected from the two stream stations at a frequency of monthly for baseflow and approximately twice per quarter year during storm events. The Stringtown Road Station monitored sediment in the “Town Center Tributary” just downstream of the Clarksburg Town Center Development. The Route 27 station in an unnamed tributary to Little Seneca Creek served as a comparison station with a similar drainage area but no active construction at the time of montioring. Continuous-flow-logging apparatus recorded stream flow rates at both instream stations in order to compute a total annual loading of TSS (Jones 2010b). Table TA-3.14 presents TSS concentration data from stream baseflow sampling.

Table TA-3.14. Instream baseflow results and instantaneous discharge volumes at two stream sampling stations for Clarksburg Town Center 2009 TSS study.

Sampling Event	DATE	Stringtown Road Stream Station		Route 27 Stream Station	
		Discharge Volume (CF)	TSS Concentration (mg/L)	Discharge Volume (CF)	TSS Concentration (mg/L)
1	10/21/2008	0.143	B.D.L	0.116	6
2	11/17/2008	0.199	2	0.214	2
3	12/30/2008	0.414	1	0.34	1
4	1/22/2009	0.176	1	0.337	B.D.L
5	2/26/2009	0.139	B.D.L	0.248	2
6	3/12/2009	0.248	B.D.L	0.268	B.D.L
7	4/24/2009	0.782	1	0.423	2
8	5/22/2009	0.382	B.D.L	0.405	1
9	6/22/2009	0.208	1	0.539	6
10	7/7/2009	0.16	1	0.279	2
11	8/11/2009	0.294	4	0.01	6
12	8/19/2009	0.165	B.D.L	0.243	B.D.L
13	9/14/2009	0.166	B.D.L	0.424	B.D.L
B.D.L – Below detection limit of 1 mg/L TSS concentration.					

A total of eleven storms events were captured and characterized. Only seven of the same events were captured at both stations; ten storms were captured at the Stringtown Road Station and eight storms at the Route 27 instream station. Table TA-3.15 presents the results from stream stormflow TSS sampling. Measurements of TSS concentration for each “limb” (storm portion) were weighted by the limb discharge to obtain the mean concentrations for individual storm events. These Event Mean Concentration (EMC) values were then multiplied by the total storm discharge to obtain the TSS loading for each storm. EMC and loadings were calculated for eleven storm events (Table TA-3.16).

Table TA-3.15. Instream stormflow and discharge results at two stream sampling stations for Clarksburg Town Center 2009 TSS study.

Storm Date	Limb[1]	Stringtown Road Stream Station		Route 27 Stream Station	
		Discharge Volume (CF)	TSS Concentration (mg/L)	Discharge Volume (CF)	TSS Concentration (mg/L)
10/25/2008	Rising	1,672	2	2,552	25
	Peak	38,142	100	15,651	120
	Falling	13,490	2	5,394	4
11/13/2008	Rising	3,319	190	2,796	B.D.L.
	Peak	12,540	31	4,681	10
	Falling	5,025	19	2,833	B.D.L.
1/6/2009	Rising	N.A.		6,444	7
	Peak	N.A.		22,527	20

	Falling	N.A.		16,565	10
2/18/2009	Rising	1,254	B.D.L.	N.A.	
	Peak	1,356	2	N.A.	
	Falling	1,279	1	N.A.	
3/26/2009	Rising	1,168	1	1,639	B.D.L.
	Peak	1,290	B.D.L.	2,148	2
	Falling	1,183	1	1,851	1
4/13/2009	Rising	11,159	1	11,200	B.D.L.
	Peak	24,347	2	14,795	1
	Falling	21,471	2	12,092	1
5/28/2009	Rising	19,118	3	N.A.	
	Peak	39,018	3	N.A.	
	Falling	46,270	2	N.A.	
7/31/2009	Rising	282	350	N.A.	
	Peak	1,676	140	N.A.	
	Falling	3,952	86	N.A.	
8/27/2009	Rising	15,236	3	14,804	2
	Peak	20,536	3	25,597	7
	Falling	15,844	5	14,053	2
9/11/2009	Rising	2,014	1	5,722	1
	Peak	5,335	3	6,785	B.D.L.
	Falling	4,430	2	6,215	B.D.L.
9/26/2009	Rising	3,886	6	5,206	5
	Peak	10,241	5	8,287	5
	Falling	7,782	1	6,088	B.D.L.

[1] – Samples were collected at different times during the storm hydrograph in order to produce data needed for Event Mean Concentration calculation.
B.D.L – Below detection limit of 1 mg/L TSS concentration.
N.A. = Storm results invalidated due to equipment problems.

Table TA-3.16. Event Mean Concentrations (EMC) and calculated loadings for two stream sampling stations for Clarksburg Town Center 2009 TSS study.

	Rainfall Statistics				Stringtown Road			Route 27		
Storm Date	Total (in)	Duration (hours)	Rate (in/hr)	Return Interval (yr)	EMC (mg/L)	Discharge Volume (CF)	TSS Loading (lbs)	EMC (mg/L)	Discharge Volume (CF)	TSS Loading (lbs)
10/25/2008	1.3	38	0.034	< 1	72.1	107,844	486	83.2	33,275	173
11/13/2008	0.65	20	0.033	< 1	53.4	36,377	121	4.5	24,147	7
1/6/2009	0.14	40	0.004	< 1	N.A.			14.5	132,408	120
2/18/2009	0.17	40	0.004	< 1	1	24,375	2	N.A.		
3/26/2009	0.36	30	0.012	< 1	0.6	16,273	1	1.1	20,600	1
4/13/2009	0.53	95	0.006	< 1	1.8	182,529	21	0.7	145,855	6
5/28/2009	0.5	20	0.025	< 1	2.6	225,100	36	N.A.		
7/31/2009	0.47	17	0.028	< 1	113.9	56,911	405	N.A.		

8/27/2009	0.92	50	0.018	< 1	3.6	81,182	4	4.4	60,652	16
9/11/2009	0.57	30	0.019	< 1	2.3	27,291	27	0.3	108,353	2
9/26/2009	0.81	28	0.029	< 1	3.8	114,909	2	3.4	74,597	16
N.A. = Storm results invalidated due to equipment problems. * = Source: National Weather Service 2009.										

Data from Table TA-3.16 were then used to estimate the annual loadings of TSS at each instream station presented in Table 3.6 in the main document. According to Jones (2010b),

> *Annual loadings of TSS at each instream station were estimated by determining the annual, mean, volume-weighted, baseflow concentration and the volume-weighted storm EMC. The storm EMC was determined from composite data for rising, peak, and falling TSS concentration and limb discharge data. The baseflow mean concentration was multiplied by total baseflow for the year as measured by the continuous-flow-logging apparatus in order to obtain baseflow loading. The storm-flow loading was obtained in a similar fashion using total [stormflow] measurements.*

Jones (2010b) also examined statistical significance of the results, finding no significant difference:

> *An ANOVA performed on individual baseflow and storm EMCs and individual baseflow and storm loading data, however, showed no significant differences between the two stations in terms of mean concentrations or loading.*

<u>Clarksburg Town Center 2009 Pond Outfall TSS Study</u>

Monitoring of TSS at the outfall of three BMPs occurred from October 2008 to September 2009. Automated flow-weighted composite storm samples were collected at three pond outfalls. Only storms that yielded more than 0.50 in. of rainfall within a 24-hour period were accepted as valid for the pond outfall monitoring. Eight storm events were captured and analyzed. During storm events, all samplers were deployed and programmed to obtain samples at identical sampling intervals (Jones 2010). All available data were presented in Tables 3.7 and 3.8 in the main document.

Jones (2010b) found no significant difference between study ponds:

> *An ANOVA performed on individual, volume-weighted [same as flow-weighted] storm concentration and loading data at each of the pond outfalls in Clarksburg Town Center showed no significant differences among the three stations in terms of concentration or loading.*

Stringtown Rd. Extension Sediment Basin #3 (Clarksburg SPA)

No monitoring other than TSS during construction and pollutant removal efficiency post construction is required at this property. Aerial images of the site are provided (Figs. TA-3.8 and TA-3.9)

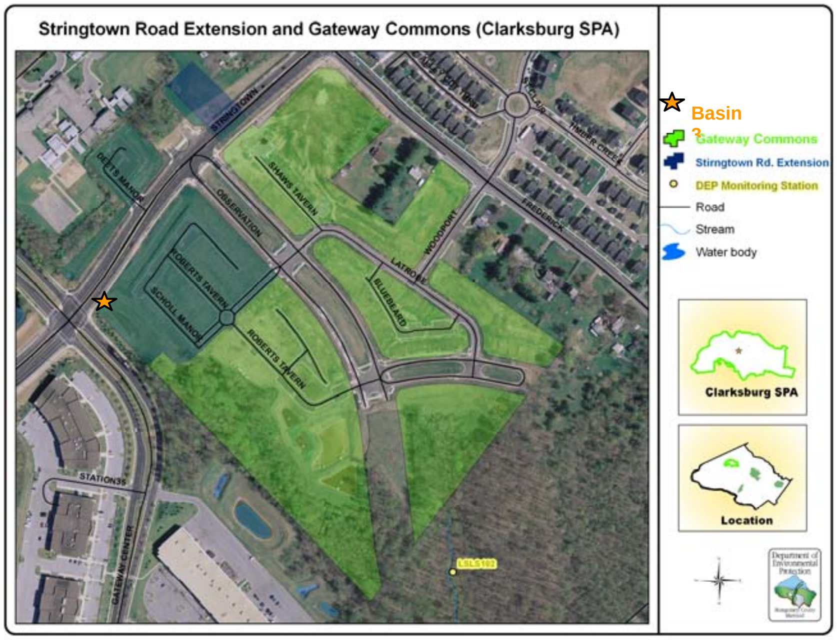


Figure TA-3.8. 2008 aerial image of Stringtown Road Extension and Gateway Commons.

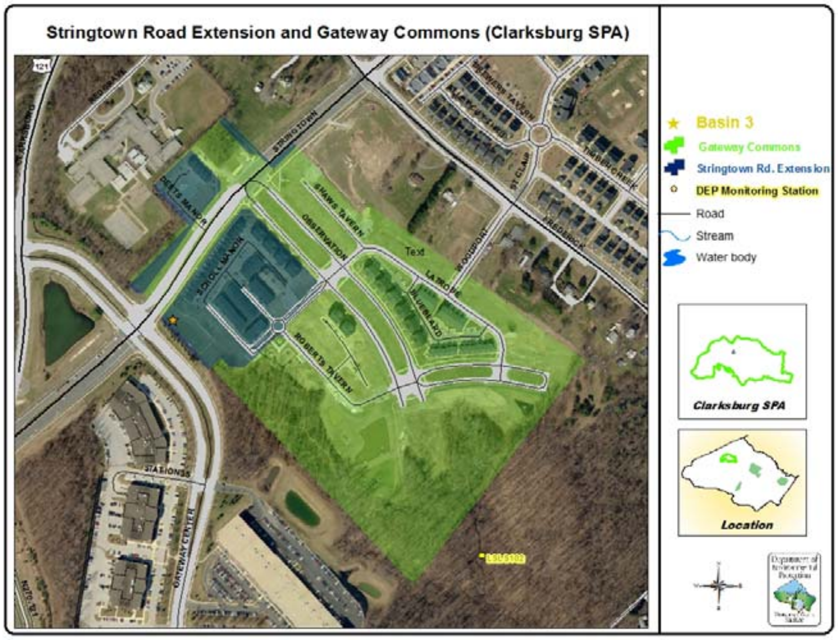


Figure TA-3.9. 2010 aerial image of Stringtown Road Extension and Gateway Commons.

Storm event TSS concentrations and loadings are provided in Table TA-3.17. The site plan and sampling locations for Stringtown Rd. Extension Sediment Basin #3 are provided (Fig. TA-3.10).

TSS sampling at the inlet and the outfall of Sediment Basin #3 took place from September 2006 through December 2007. Construction on the Stringtown Road Extension has been completed since November 2006, but Basin #3 will not be converted to SWM until construction is completed at Gateway Commons since the two properties both drain to this basin.

Table TA-3.17. Total suspended solids monitoring at Stringtown Rd. Extension Sediment Basin #3. Previously reported loadings were affected by a calculation error; corrected and final loading values provided.

	Rainfall			TSS (mg/L)		TSS loading (lbs) (2009 Correction)		TSS Load Reduction	Discharge (CF)	
Date of Event	Total (in.)	Duration (hrs)	Return Interval (yr)	Station #1	Station #2	Station #1	Station #2	Station #1 to Station #2	Station #1	Station #2
9/1/2006	1.95	31.58	< 1	15	N.S.(b)	7.35	N.S.(b)	100%	7,852	1,402
9/28/2006	0.79	5.5	< 1	380	N.S.(b)	38.25	N.S.(b)	100%	1,612	414
3/15/2007	2.09	47	< 1	23	15	(a)	10.18	(a)	(a)	10,872
4/11/2007	0.84	7.42	< 1	28	14	5.10	0.57	88.80%	2,917	655
6/28/2007	0.79	0.67	< 1	1700	9	366.88	0.15	99.96%	3,457	269
12/2/2007	0.57	8.33	< 1	16	2	1.84	0.10	94.50%	1,843	811
mean	1.17	16.75		360	10	83.88	2.75	97%	3536	2404

(a) Not calculated due to backwater in Station #1 pipe

(b) N.S. denotes no samples taken due to low water levels in Station #2 pipe.

According to Jones (2008a):

"A paired Student's t-test on the compiled data from five of the six storms showed that the reduction in loading that occurred between Station #1 and Station #2 was not statistically significant (P=0.30), most likely because of the small number of samples."

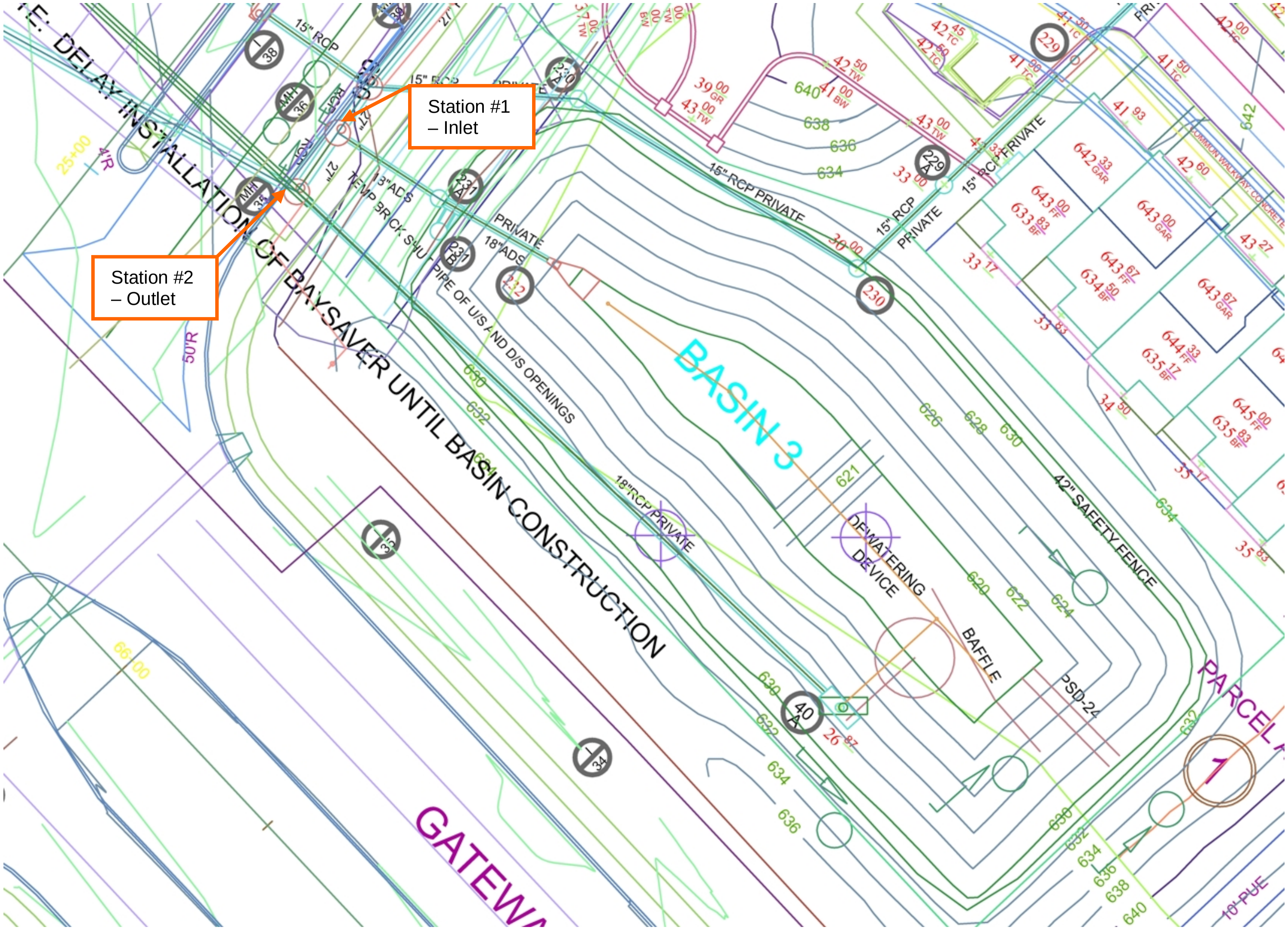


Figure TA-3.10. Plan view and sampling locations of Stringtown Rd. Extension Sediment Basin #3 (Jones 2008a).

Sediment Basin #2 Gateway Commons (Clarksburg SPA)

Monitoring requirements and the dates of monitoring are provided in Table TA-3.18. A site plan with monitoring stations in Gateway Commons provided in Fig. TA-3.11.

Table TA-3.18. Gateway Commons monitoring schedule.

Monitoring Requirement	Monitoring dates [(a)]
Groundwater elevations; year-round	1/30/2003 - present
Cross sections	1/30/2003 - present
Instream temperature	6/1/2003 - present
Continuous flow	2/5/2003 - present
S&EC Basin (TSS); quarterly	10/27/2005 - present; during construction only
SWM BMP Efficiency	n/a; post-construction only

(a) - Gateway Commons is still under construction and post-construction monitoring will not begin until S&EC structures are converted, as-builts are approved, and a post-construction stream monitoring bond has been posted.

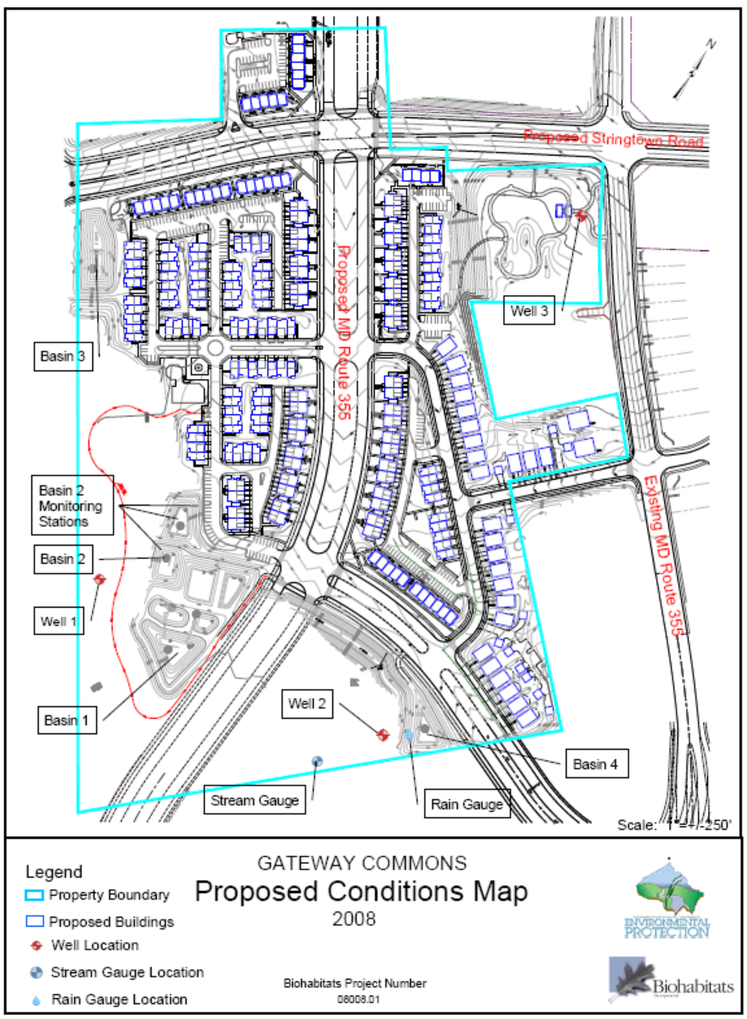


Figure TA-3.11. Gateway Commons site plan (proposed) and monitoring locations (Thompson 2009).

Sediment Basin #2 (Fig. TA-3.12) on Roberts Tavern Drive in Gateway Commons is monitored quarterly for TSS using flow-weighted composite sampling. Monitoring was conducted from April through October 2006. Construction began on February 12, 2005, but monitoring was delayed by the need to finalize the basin configuration and to direct overland flows to the basin. Construction activities ceased in March 2006 while an additional plan was reviewed.

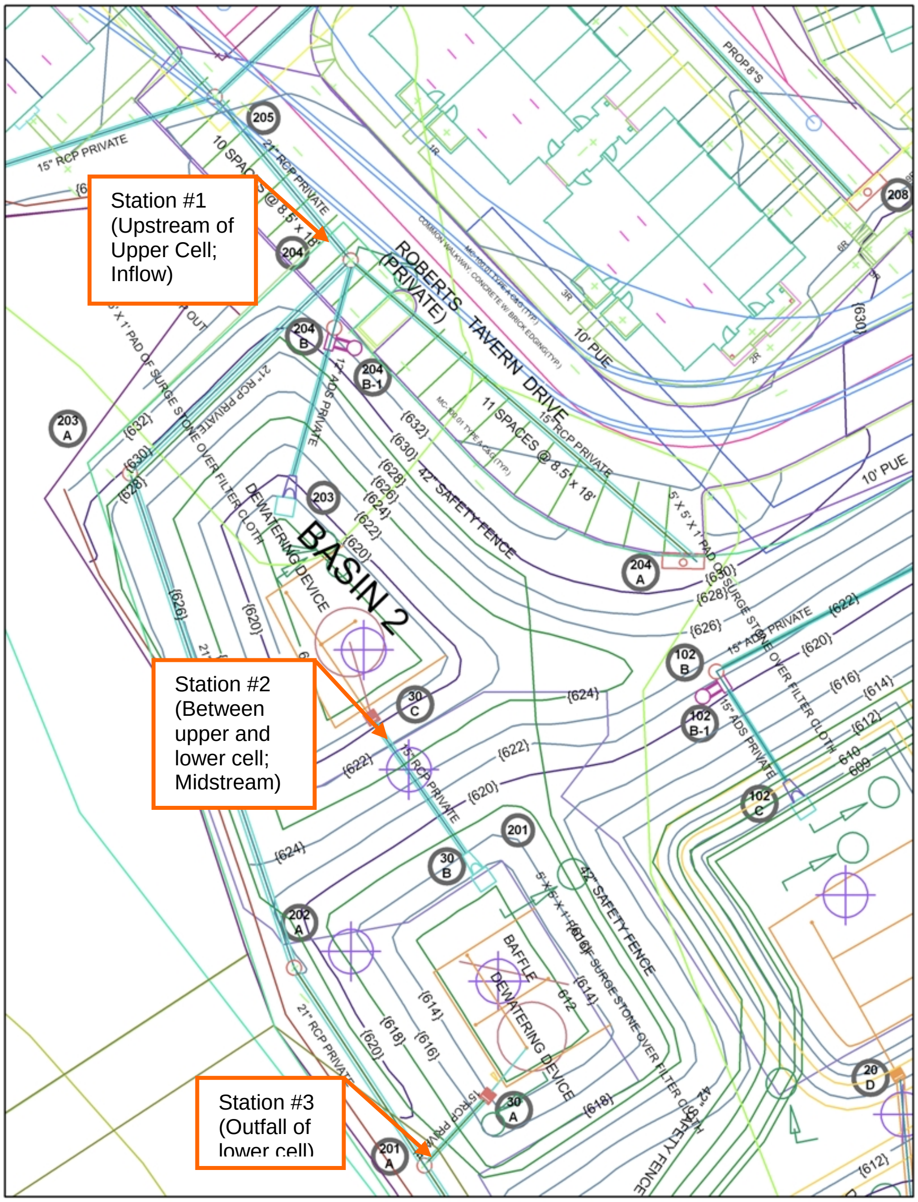


Figure TA-3.12. Plan view and sampling locations of Gateway Commons Sediment Basin #2 (Jones 2010a).

Complete storm event information and TSS concentrations, loadings, and reductions (Table TA-3.19) are provided.

Table TA-3.19. Total suspended solids monitoring at Gateway Commons Sediment Basin #2.
Previously reported loadings were affected by a calculation error; corrected and final loading values provided.

	Rainfall			TSS Concentration (mg/L)			TSS Loading (lbs) (2009 Correction)			TSS Load Reduction		Discharge Volume (CF)		
Date of Event	Amount (in)	Duration (hrs)	Return Interval (yr)	Station #1 [a]	Station #2	Station #3	Station #1	Station #2	Station #3	Station #1 to Station #2	Station #1 to Station #3	Station #1	Station #2	Station #3
4/21/2006	1.11	40.67	< 1	11	57	n.a.	87.7	16.4	n.a.	81%	n.a.	127646.4	4598.4	n.a.
5/11/2006	1.76	13	< 1	22	19	n.a.	51.7	3.9	n.a.	92%	n.a.	37628.4	3286.5	n.a.
9/1/2006	1.95	31.58	< 1	1	n.a.	n.a.	1.3	n.a.	n.a.	100%	n.a.	21450.6	n.a.	n.a.
9/28/2006	0.79	5.5	< 1	31	n.a.	n.a.	11.8	n.a.	n.a.	100%	n.a.	6084.6	n.a.	n.a.
9/25/2008	1.88	62.25	< 1	62	150	80	128.2	48.3	2.5	62%	99%	33122.4	5161.2	492.6
12/16/2008	0.64	19.1	< 1	18	150	38	48.3	108.3	2.4	-273%	95%	43015.4	19251.2	1002.7
1/6/2009	1.50	24.92	< 1	39	34	36	69.1	10.7	2.1	85%	99%	28392.5 [d]	5018.7	906.0
4/4/2009	0.52	48.42	< 1	18	n.a.	n.a	3.2	n.s	n.a	n.a.	n.a.	2869.0	68.5	28.4
5/28/2009	1.12	30.25	< 1	22	34	58	17.7	0.1	4.5	99.6%	75%	12910.2 [d]	36.2	1233.9
9/26/2009	1.24	16.5	< 1	14	n.a	n.a	8.4	n.s	n.a	n.a.	n.a.	9647.6	8.1	4.9
10/14/2009	2.90	88	< 1	14	n.a	12	33.5	n.s	5.7	n.a.	83%	38336.6 [d]	282.1	7583.7
12/2/2009	0.62	21.92	< 1	190	n.a	170	90.2	n.s	12.3	n.a.	86%	7602.4 [d]	82.7	1156.5
mean	1.34	33.51		37	74	66	45.9	31.3	4.9	43% [c]	98%	30725.5	3779.36	1551.1

[a] Station locations provided in figure TA-3.15.

[b] n.a. not applicable (no samples taken due to low water levels in pipe)

[c] TSS load reduction of first cell increases to 93% when storm even on 12/16/2008 is excluded.

[d] Flow value represents calculated adjustments due to backwater conditions.

According to Jones (2010a):

"A paired Student's t-test on the compiled data from twelve storms showed that the reduction in loading that occurred between Station #1 and Station #2 was not statistically significant (P=0.18), probably because of the results of the December 2008 storm. Omitting the results of the December 2008 [event] raises the overall removal efficiency in the upper cell to 93% (P=0.003). When comparing Station #1 to Station #3 loading data, the Student's paired t-test showed a significant (P=0.01) reduction).

Paired Student's T-Test

This statistical analysis is used to compare a set of quantitative data where the data points are related and paired – in this case **loadings in vs loadings out** during the same storm event.

Sediment Trap #7/7A Greenway Village (Clarksburg SPA)

The locations of monitoring stations in Greenway Village are provided in Figs. TA-3.13 and TA-3.14. Monitoring requirements and dates of monitoring are provided in Table TA-3.20.

Table TA-3.20. Greenway Village monitoring schedule.

Monitoring Requirement	Monitoring Dates — Pre	During	Post [a]
Continuous Stream Flow (1; 15 minute intervals)	December 2001 – December 2002	March 2003 – present	Some post construction monitoring data collection is anticipated for 2011 (e.g., SWM BMP removal efficiency for Phase I and II structures)
Cross sections (4)			
Embeddedness (4)			
Groundwater Elevations (7)			
Surface Water Chemistry (1)			
Temperature (1)	June 2002 – September 2002	June 2003 – present	
S&EC Basin (TSS; 2 basins)	Not Required	June 2005 – 2010	
SWM BMP Efficiency	Not Required	Not Required	

(a) – Greenway Village has been developed in phases, with Phases I-II entering the post construction phase in 2010. A bond for each phase was posted in February 2010. Greenway Village Phases III-V remains in the "during construction" phase until sediment basins are converted, as-builts are approved, and the post construction monitoring bonds are posted.

Sediment Basin 7/7A is located in Phases III-V of Greenway Village. A sampling location diagram is provided (Fig. TA-3.14).TSS sampling of this structure is required for this phase group quarterly throughout the construction phase. Automated samplers were deployed in November 2007. Data from four storms were available for analysis. Difficulties in data collection resulted from equipment malfunction, backwatering, high flows that displaced the suction tube, and insufficient water levels.

Sediment Basin 5 was sampled for Phases I-II of Greenway Village for a total of seven storm events, but also had sampling difficulties resulting in a lack of available data. Table TA-3.21 provides a list of sampling dates and why data could not be used.

Table TA-3.21. Greenway Village Sediment Basins 5 and 7/7A Sampling Data Availability.

Structure	Date of Storm Event	Data Valid?	Comments
Trap #7/7A (Phases III-V)	08/20/2007	No	Sample obtained at one inflow sampler (S2) only
	10/26/2007	No	No sample captured at bypass sampler (S4)
	11/15/2007	Yes	-
	05/12/2008	No	Problems with automated samplers, samples composited manually; different sampling method – not directly comparable
	05/20/2008	No	
	10/27/2009	Yes	-
	09/28/2010	Yes	No significant flow at S3
	10/14/2010	Yes	No significant flow at S3
Trap #5 (Phases I-II)	06/29/2005	No	Sample obtained at one inflow sampler only (1 of 4 sampling stations producing TSS concentration and loading informatoin)
	07/07 - 07/08/2005	No	Sample obtained at the outfall sampler only (1 of 4 samplers)
	07/15/2005	No	Sampling attempt, but no samples captured

			(0 of 4 samplers) ; grab samples collected: different sampling method – not directly comparable
	10/08/2005	No	Sample obtained at the outfall sampler only (1 of 4 samplers)
	09/05/2006	No	Sample obtained at one inflow sampler and one outflow sampler only (2 of 4 samplers)
	09/13 - 09/14/2006	No	Sample obtained at one inflow sampler (1 of 4 samplers)
	10/17/2006	No	Sampling attempt, but no samples captured (0 of 4 samplers) ; grab samples collected: different sampling method – not directly comparable

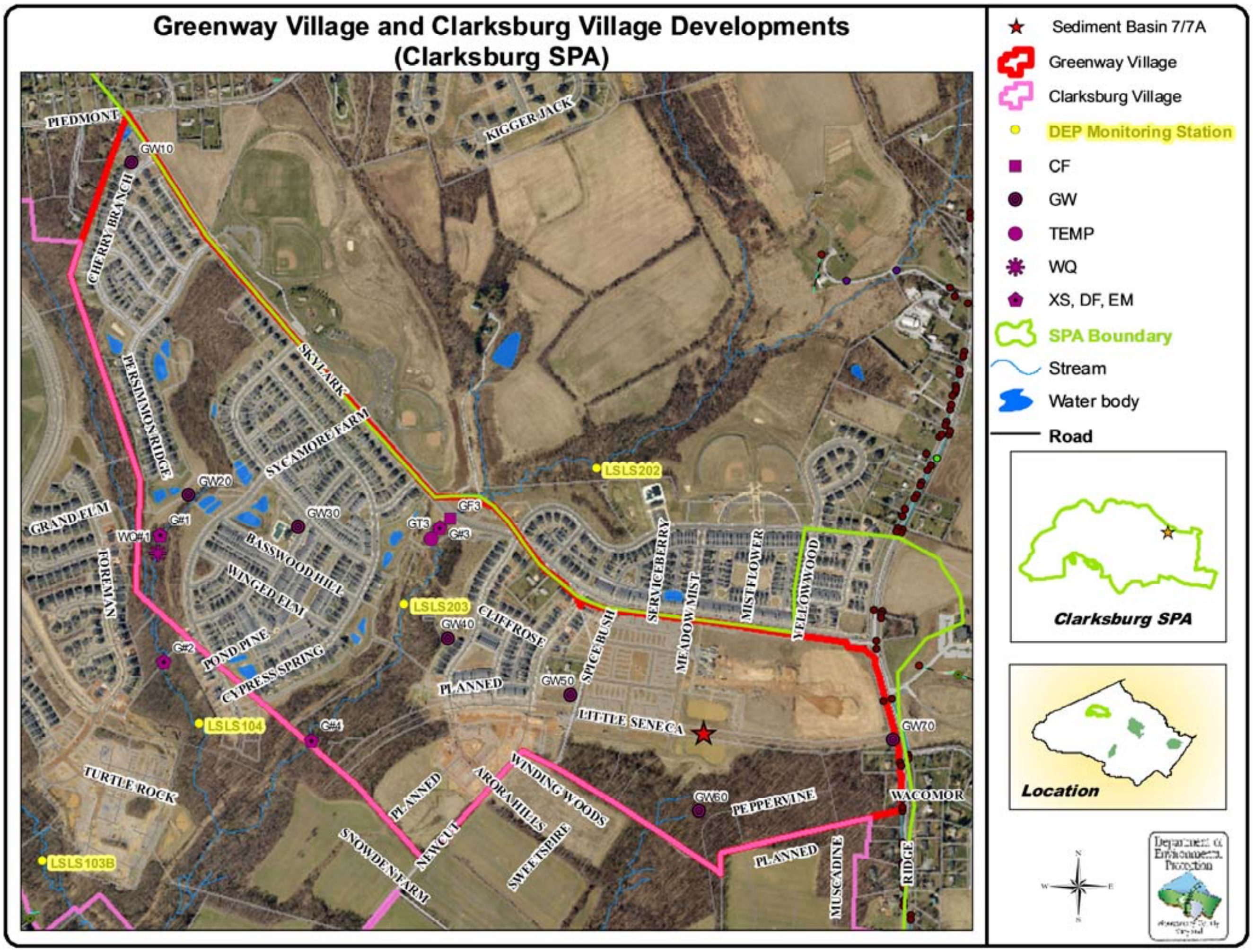


Figure TA-3.13. Greenway Village 2010 aerial and monitoring locations.

Approximate consultant monitoring stations denoted in purple: CF = Continuous Flow; TEMP = Temperature, GW = Groundwater Well, WQ = Surface Water Quality (stream chemistry); XS, DF, EM = Cross Section, Discrete Flow, and Embeddedness.

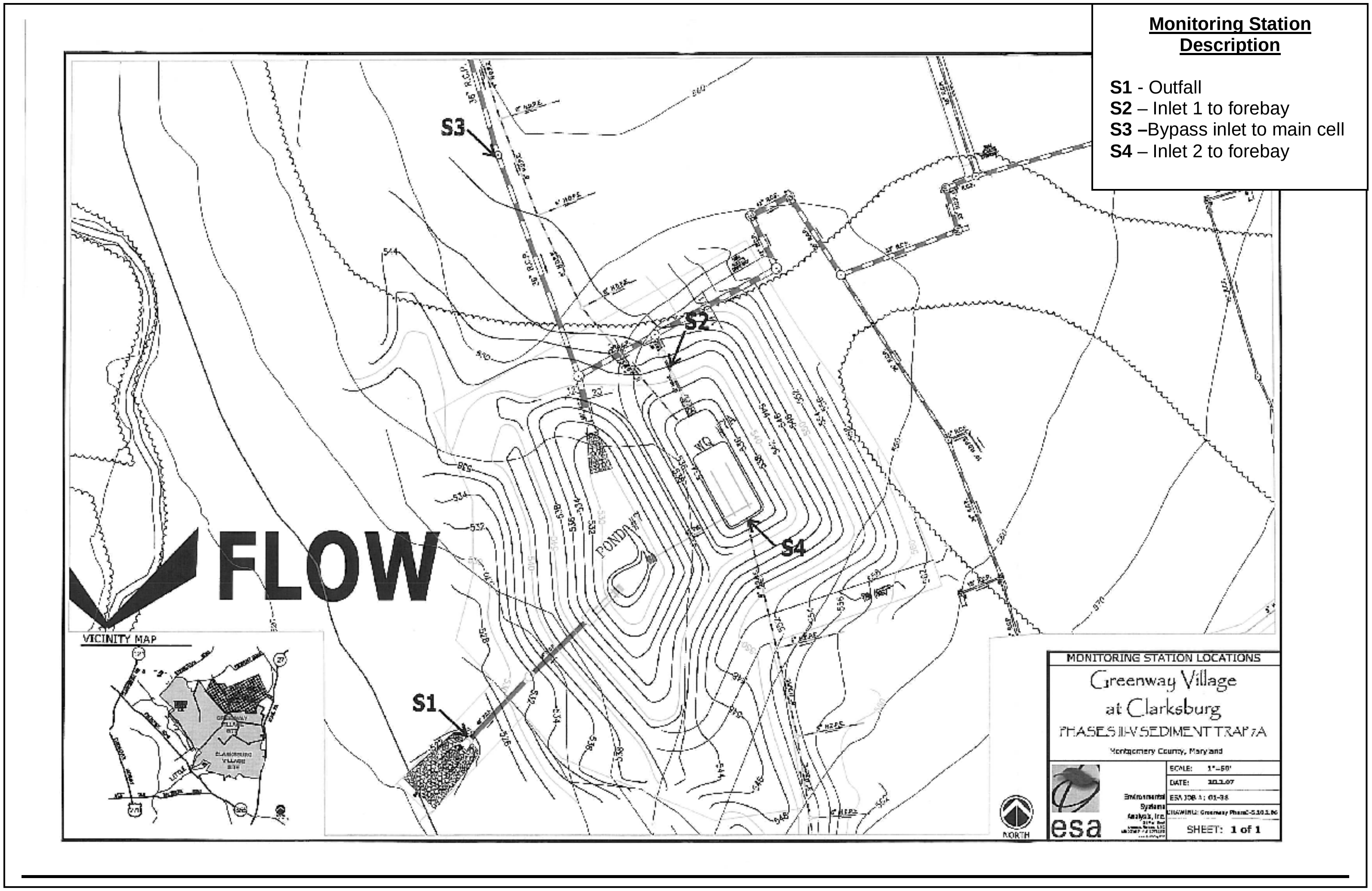


Figure TA-3.14. Plan view and sampling locations of Greenway Village Sediment Basin #7/7A (ESA 2009b)

Paint Branch High School Sediment Basin #2 (Paint Branch SPA)

No monitoring other than TSS during construction and pollutant removal efficiency post construction is required at this property. An aerial image of the site is provided (Fig. TA-3.15).

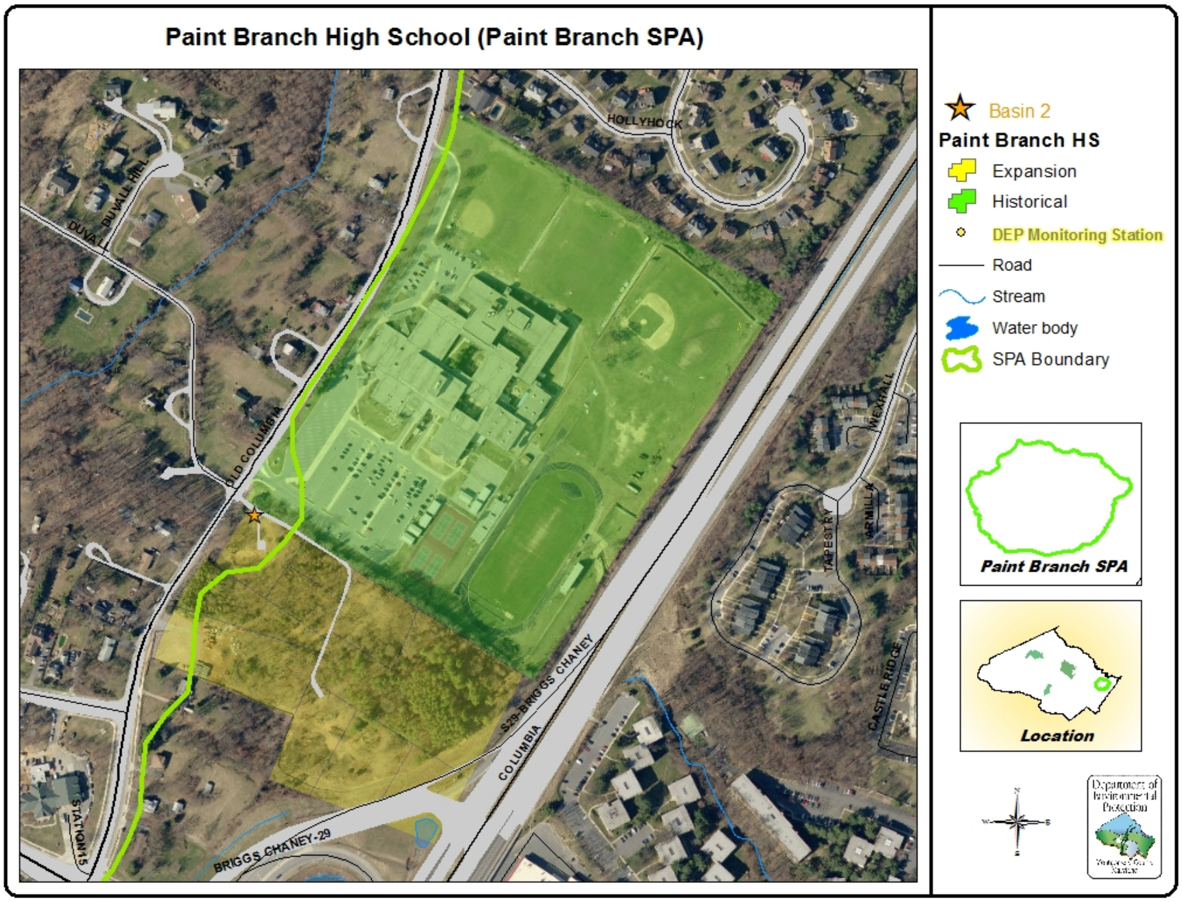


Figure TA-3.2. 2010 aerial image of Paint Branch High School.

Storm event TSS concentrations and loadings are provided in Table TA-3.22. The site plan and sampling locations for Paint Branch High School Sediment Basin #2 are provided (Fig. TA-3.16).

TSS sampling at the inlet and the outfall of Sediment Basin #2 took place from July 2010 through December 2010. Basin #2 is anticipated to be converted to SWM in 2011.

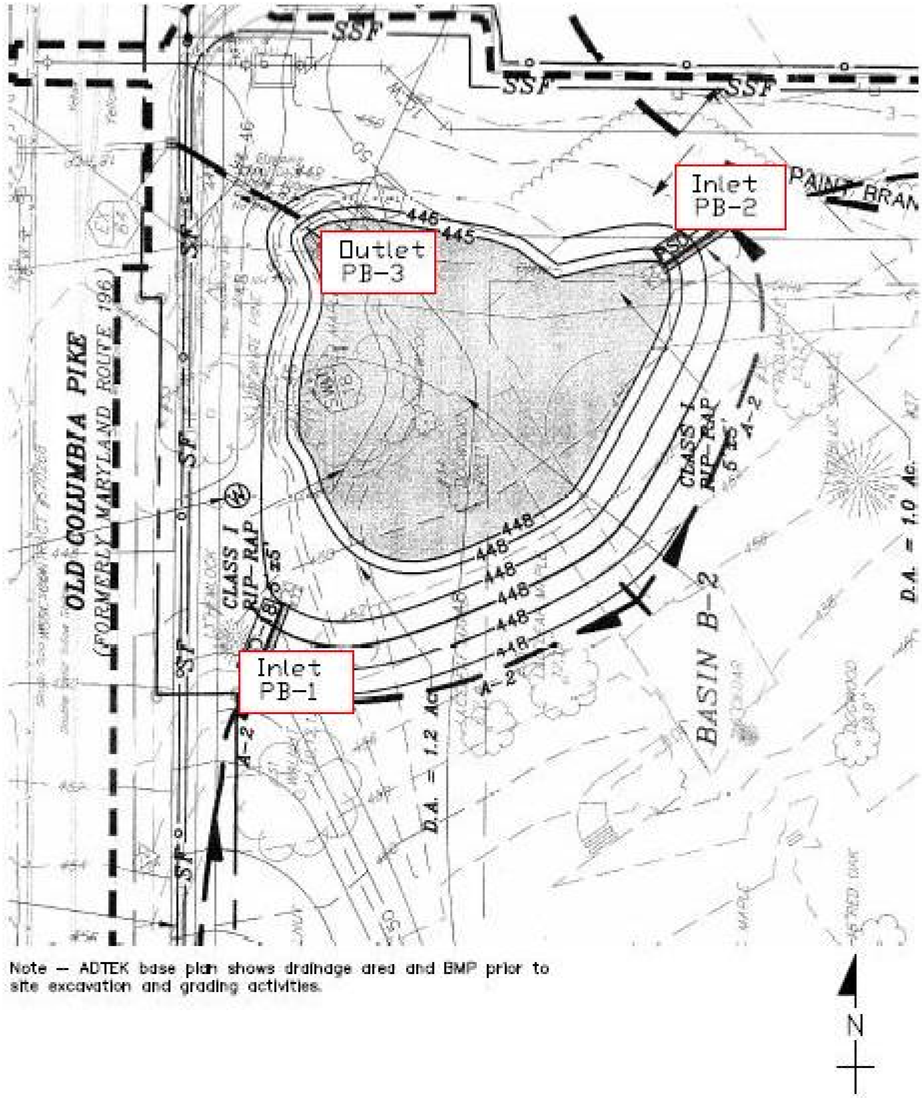


Figure TA-3.16. Plan view and sampling locations of Paint Branch High School Sediment Basin #2 (Schnable 2010).

Table TA-3.22. Total suspended solids monitoring at Paint Branch High School Sediment Basin #2.

Date of Event	Storm Characteristics			Discharge Volume (cf)		TSS Loadings (grams)		TSS Reduction
	Total (in)	Duration (hrs)	Return Interval	Inlets (combined, sum)	Outfall	Inlets	Outfall	
7/12/10	1.87	8.33	< 1 yr	537.0	260.0	4,246.0	339.0	92%
7/13/10	2.05	16.33	< 1 yr	908.0	1,251.0	6248.0	2940.0	53%
10/01/10	3.89	25.16	3.5 yr	126.0	651.0	2,685.0	664.0	75%
					Mean	4,393.0	1314.33	73%

TA-3.4. Stormwater Management (SWM) BMP Monitoring

Stormwater Treatment Trains in SPAs

Various BMPs are combined in series or as part of a treatment train in order to maximize pollutant reduction and improve stormwater treatment performance. Redundant controls (treatment trains) are required for stormwater quality control in SPAs (Fig. TA-3.17).

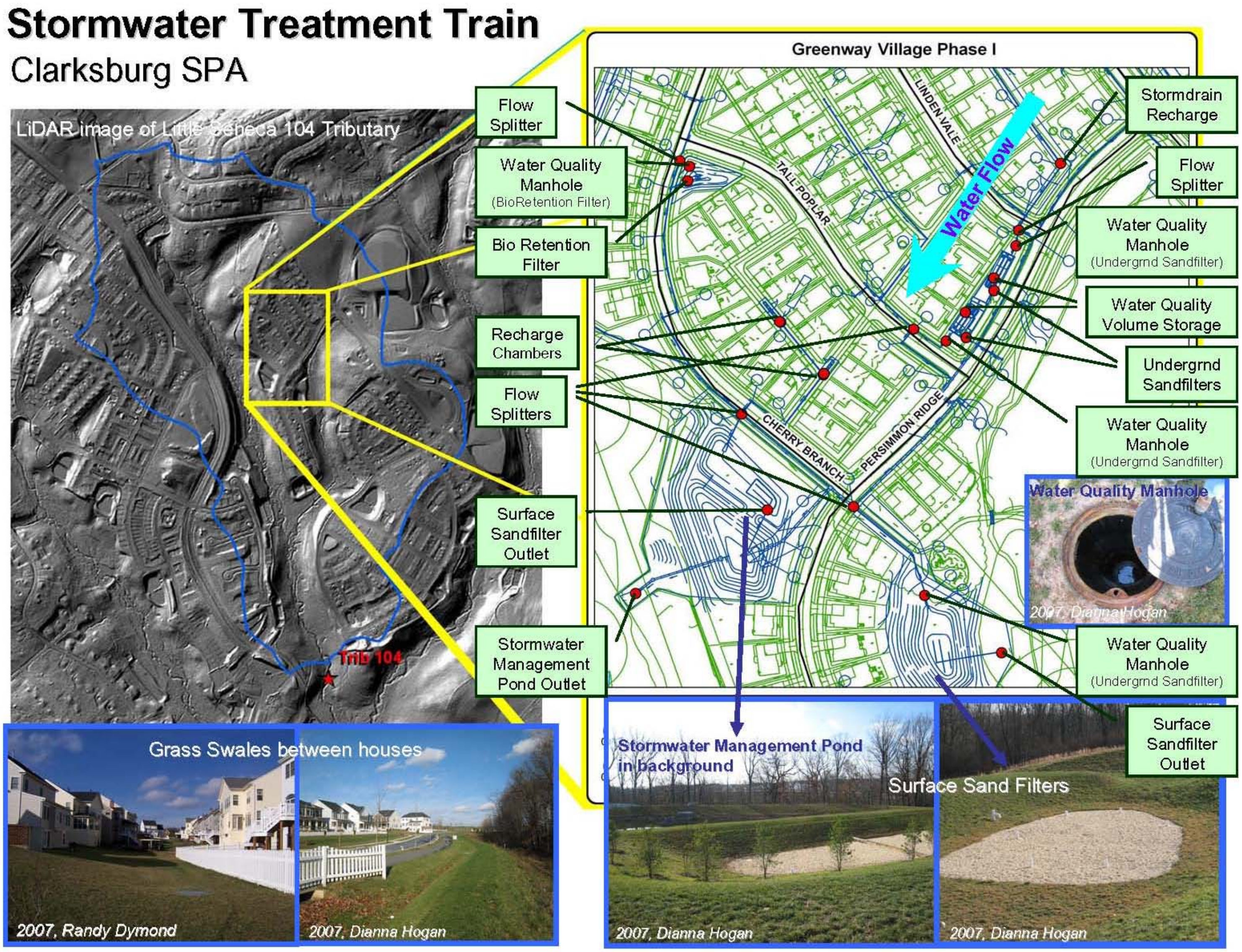


Figure TA-3.17. Enlargement of a section of the 2007 LiDAR image of Greenway Village Development (Newcut Road Neighborhood) showing the redundant water quality and quantity SWM BMPs designed to mitigate imperviousness impacts.

TA-3.4.1 Background on Monitored Technologies

Surface Sand Filter

Montgomery County Sand Filter (MCSF) design details are provided in Figure TA-3.18. Photographs of representative sand filters in Montgomery County Special Protection Areas are also featured (Fig TA-3.19).

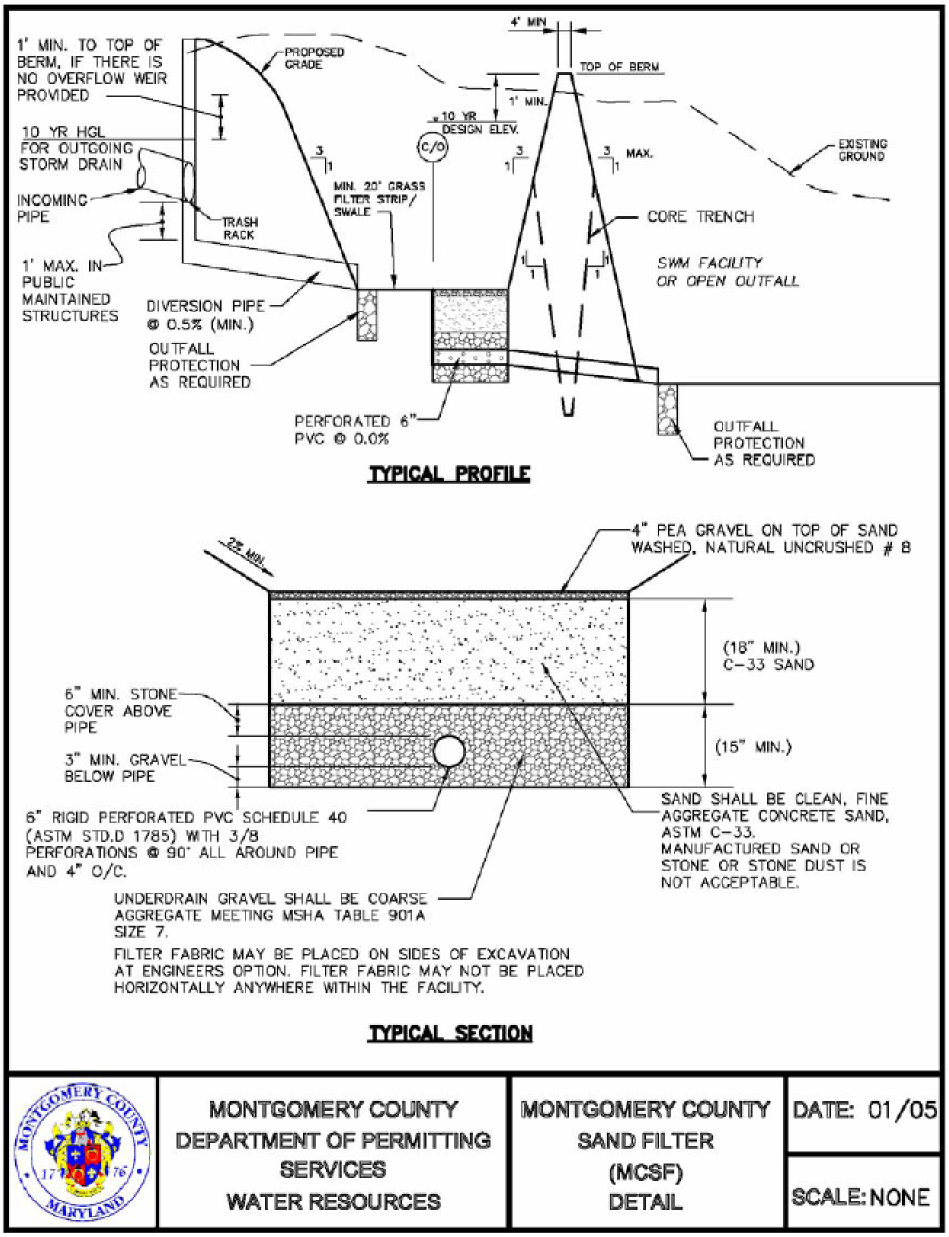


Figure TA-3.18. MCDPS Montgomery County Sand Filter detail diagram.

Figure TA-3.19. Photographs of two sand filters monitored for the Special Protection Area.
Left: Briarcliff Meadows in the Upper Paint Branch SPA; Right: Summerfield Crossing in the Clarksburg SPA.

For more information on surface sand filters, please consult the following suggested materials:

http://permittingservices.montgomerycountymd.gov/permitting/docs/Montgomery%20County%20Sand%20Filter.pdf - Montgomery County Sand Filter (MCDPS 2009)

http://www.epa.gov/owm/mtb/sandfltr.pdf – Fact Sheet Sand Filters (US EPA 1999a)

http://www.epa.gov/nrmrl/pubs/600r04184/600r04184.pdf - The Use of Best Management Practices (BMPs) in Urban Watersheds (US EPA 2004).

http://www.fhwa.dot.gov/environment/ultraurb/3fs8.htm –Fact Sheet – Surface Sand Filters (Shoemaker et al. 2002a)

http://www.metrocouncil.org/environment/Watershed/BMP/CH3_STFiltSurfSand.pdf – Chapter 3: Best Management Practices: Surface Sand Filters (Metropolitan Council & Barr Engineering Co. 2001)

http://www.cwp.org – Articles available for download or purchase, including:

Article 105 - Developments in Sand Filter Technology to Treat Stormwater Runoff. (CWP 2000a)

Article 106 - Further Developments in Sand Filter Technology to Treat Stormwater Runoff (CWP 2000b)

Article 107 - Performance of Delaware Sand Filter Assessed (CWP 2000c)

Article 108 - Field Evaluation of a Stormwater Sand Filter (CWP 2000d)

Full citations are provided in the Literature Cited section at the end of this document.

Biofilters

A diagram featuring components of a typical Montgomery County biofilter design is provided (Fig. TA-3.20). Fig. TA-3.21 features the biofilter monitored at Briarcliff Meadows South.

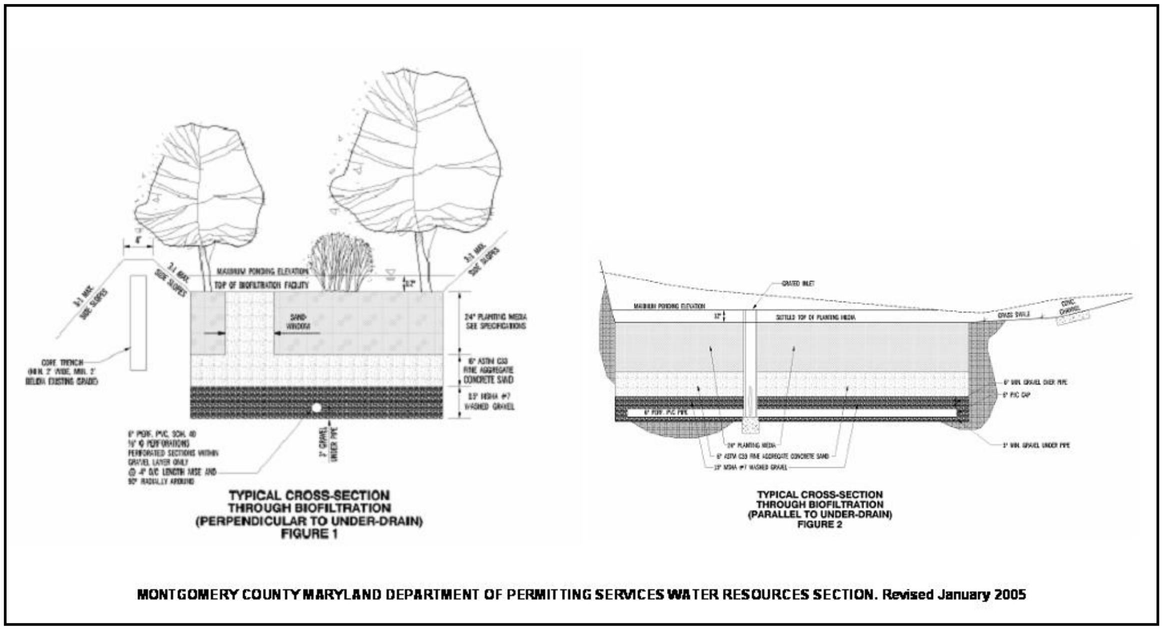


Figure TA-3.20. MC DPS Biofiltration diagram.

Figure TA-3.21. 2008 Photograph of the Briarcliff Meadows South Biofilter.

For more information on biofilters, please consult the following suggested materials:

http://permittingservices.montgomerycountymd.gov/permitting/docs/revBiofiltration.pdf – Montgomery County Biofiltration (BF) (MCDPS 2005)

http://www.co.pg.md.us/Government/AgencyIndex/DER/ESG/Bioretention/pdf/Bioretention%20Manual_2009%20Version.pdf – Prince George's County, MD Department of Environmental Resources (PGDER 2007)

http://www.deq.state.or.us/wq/stormwater/docs/nwr/biofilters.pdf - Biofilters (Bioswales, Vegetative Buffers, & Constructed Wetlands) for Storm Water Discharge Pollution Removal (Juries 2003)

http://www.stormwatercenter.net – Stormwater Fact Sheet: Bioretention (SMRC 2010)

http://www.cwp.org – Articles available for download or purchase, including:

Article 110 – Bioretention as a Water Quality Best Management Practice (Bitters and Bowers 2002)

Full citations are provided in the Literature Cited section at the end of this document.

Stormfilter®

Contech Construction Products, Inc. is a distributor of the Stormfilter® and provides structure guidelines and configurations (Fig TA-3.22). Monitoring of a Stormfilter®, identified as "Underground Filter 1," began in 2009 at the Summerfield Crossing Development in the Clarksburg SPA (Fig TA-3.23).

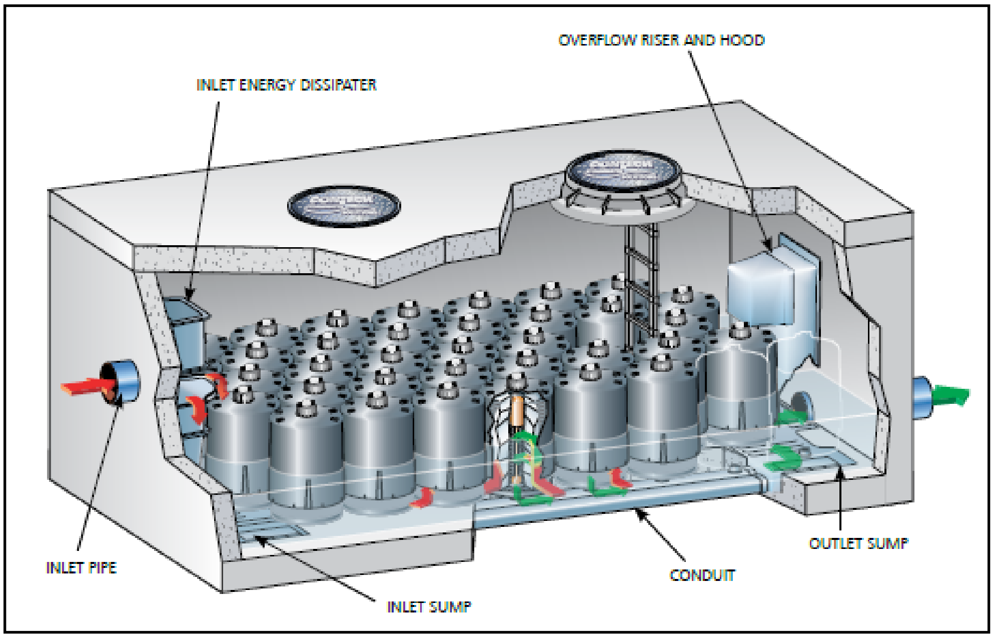


Figure TA-3.22. Basic design and function of "The Stormwater Management Stormfilter®" (Contech 2007).

Figure TA-3.23. Summerfield Crossing Underground Stormfilter 1. Structure is located beneath open space near a playground. (Inset: Cartridge filters in manhole).

For more information on Stormfilters®, please consult the following suggested materials:

http://www.contech-cpi.com/Products/StormwaterManagement/Filtration/StormwaterManagementStormFilter.aspx - Articles available for download, including:

http://www.contechcpi.com/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=2793&PortalId=0&TabId=144 - Contech Construction Products Inc., Filtration Products: The Stormwater Management Stormfilter® (Contech 2007).

http://www.contechcpi.com/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=2802&PortalId=0&TabId=144 - Contech Stormfilter Configuration Guide (Contech 2009).

Performance of the Stormwater Management StormFilter Relative to Ecology Performance Goals for Basic Treatment (Contech 2004).

Product Evaluation: Influence of analytical method, data summarization method, and particle size on total suspended solids (TSS) removal efficiency (Contech 2002).

Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with CSF Leaf Media (Contech 2003).

Evaluation of the Stormwater Management StormFilter® system for the removal of total nitrogen: Kearny Mesa Maintenance Station case study (Contech 2001)

http://www.wateronline.com/product.mvc/The-Stormwater-Management-StormFilter-0001 – Materials on StormFilter Technology available for download(Water Online 2010)

Full citations are provided in the Literature Cited section at the end of this document.

Hydrodynamic Device: BaySeparator™

The BaySeparator is a hydrodynamic device that redirects the flow of water to remove pollutants (Figs TA-3.24 and TA-3.25). It functions as pre-treatment for other SWM BMPs in a treatment train; at Clarksburg Ridge, the BaySeparator serves as pretreatment to two sandfilters and a dry pond (Fig TA-3.26).

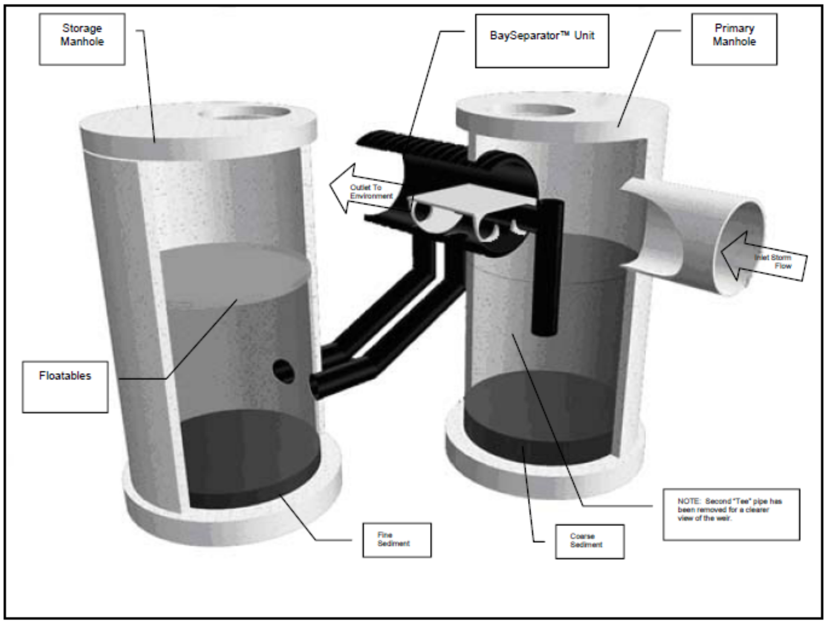


Figure TA-3.24. Basic design and function of the BaySaver BaySeparator (Baysaver Technologies, Inc. 2008).

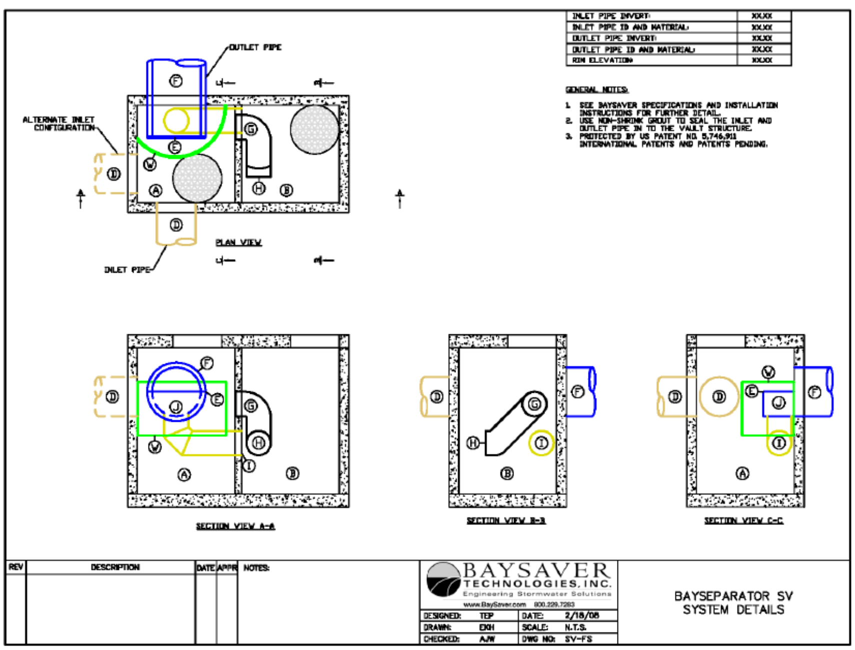


Figure TA-3.25. BaySeparator System Details (Baysaver Technologies, Inc. 2008).

Figure TA-3.26. Clarksburg Ridge BaySeparator. Structure Left: Trash rack inside of BaySeparator storage manhole; Right: SWM BMP treatment train with manhole cover to BaySeparator pulled.

For more information on the BaySeparator, please consult the following suggested materials:

http://www.baysaver.com/downloads/Whitepapers/BaySeparator%20Technical%20and%20Design%20Manual.pdf – BaySeparator Technical and Design Manual (Baysaver Technologies, Inc. 2008)

http://www.baysaver.com/downloads/Whitepapers/MD%20RMHS%20report%2001-07-09.pdf – Efficiency Assessment of BaySeparator and BayFilter Systems in the Richard Montgomery High School (Liu 2009).

http://www.hancor.com/pdf/Hancor_BaySeparator_Brochure_12240609.pdf – Distributor Brochure (Hancor, Inc. 2009).

Full citations are provided in the Literature Cited section at the end of this document.

Hydrodynamic Device: Stormceptor®

A schema of the StormCeptor® Model 1800 is provided (Fig TA-3.27).

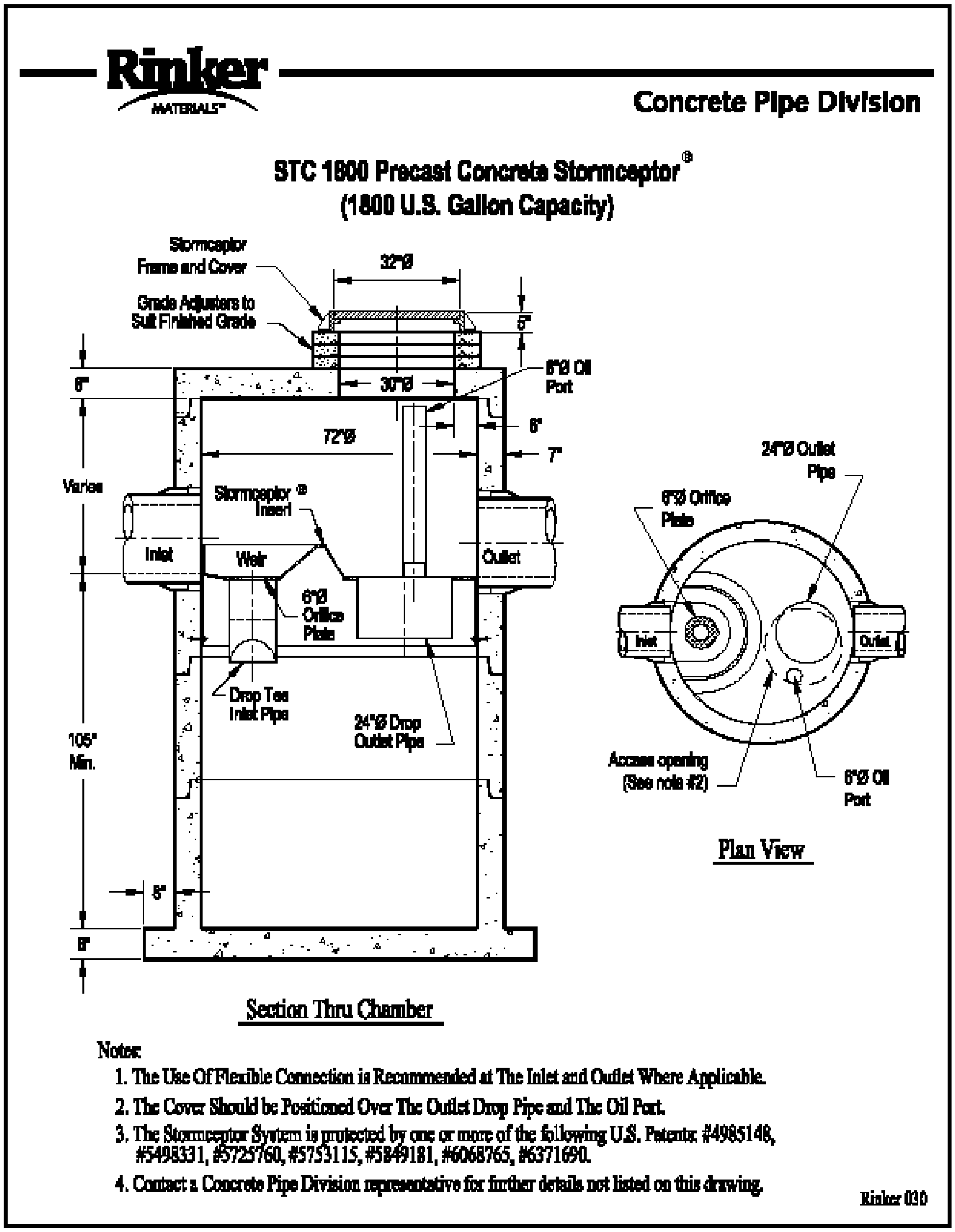


Figure TA-3.27. Stormceptor® 1800 Model (1800 U.S. Gallons) Schema (Imbrium Systems and Rinker Materials).

Suggested materials for information on Stormceptor® function and effectiveness:

http://www.epa.gov/region1//assistance/ceitts/stormwater/techs/stormceptor.html – Storm Water Virtual Trade Show Stormceptor® (Rinker Materials 2007)

http://www.ceere.org/ees/EES_Publications/step/Stormceptor%20fact%20sheet%20revised%20203.pdf – Stormwater Technology: Stormceptor (STEP 2003)

http://www.stormwatercenter.net/Practice/120-Stormceptor.pdf – Performance of a Proprietary Stormwater Treatment Device: The Stormceptor® (RAC 2002)

http://www.stormceptor.com/ – Stormceptor ® home page (Imbrium Systems Inc. 2007)

http://www.fhwa.dot.gov/environment/ultraurb/3fs14.htm – Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring Fact Sheet - Manufactured Systems (Shoemaker et al. 2002b)

http://www.epa.gov/OW-OWM.html/mtb/hydro.pdf - EPA Storm Water Technology Fact Sheet: Hydrodynamic Separators (US EPA 1999b).

Full citations are provided in the Literature Cited section at the end of this document.

TA-3.4.2 2010 SWM BMP Monitoring Results

In 2010, SWM BMP monitoring occurred at four properties; three (Summerfield Crossing, Clarksburg Ridge, and Parkside) in the Clarksburg SPA, and one in the Paint Branch SPA (Briarcliff Meadows).

Summerfield Crossing (Clarksburg SPA) – 2010

An aerial and plan views of the Summerfield Crossing SWM treatment train (two sand filters and a dry pond) comprising Pond A, and of Stormfilter® SF-1 are provided (Figs TA-3.28, TA-3.29 and TA-3.30). BMP pollutant removal efficiency data was collected using flow-weighted composite sampling. Table TA-3.23 lists the parameters and detection limits for the Summerfield Crossing SWM BMP monitoring (Jones 2008b).

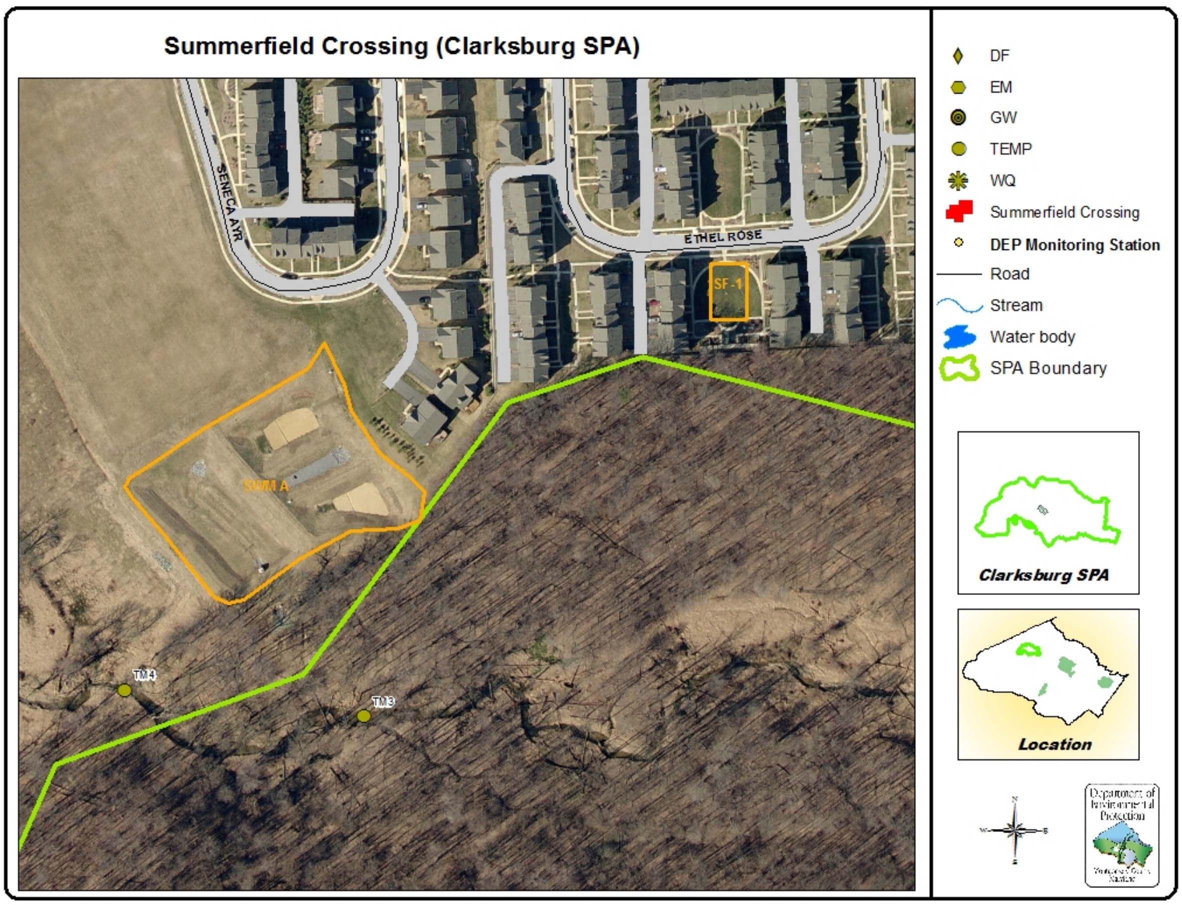
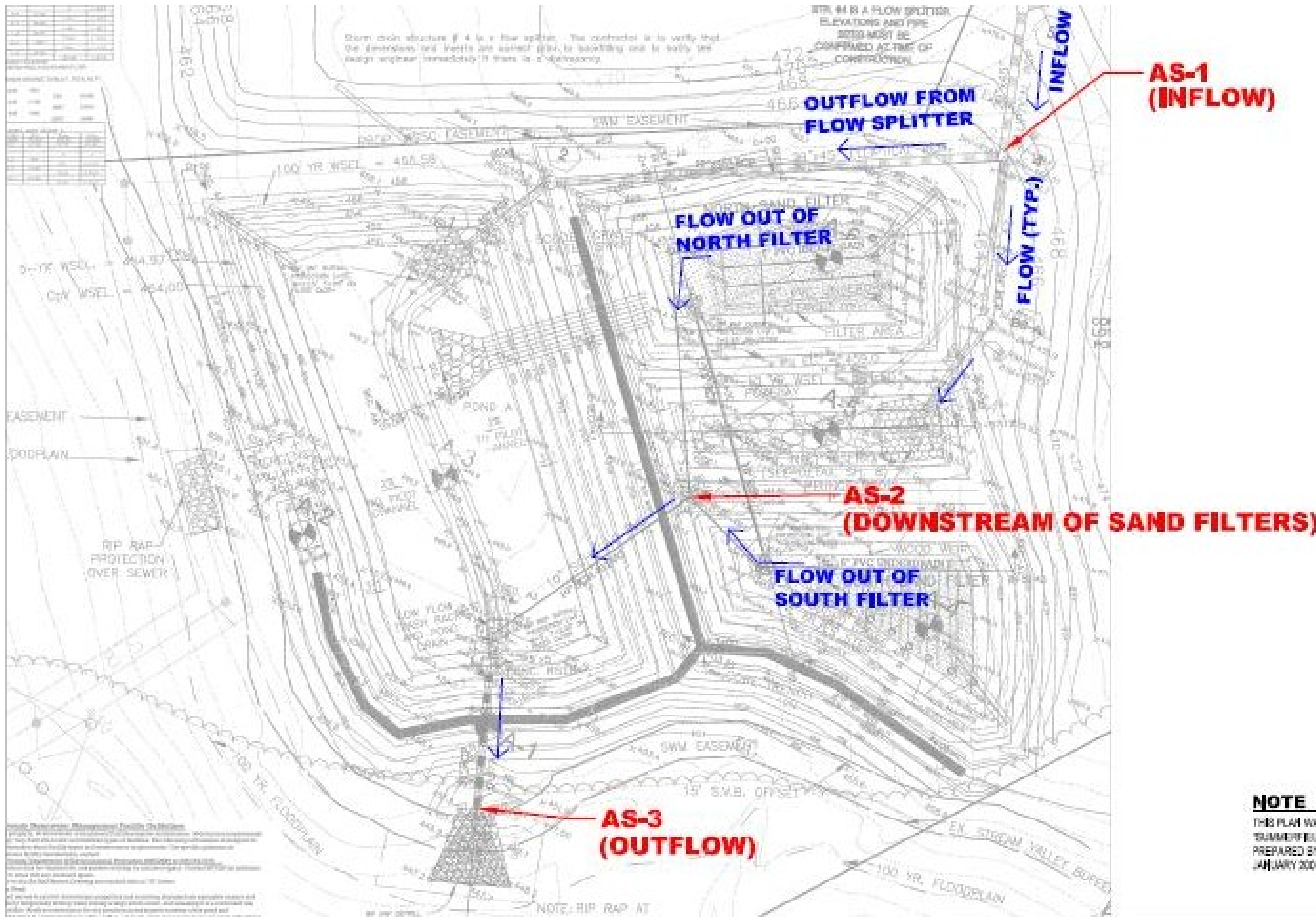


Figure TA-3.3. Aerial image of Summerfield Crossing sand filters and dry pond.



NOTE

THIS PLAN WAS PREPARED ON A BASE PLAN ENTITLED "SUMMERFIELD CROSSING SOUTH-WEST STORMWATER POND A" PREPARED BY RODGERS CONSULTING, INC. AND DATED JANUARY 2004 AND REVISED 2008.

Figure TA-3.29. Plan view of Summerfield Crossing BMP with monitoring locations (3) denoted (Jones 2008b).

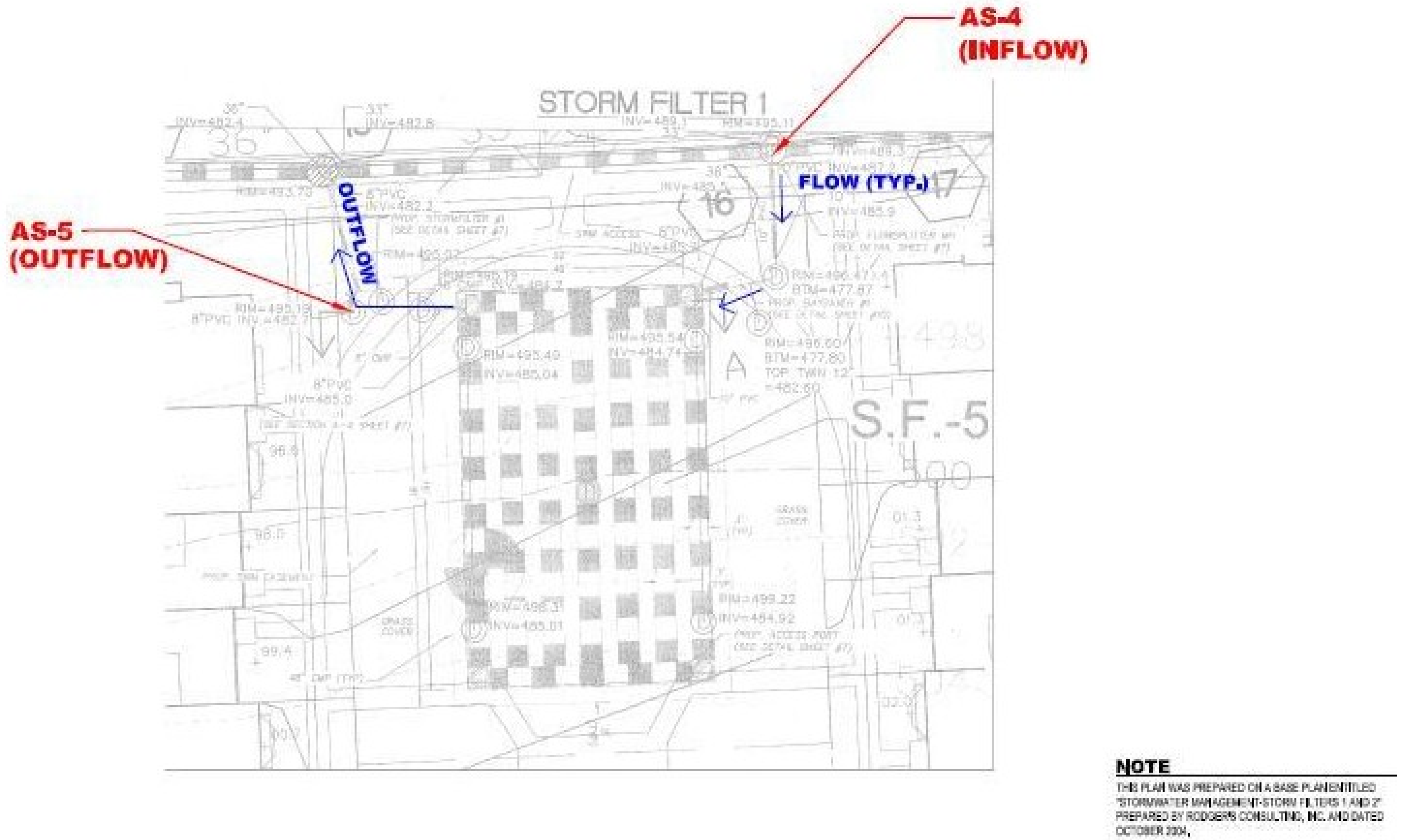


Figure TA-3.30. Plan view of Summerfield Crossing Storm Filter with monitoring locations (2) denoted (Jones 2008b).

Table TA-3.23. Parameters and detection limits for Summerfield Crossing BMP monitoring.

Parameter	Detection Limit (mg/L)	Method	MD Freshwater Acute Criteria (mg/L)*
Cadmium	0.0005 – 0.0006	SW-846-6010 & EPA 200.8	0.002
Copper	0.001 – 0.01	SW-846-6010 & EPA 200.8	0.013
Lead	0.002 – 0.0015	SW-846-6010 & EPA 200.8	0.065
Zinc	0.002 – 0.0038	SW-846-6010 & EPA 200.8	0.12
Nitrate	0.02 – 0.05	EPA 300 & SM 4500NO3-H	None
Nitrite	0.02	EPA 300 & SM 4500NO3-H	None
Total Kjeldahl Nitrogen (TKN)	0.2 – 0.5	EPA 351.2 & SM4500NH3-C	None
Total Suspended Solids (TSS)	1.0 – 4.0	SM 2540 D	None
Total Phosphorus	0.01	EPA 365.4 & SM 4500P-E	None
Orthophosphate	0.01	EPA 365.3 & 4500P-E	None

* Water quality criteria for metals are based on dissolved forms; water chemistry data provided are for total metal concentration.

Monitored storm events (Table TA-3.24) and concentrations and loadings of pollutants from monitored storm events are presented (Table TA-3.25).

Table TA-3.24. Characteristics of monitored storms at the Summerfield Crossing sand filters.

Date of Event	Storm Characteristics				Discharge Volume (m^3)				
	Rain (in)	Rainfall Duration (hours)	Rainfall Return Interval	Preceding drying time (h)	SWM 3 (#1)	SWM 3 (#2)	SWM 3 (#3)	SF-1 (IN)	SF-1 (OUT)
1/17/2010	0.75	12	< 1		21.66	23.87	26.53	37.71	23.42
9/27/2010	0.72	11	< 1		25.89	23.82	18.38	11.65	NR*
9/30/2010	3.65	24	3		3125	3023	3522	1874	1509

*NR No flow data reported

Table TA-3.25. Summerfield Crossing storm concentrations and loadings of metals. Loadings are not calculated if concentration was below the detection limit. A negative percent reduction indicates that more of pollutant is leaving the system than is entering.

Date	Location	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Total Phosphate (mg/L)	TSS (mg/L)	TKN (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L:)	Zinc (mg/L)
1/17/2010	AS1	0.14	**	0.17	0.30	39.00	2.20	**	0.013	**	0.270
	AS2	1.99	**	0.08	0.09	**ND	0.41	**	0.007	**	--
	% Mass Removal AS-1 to AS-2	Neg.		48.16	66.95	88.70 to 100	94.84	--	40.68	--	97.96 to 100
	AS3	2.35	**	0.08	0.08	**ND	0.52	**	0.009	**	<0.005
	% Mass Removal AS-1 to AS-3	Neg.	--	42.36	67.34	87.44 to 100	90.18	--	15.21	--	97.73 to 100
	AS4	0.16	--	0.17	0.18	74.00	1.09	--	0.007	0.017	--
	AS5	0.58	--	0.20	0.27	17.00	1.64	--	0.008	<0.01	--
	% Mass Removal AS-4 to AS-5	Neg.	37.88	26.92	6.82	85.73	76.06	37.88	29.01	63.46 to 100	--
9/27/2010	AS1	1.90	0.03	0.17	0.18	13.00	1.90	**	0.0055	0.0022	0.0280
	AS2	2.10	--	0.07	0.08	10.00	1.30	**	**	**	0.0100
	% Mass Removal AS-1 to AS-2	Neg.	38.66 to 100	62.12	59.11	29.23	84.14	--	66.54	16.36	67.14
	AS3	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
	% Mass Removal AS-1 to AS-3	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	AS4	0.55	--	0.15	0.29	16.00	1.80	<0.0005	0.0022	**	0.0240
	AS5	0.47	--	0.20	0.25	25.00	1.70	<0.0005	<0.002	--	0.0220
	% Mass Removal AS-4 to AS-5	17.25	--	Neg.	16.52	Neg.	51.36	--	11.97 to 100	--	11.24
9/30/2010	AS1	1.00	**	0.24	0.25	10.00	1.60	**	**	**	0.012
	AS2	0.97	0.03	0.22	0.31	5.00	1.50	**	<.002	<.002	**
	% Mass Removal AS-1 to AS-2	6.14	--	11.30	Neg.	51.62	99.82	--	--	--	19.36 to 100
	AS3	0.64	**	0.13	0.17	3.00	1.00	**	**	**	0.032
	% Mass Removal AS-1 to AS-3	23.13	--	31.16	36.11	37.82	0.00	--	--	--	Neg.
	AS4	0.50	**	0.18	0.40	7.00	1.80	**	**	**	**
	AS5	0.40	**	0.13	0.22	5.00	1.20	**	**	**	**
	% Mass Removal AS-4 to AS-5	35.58	19.48	41.84	55.71	42.48	99.79	--	--	--	--

** Non detect

-- Loadings are not calculated; concentration was below the detection limit

Neg. A negative percent reduction indicates that more of pollutant is leaving the system than is entering.

Clarksburg Ridge (Clarksburg SPA) – 2010

Monitoring at the Clarksburg Ridge BaySeparator™ and sand filters concluded in 2010. No SWM BMP monitoring results or technical appendix materials are available; unreliable flow rates prevented accurate loading calculations.

Parkside (Clarksburg SPA) – 2010

Monitoring at Parkside was limited to a temperature study to assess efficiency of one of the turf filters in reducing temperature of water leaving the facility. No SWM BMP monitoring results or technical appendix materials are available.

Briarcliff Meadows (Upper Paint Branch SPA) – 2010

An aerial and plan views of the Briarcliff Meadows (two sand filters and a dry pond) comprising Pond A, and of Stormfilter® SF-1 are provided (Figs TA-3.31, TA-3.32 and TA-3.33). BMP pollutant removal efficiency data was collected using flow-weighted composite sampling. Table TA-3.26 lists the parameters and detection limits for the Summerfield Crossing SWM BMP monitoring (Jones 2008b).

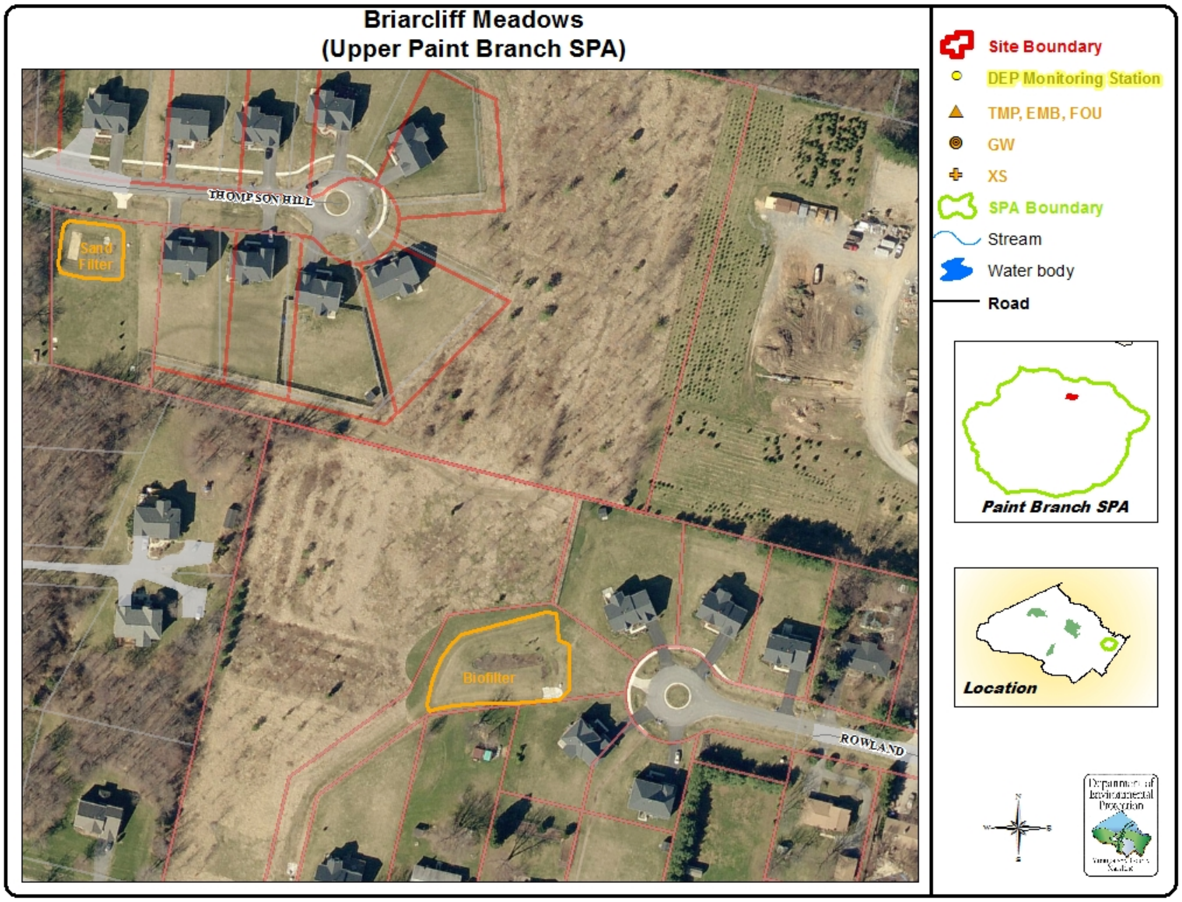


Figure TA-3.31. Aerial image of Briarcliff Meadows sand filter and biofilter.

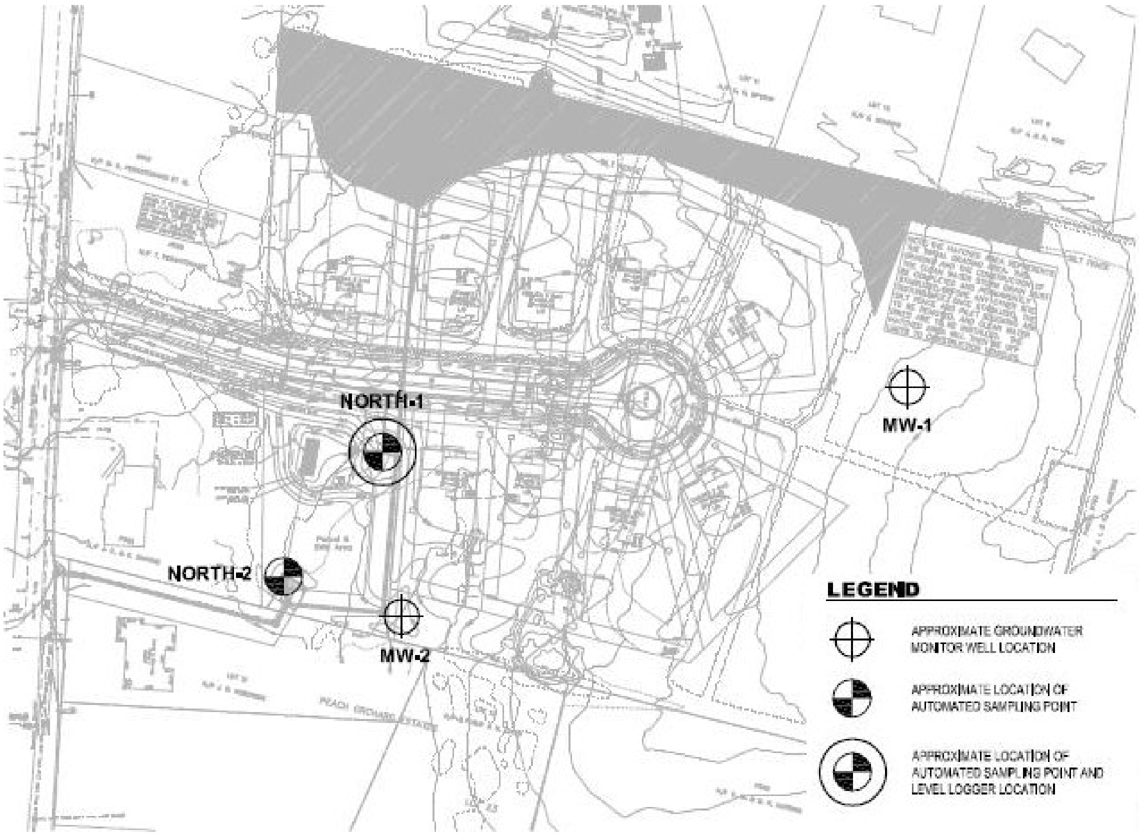


Figure TA-3.32. Plan view of Briarcliff Meadows North Sand Filter with monitoring locations (2) denoted (Jones 2008b).

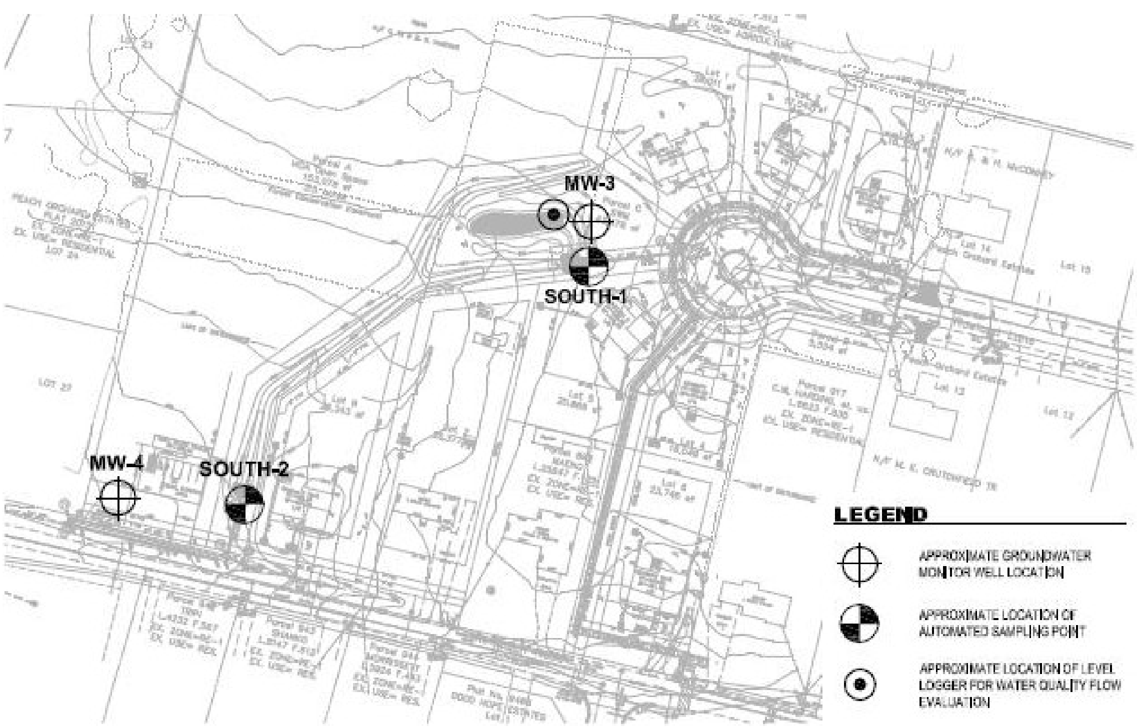


Figure TA-3.33. Plan view of Briarcliff Meadows South Biofilter with monitoring locations (2) denoted (Jones 2008b).

Table TA-3.26. Parameters and detection limits for Briarcliff Meadows BMP monitoring.

Parameter	Detection Limit (mg/L)	Method	MD Freshwater Acute Criteria (mg/L)
Nitrate	0.02 – 0.06	EPA 300 & SM 4500NO3-H	None
Nitrite	0.02 – 0.023	EPA 300 & SM 4500NO3-H	None
Total Kjeldahl Nitrogen (TKN)	0.1 – 0.5	EPA 351.2 & SM4500NH3-C	None
Total Suspended Solids (TSS)	1.0	SM 2540 D	None
Total Phosphorus	0.01 – 0.021	EPA 365.4 & SM 4500P-E	None
Orthophosphate	0.01 – 0.017	EPA 365.3 & 4500P-E	None

Monitored storm events (Table TA-3.27) and concentrations and loadings of pollutants from monitored storm events are presented (Table TA-3.28).

Table TA-3.27. Characteristics of monitored storms at the Briarcliff Meadows sand filter and biofilter.

	Storm Characteristics				Discharge Volume (m^3)			
Date of Event	**Rain (in)**	**Rainfall Duration (hours)**	**Rainfall Return Interval**	**Preceding drying time (h)**	**North (IN)**	**North (OUT)**	**South (IN)**	**South (OUT)**
1/17/2010	0.74	13	< 1		32.60	26.68	NR	NR
3/13/2010	1.94	17	< 1		NR	NR	59.40	56.51
4/25/2010	0.89	8	< 1		147.0	128.8	116.7	94.5
9/30/2010	2.66	15	3		167.10	156.30	87.99	78.15

***NR No flow data reported**

Table TA-3.28. Briarcliff Meadows storm concentrations and loadings.

Date	Location	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Total Phosphate (mg/L)	TSS (mg/L)	TKN
1/17/2010	North 1	**	**	0.28	0.39	26	1.55
	North 2	**	**	0.15	0.23	5	1.11
	% Efficiency	--	--	56.82	52.47	84.5	42.3
3/13/2010	South 1	0.11	**	0.13	0.23	9	1.3
	South 2	1.17	**	0.91	0.63	130	1.61
	Efficiency	Neg.	--	Neg.	Neg.	Neg.	Neg.
4/25/2010	North 1	0.58	**	0.07	0.3	122	3.19
	North 2	0.98	**	0.19	0.15	22	1.86
	% Efficiency	Neg.	--	Neg.	57.55	84.69	50.5
	South 1	0.7	**	0.09	0.08	34	2.37
	South 2	4.26	**	0.27	0.22	19	2.23
	Efficiency	Neg.	--	Neg.	Neg.	54.75	23.8
9/30/2010	North 1	0.19	**	0.37	0.62	1	2
	North 2	0.91	**	0.36	0.37	4	1.1
	% Efficiency	Neg.	--	8.9	44.18	Neg.	48.6
	South 1	2.3	**	0.24	0.73	3	1.5
	South 2	0.13	**	0.3	0.78	2	1.1
	Efficiency	49.79	--	Neg.	5.1	40.79	34.9

** Non detect
-- Loadings are not calculated; concentration was below the detection limit
Neg. A negative percent reduction indicates that more of pollutant is leaving the system than is entering.

No SWM BMP monitoring results or technical appendix materials were available for 2009. Monitoring at Willow Oaks, Snider's Estates, and Cloverly Safeway were completed in 2008.

Willow Oaks (Piney Branch SPA) – 2008

An aerial and plan view of the Willow Oaks sand filters (two in series) are provided (Figs TA-3.34 and TA-3.35). BMP pollutant removal efficiency data was collected using flow-weighted composite sampling. Table TA-3.29 lists the parameters and detection limits for the Willow Oaks SWM BMP monitoring (Jones 2008b).

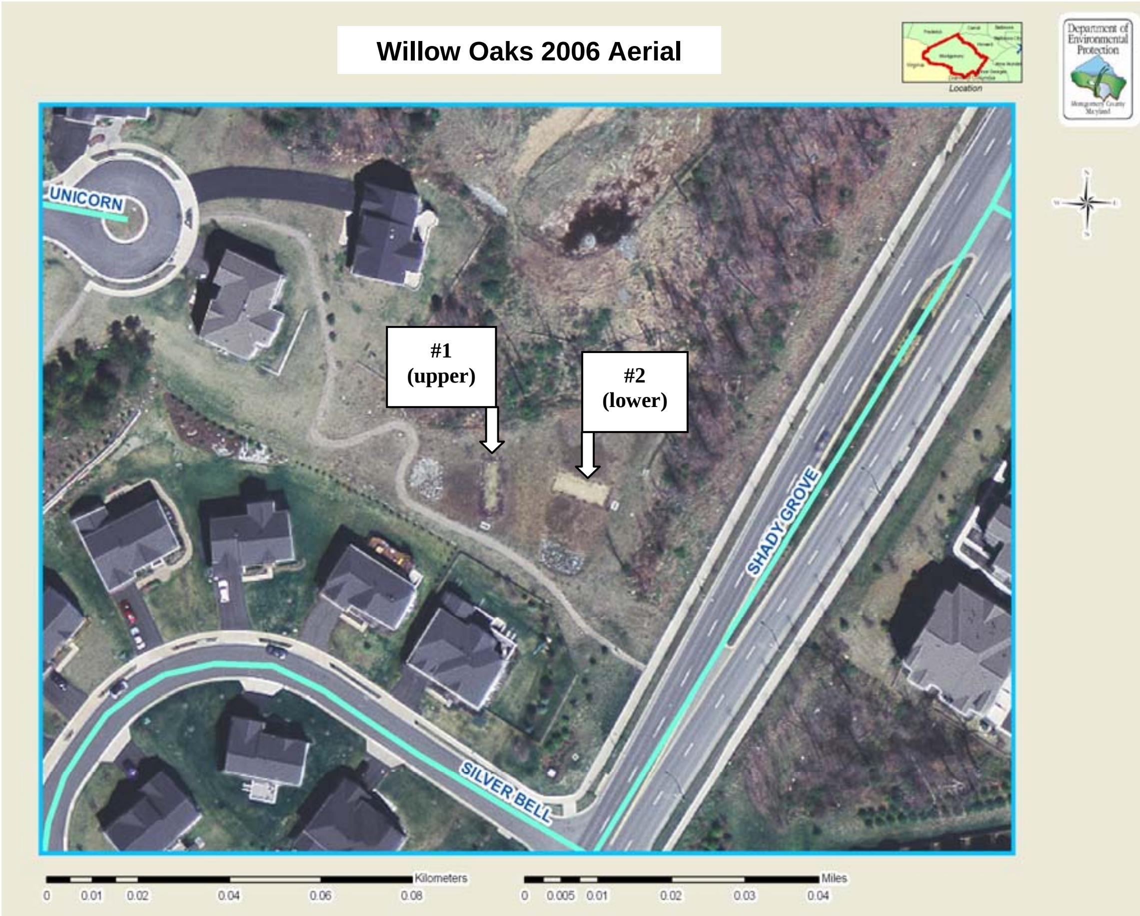


Figure TA-3.34. Aerial image of Willow Oaks sand filters.

The only other monitoring requirement at Willow Oaks was for TSS sampling during construction, but this requirement was dropped when the structure was deemed unsampleable. An alternate sediment basin could not be selected due to the relatively small development and level of disturbance.

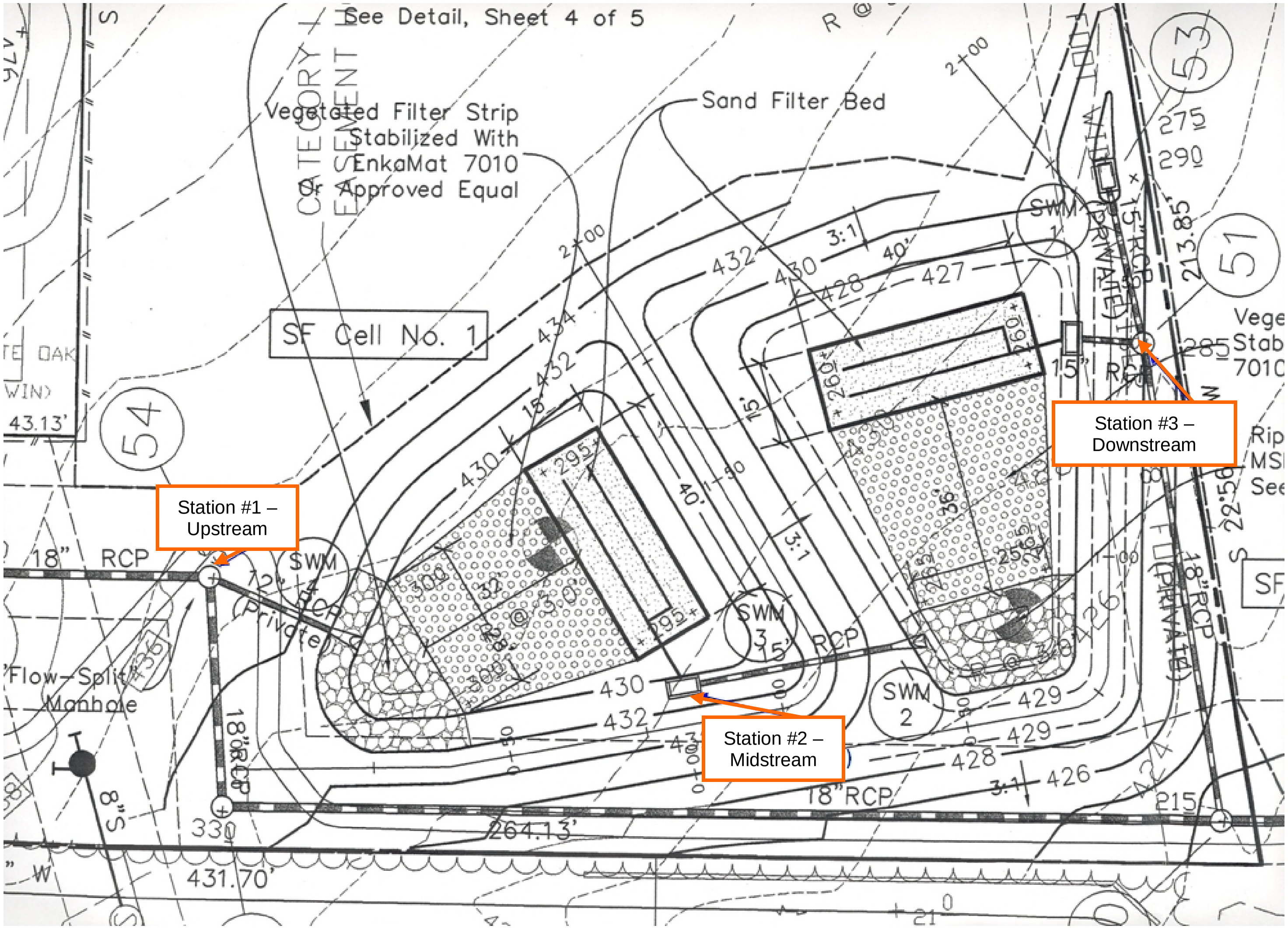


Figure TA-3.35. Plan view of Willow Oaks BMP with monitoring locations (3) denoted (Jones 2008b).

Table TA-3.29. Parameters and detection limits for Willow Oaks BMP monitoring.

Parameter	Detection Limit (mg/L)	Method	MD Freshwater Acute Criteria (mg/L)*
Cadmium	0.0005	EPA 200.8	0.002
Copper	0.002	EPA 200.8	0.013
Lead	0.002	EPA 200.8	0.065
Zinc	0.010	EPA 200.8	0.12
Nitrate	0.02	EPA 353.1& SM 4500NO3-H	None
Nitrite	0.02	EPA 353.1 & SM 4500NO3-H	None
Total Kjeldahl Nitrogen (TKN)	0.5	EPA 351.3& SM4500NH3-C	None
Total Nitrogen	0.02	EPA 353.1 & SM 4500NO3-H	None
Total Suspended Solids (TSS)	1.0	EPA 160.2 & SM 2540 D	None
Total Phosphorus	0.01	EPA 365.2 & SM 4500P-E	None
Orthophosphate	0.01	EPA 365.2 & 4500P-E	None

* Water quality criteria for metals are based on dissolved forms; water chemistry data provided are for total metal concentration.

Monitored storm events (Table TA-3.30) and concentrations and loadings of pollutants from monitored storm events are presented (Tables TA-3.31 – TA-3.33).An estimated flow value was provided for the 2/1/2008 storm event (Table TA-3.30). An equipment failure caused a loss of flow data for a period. An integration below the curve of the hydrograph (Fig.TA-3.36) at the points where the unit cut off and regained function allowed for a calculated estimate. Furthermore, the hydrograph is usually relatively flat during other monitored storms at Station 3 / the downstream station (Jones 2008b; Jones 2009, personal communication).

Table TA-3.30. Characteristics of monitored storms at the Willow Oaks sand filters.

Date of Event	Storm Characteristics				Discharge Volume (m^3)		
	Rain (in)	Rainfall Duration (hours)	Rainfall Return Interval	Preceding drying time (h)	Station #1	Station #2	Station #3
7/7/2005	2.59	14.5	1-2	42.25	5,712	6,440[(a)]	24,577[(b)]
10/24/2005	1.35	29.25	< 1	46.5	4,660	981	15,396[(b)]
1/22/2006	0.8	14.5	< 1	108.25	2,737	410	293
4/21/2006	1.51	26.75	< 1	104.5	2,649	2,984[(a)]	269
9/28/2006	0.73	4.75	< 1	98.5	636	34	1,497[(b)]
10/17/2006	0.74	9	< 1	116.5	1,161	73	37
11/16/2006	1.6	7.75	< 1	72	3,887	8,337[(a)]	99

4/11/2007	0.72	7.25	< 1	105	723	57	85
12/15/2007	0.76	14.5	< 1	36.17	1972	117	373
2/1/2008	1.3	7.92	< 1	64.17	861	4202[a]	638[c]
3/4/2008	2.11	13.92	< 1	168.17	616	869[a]	228
3/7/2008	0.67	27.5	< 1	54.75	338	59	153
3/19/2008	0.56	13.83	< 1	50.67	229	40	75

[a] Inaccurate flow rate measurement due to ponding in weir (Station #2)

[b] Inaccurate flow rate measurement due to bubble line misplacement or pinching (Station #3)

[c] Discharge includes estimated amount

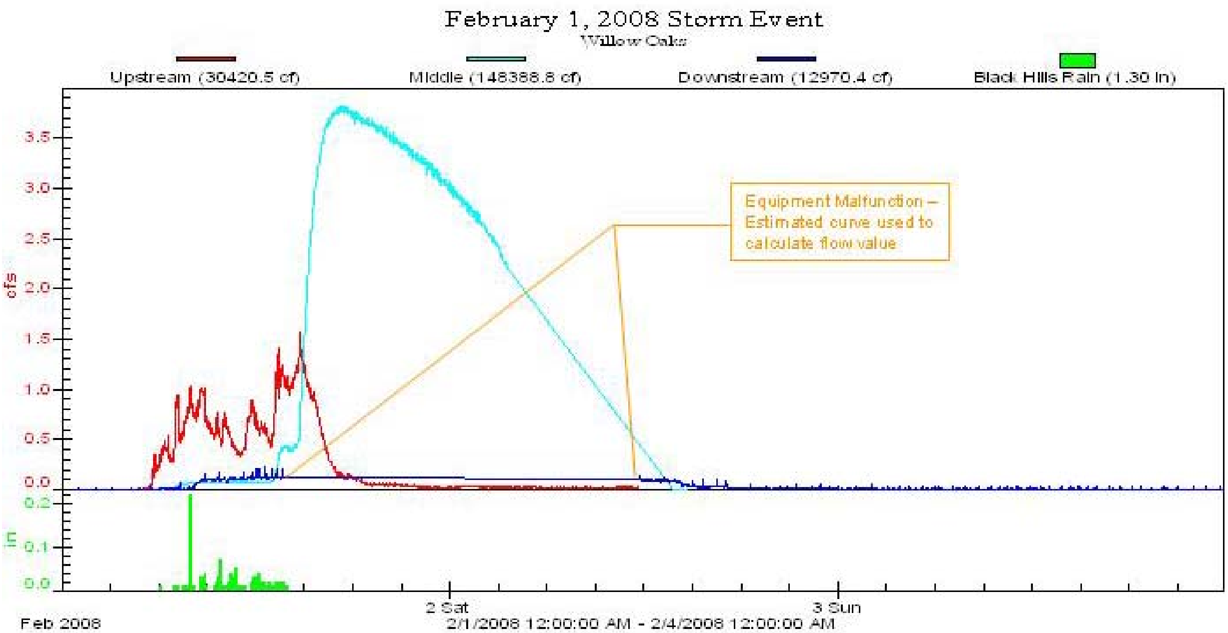


Figure TA-3.36. Hydrograph and rainfall for the Willow Oaks February 1, 2008 storm (Jones 2008b).

Table TA-3.31. Willow Oaks storm concentrations and loadings of metals. Loadings are not calculated if flow value is inaccurate and not presented if concentration was below the detection limit. A negative percent reduction indicates that more of pollutant is leaving the system than is entering.

	Cadmium				Copper				Lead				Zinc			
Storm Date	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)
Analytical Concentration (mg/L) and Pollutant Reduction (%)																
7/7/2005	B.D.L.	B.D.L.	B.D.L.	n.c.	0.005	0.006	0.008	-60.0%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.022	0.021	0.023	-4.5%
10/24/2005	B.D.L.	B.D.L.	B.D.L.	n.c.	0.009	0.01	0.006	33.3%	B.D.L.	B.D.L.	B.D.L.	n.c.	B.D.L.	0.01	0.012	n.c.
1/22/2006	B.D.L.	B.D.L.	B.D.L.	n.c.	0.011	0.008	0.011	0.0%	0.0032	B.D.L.	B.D.L.	n.c.	0.0619	0.0221	0.0277	55.3%
4/21/2006	B.D.L.	B.D.L.	B.D.L.	n.c.	0.017 [†]	0.012	0.01	41.2%	0.004	B.D.L.	B.D.L.	n.c.	0.041	0.016	0.012	70.7%
9/28/2006	B.D.L.	0.0007	B.D.L.	n.c.	0.021[†]	0.110 [†]	0.015 [†]	28.6%	0.003	0.015	B.D.L.	n.c.	0.068	0.14 [†]	0.028	58.8%
10/17/2006	B.D.L.	B.D.L.	B.D.L.	n.c.	0.008	0.008	0.009	-12.5%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.042	0.028	0.027	35.7%
11/16/2006	B.D.L.	B.D.L.	B.D.L.	n.c.	0.007	0.009	B.D.L.	n.c.	0.003	B.D.L.	B.D.L.	n.c.	0.054	0.048	B.D.L.	n.c.
4/11/2007	B.D.L.	B.D.L.	B.D.L.	n.c.	0.0083	0.0093	0.0078	6.0%	0.0023	B.D.L.	B.D.L.	n.c.	0.062	0.0446	0.0616	0.6%
12/15/2007	B.D.L.	B.D.L.	B.D.L.	n.c.	0.0058	0.01	0.0093	-60.3%	B.D.L.	B.D.L.	B.D.L.	n.c.	B.D.L.	0.021	0.041	n.c.
2/1/2008	B.D.L.	B.D.L.	B.D.L.	n.c.	0.005	0.0074	0.0087	-74.0%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.018	0.012	0.017	5.6%
3/4/2008	B.D.L.	B.D.L.	B.D.L.	n.c.	0.0068	0.0092	0.0097	-42.6%	0.002	B.D.L.	B.D.L.	n.c.	0.027	0.013	0.014	48.1%
3/7/2008	B.D.L.	B.D.L.	0.001	n.c.	0.008	0.009	0.0086	-7.5%	0.0023	B.D.L.	B.D.L.	n.c.	0.036	0.013	0.027	25.0%
3/19/2008	B.D.L.	B.D.L.	B.D.L.	n.c.	0.0086	0.0099	0.011	-27.9%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.03	0.012	0.025	16.7%
Pollutant Loadings (g) and Pollutant Reduction (%)																
7/7/2005	n.c.	*	*	n.c.	28.6	*	*	n.c.	n.c.	*	*	n.c.	125.7	*	*	n.c.
10/24/2005	n.c.	n.c.	*	n.c.	41.9	9.8	*	n.c.	n.c.	n.c.	*	n.c.	n.c.	9.8	*	n.c.
1/22/2006	n.c.	n.c.	n.c.	n.c.	30.1	3.3	3.2	89.3%	8.8	n.c.	n.c.	n.c.	169.4	9.1	8.1	95.2%
4/21/2006	n.c.	*	n.c.	n.c.	45	*	2.7	94.0%	10.6	*	n.c.	n.c.	108.6	*	3.2	97.0%
9/28/2006	n.c.	0.02	*	n.c.	13.4	3.8	*	n.c.	1.9	0.5	*	n.c.	43.3	4.8	*	n.c.
10/17/2006	n.c.	n.c.	n.c.	n.c.	9.3	0.6	0.3	96.4%	n.c.	n.c.	n.c.	n.c.	48.8	2	1	97.9%
11/16/2006	n.c.	*	n.c.	n.c.	27.2	*	n.c.	n.c.	11.7	*	n.c.	n.c.	209.9	*	n.c.	n.c.
4/11/2007	n.c.	n.c.	n.c.	n.c.	6	0.5	0.7	89.0%	1.7	n.c.	n.c.	n.c.	44.9	2.5	5.2	88.4%
12/15/2007	n.c.	n.c.	n.c.	n.c.	11.44	1.17	3.47	69.7%	n.c.	n.c.	n.c.	n.c.	n.c.	2.5	15.3	n.c.
2/1/2008	n.c.	*	0.64	n.c.	4.31	*	5.55	-28.8%	n.c.	*	n.c.	n.c.	15.5	*	10.8	30.1%
3/4/2008	n.c.	*	n.c.	n.c.	4.19	*	2.21	47.2%	1.2	*	n.c.	n.c.	16.6	*	3.2	80.2%
3/7/2008	n.c.	n.c.	n.c.	n.c.	2.71	0.53	1.32	51.4%	0.8	n.c.	n.c.	n.c.	12.2	0.8	4.1	66.1%
3/19/2008	n.c.	n.c.	n.c.	n.c.	1.97	0.39	0.82	58.1%	n.c.	n.c.	n.c.	n.c.	6.9	0.5	1.9	72.7%

* - Loading not calculated due to inaccurate flow rate measurement

[†] At or above acute criteria value (Refer to Table TA-3.18)

B.D.L - Concentration (mg/L) below detection limit (Refer to Table TA-3.18)

n.c. - Not Calculated (if concentration was below detectable limit or flow value was inaccurate)

Table TA-3.32. Willow Oaks storm concentrations and loadings of nitrogen-based nutrients (nitrate, nitrite, total Kjeldahl nitrogen (TKN), total nitrogen). Loadings are not calculated if flow value is inaccurate and not presented if concentration was below the detection limit. A negative percent reduction indicates that more of pollutant is leaving the system than is entering

Storm Date	Nitrate				Nitrite				TKN				Total Nitrogen			
	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)
Analytical Concentration (mg/L) and Pollutant Reduction (%)																
7/7/2005	0.1	0.06	0.08	20.0%	0.02	0.02	B.D.L.	n.c.	1	1.2	B.D.L.	n.c.	1.1	1.3	0.08	92.7%
10/24/2005	0.18	0.25	0.35	-94.4%	B.D.L.	0.02	0.02	n.c.	1	0.7	0.6	40.0%	1.2	0.95	0.97	19.2%
1/22/2006	0.24	0.2	0.14	41.7%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.6	0.6	0.6	0.0%	0.84	0.8	0.74	11.9%
4/21/2006	0.46	0.47	0.63	-37.0%	B.D.L.	0.04	0.04	n.c.	1.6	1	0.7	56.3%	2.1	1.5	1.4	33.3%
9/28/2006	0.59	0.46	0.42	28.8%	0.02	0.03	0.02	0.0%	B.D.L.	B.D.L.	0.8	n.c.	0.61	0.49	0.52	14.8%
10/17/2006	0.35	0.3	0.23	34.3%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.7	B.D.L.	B.D.L.	n.c.	0.42	0.3	0.23	45.2%
11/16/2006	0.25	0.15	0.23	8.0%	0.02	B.D.L.	B.D.L.	n.c.	B.D.L.	B.D.L.	B.D.L.	n.c.	0.27	0.15	0.23	14.8%
4/11/2007	1.5	2.18	2.8	-86.7%	0.02	0.02	B.D.L.	n.c.	0.9	B.D.L.	B.D.L.	n.c.	2.4	2.2	2.8	-16.7%
12/15/2007	0.35	0.3	0.23	34.3%	B.D.L.	B.D.L.	B.D.L.	n.c.	B.D.L.	B.D.L.	B.D.L.	n.c.	0.35	0.3	0.23	34.3%
2/1/2008	0.58	0.52	0.33	43.1%	B.D.L.	B.D.L.	B.D.L.	n.c.	1	0.9	0.6	40.0%	1.6	1.4	0.93	41.9%
3/4/2008	0.43	0.52	0.35	18.6%	B.D.L.	B.D.L.	B.D.L.	n.c.	4.1	3.2	2.8	31.7%	4.5	3.7	3.2	28.9%
3/7/2008	0.34	0.79	0.6	-76.5%	B.D.L.	B.D.L.	B.D.L.	n.c.	0.6	1.1	0.8	33.3%	0.94	1.9	1.4	-48.9%
3/19/2008	0.3	0.4	0.34	-13.3%	B.D.L.	B.D.L.	B.D.L.	n.c.	1	0.6	0.7	30.0%	1.3	1	1	23.1%
Pollutant Loadings (g) and Pollutant Reduction (%)																
7/7/2005	571.2	*	*	n.c.	114.2	*	*	n.c.	5712.2	*	*	n.c.	6283.5	*	*	n.c.
10/24/2005	838.8	245.3	*	n.c.	n.c.	19.6	*	n.c.	4660.1	686.9	*	n.c.	5592.1	932.2	*	n.c.
1/22/2006	656.9	82	41	93.8%	n.c.	n.c.	n.c.	n.c.	1642.2	245.9	175.5	89.3%	2299.1	327.9	216.5	90.6%
4/21/2006	1218.6	*	169.3	86.1%	n.c.	*	10.8	n.c.	4238.5	*	188.2	95.6%	5563	*	376.3	93.2%
9/28/2006	375.3	15.8	*	n.c.	12.7	1	*	n.c.	n.c.	n.c.	*	n.c.	388	16.9	*	n.c.
10/17/2006	406.4	21.8	8.6	97.9%	n.c.	n.c.	n.c.	n.c.	812.8	n.c.	n.c.	n.c.	487.7	21.8	8.6	98.2%
11/16/2006	971.9	*	22.8	97.7%	77.7	*	n.c.	n.c.	n.c.	*	n.c.	n.c.	1049.6	*	22.8	97.8%
4/11/2007	1085.2	124.6	237.1	78.1%	14.5	1.1	n.c.	n.c.	651.1	n.c.	n.c.	n.c.	1736.2	125.8	237.1	86.3%
12/15/2007	690.2	35.2	85.8	87.6%	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	690.2	35.2	85.8	87.6%
2/1/2008	499.6	*	210.5	57.9%	n.c.	*	n.c.	n.c.	861.4	*	382.7	55.6%	1378.3	*	593.2	57.0%
3/4/2008	264.7	*	79.7	69.9%	n.c.	n.c.	n.c.	n.c.	2524.3	*	637.5	74.7%	2770.5	*	728.6	73.7%
3/7/2008	115.1	46.4	91.8	20.2%	n.c.	n.c.	n.c.	n.c.	203.1	64.6	122.4	39.7%	318.1	111.6	214.2	32.7%
3/19/2008	68.6	15.9	25.5	62.9%	n.c.	n.c.	n.c.	n.c.	228.7	23.8	52.4	77.1%	297.3	39.7	74.9	74.8%

* - Loading not calculated due to inaccurate flow rate measurement

B.D.L - Concentration (mg/L) below detection limit (Refer to Table TA-3.18)

n.c. = Not Calculated (if concentration was below detectable limit or flow value was inaccurate)

Table TA-3.33. Willow Oaks storm concentrations and loadings of phosphorus-based nutrients (total phosphorus and orthophosphate) and total suspended solids (TSS). Loadings are not calculated if flow value is inaccurate and not presented if concentration was below the detection limit. A negative percent reduction indicates that more of pollutant is leaving the system than is entering.

	Total Phosphorus				Orthophosphate				TSS			
Storm Date	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)	Station 1 (In)	Station 2 (Mid)	Station 3 (Out)	Pol. Red. (In vs. Out)
Analytical Concentration (mg/L) and Pollutant Reduction (%)												
7/7/2005	0.07	0.07	0.06	14.3%	0.04	0.04	0.03	25.0%	20	5	16	20.0%
10/24/2005	0.06	0.15	0.17	-183.3%	0.02	0.09	0.12	-500.0%	5	8	6	-20.0%
1/22/2006	0.11	0.11	0.1	9.1%	0.03	0.03	B.D.L.	n.c.	18	10	24	-33.3%
4/21/2006	0.15	0.11	0.1	33.3%	0.1	0.06	0.04	60.0%	26	8	30	-15.4%
9/28/2006	0.25	0.12	0.11	56.0%	0.13	0.05	0.02	84.6%	3	16	12	-300.0%
10/17/2006	0.24	0.11	0.04	83.3%	0.18	0.05	0.02	88.9%	13	4	5	61.5%
11/16/2006	0.22	0.13	0.18	18.2%	0.13	0.09	0.1	23.1%	18	11	20	-11.1%
4/11/2007	0.33	0.12	0.11	66.7%	0.09	0.07	0.04	55.6%	120	5	7	94.2%
12/15/2007	0.14	0.1	0.09	35.7%	0.09	0.07	0.03	66.7%	22	4	12	45.5%
2/1/2008	0.19	0.14	0.1	47.4%	0.1	0.08	0.04	60.0%	6	B.D.L.	1	83.3%
3/4/2008	0.15	0.1	0.1	33.3%	0.11	0.07	0.05	27.3%	10	6	6	40.0%
3/7/2008	0.07	0.09	0.06	14.3%	0.05	0.04	0.02	60.0%	14	4	2	85.7%
3/19/2008	0.11	0.09	0.06	45.5%	0.06	0.05	0.03	50.0%	9	4	6	33.3%
Pollutant Loadings (g) and Pollutant Reduction (%)												
7/7/2005	399.9	*	*	n.c.	228.5	*	*	n.c.	114244.7	*	*	n.c.
10/24/2005	279.6	147.2	*	n.c.	93.2	88.3	*	n.c.	23300.6	7849.9	*	n.c.
1/22/2006	301.1	45.1	29.3	90.3%	82.1	12.3	n.c.	n.c.	49265.8	4098.9	7021	85.7%
4/21/2006	397.4	*	26.9	93.2%	264.9	*	10.8	95.9%	68875.5	*	8064	88.3%
9/28/2006	159	4.1	*	n.c.	82.7	1.7	*	n.c.	1908.3	550.8	*	n.c.
10/17/2006	278.7	8	1.5	99.5%	209	3.6	0.7	99.6%	15094.1	290.1	186.3	98.8%
11/16/2006	855.2	*	17.8	97.9%	505.4	*	9.9	98.0%	69974.1	*	1980.7	97.2%
4/11/2007	238.7	6.9	9.3	96.1%	65.1	4	3.4	94.8%	86812.2	285.8	592.8	99.3%
12/15/2007	276.1	11.7	33.6	87.8%	177.5	8.2	11.2	93.7%	43384.0	469.3	4474.9	89.7%
2/1/2008	163.7	*	63.8	61.0%	86.1	*	25.5	70.4%	5168.5	*	637.8	87.7%
3/4/2008	92.4	*	22.8	75.3%	67.7	*	18.2	73.1%	6156.7	*	1366.1	77.8%
3/7/2008	23.7	5.3	9.2	61.3%	16.9	2.3	3.1	81.9%	4738.4	234.9	306.0	93.5%
3/19/2008	25.2	3.6	4.5	82.1%	13.7	2	2.2	83.6%	2058.0	159.0	449.4	78.2%

* - Loading not calculated due to inaccurate flow rate measurement

B.D.L - Concentration (mg/L) below detection limit (Refer to Table TA-3.18)

n.c. = Not Calculated (if concentration was below detectable limit or flow value was inaccurate)

According to Jones (2009b):

"A Kendall Tau b test was performed on the data to determine trend over time in outfall (Station 3) concentrations and loadings overtime. A significant trend (downward) was only found when analyzing TSS concentration over time ($p = 0.0489$), meaning that the [flow-weighted] concentrations of TSS at the discharge decreased over the time period of the monitoring project.

An ANOVA was performed to compare dry time to outfall concentration, rain quantity to outfall concentration, dry time to outfall loading, and rain quantity to outfall loading. A significant, positive relationship was found for dry time to concentration for total Kjeldahl nitrogen [TKN] ($p = 0.0191$) and total nitrogen ($p = 0.0291$); and rainfall to loading for orthophosphate ($p = 0.0438$), total Kjeldahl nitrogen ($p = 0.0164$), and total nitrogen ($p = 0.0350$)."

Kendall Tau b test

This statistical analysis measures the association and significance of correspondence between two variables.

Variables are assigned rankings:
-1 = 100% negative association / perfect inversion
0 = No association
+1 = 100 % positive association / perfect agreement

In this case, the statistical test examined performance over time as chemical concentrations vs. sampling date as well as chemical loadings vs. sampling date in a tabular format.

ANOVA – Analysis of Variance

This analysis represents a collection of statistical models and associated procedures. Generally, an ANOVA examines differences among multiple groups, testing if the means are equal.

In this case, the influence of dry time and rainfall quantity were examined against chemical concentration and loading values.

Snider's Estates (Upper Paint Branch SPA) – 2008

Total suspended solids were monitored using grab sampling at Snider's Estates during construction. TSS grab sample data is presented in Table TA-3.8. Only flow leaving the sand filter of SWM Pond 1 was monitored during post-construction.

An aerial image of the Snider's Estates property is provided in Fig. TA-3.37. The plan views of the SWM treatment train and monitoring locations are provided (Figs TA-3.38 and TA-3.39).

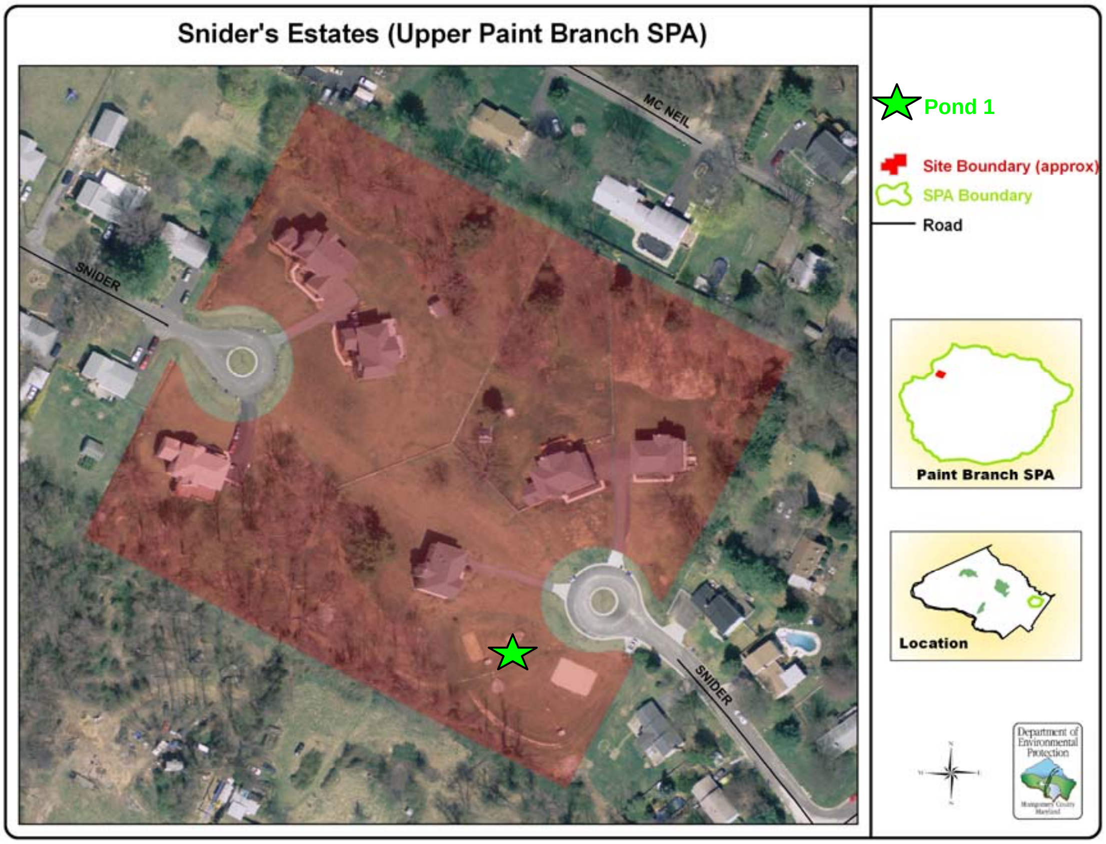


Figure TA-3.37. 2008 aerial image of Snider's Estates.

A total of fifteen storms were captured (Table TA-3.34).

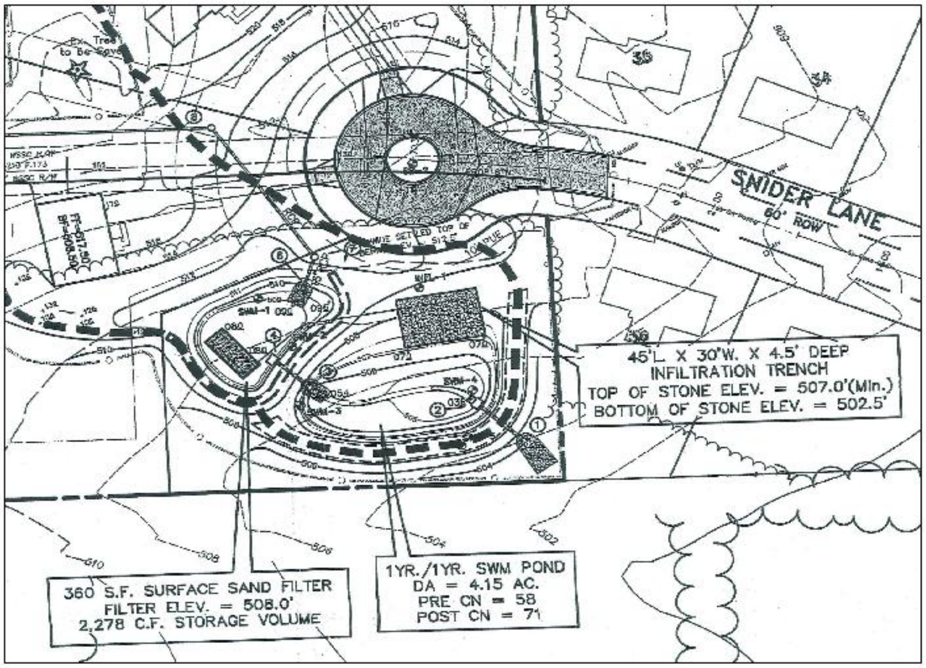


Figure TA-3.38. Snider's Estates stormwater management facility structure and drainage area detail (Jones & Schreiner 2008).

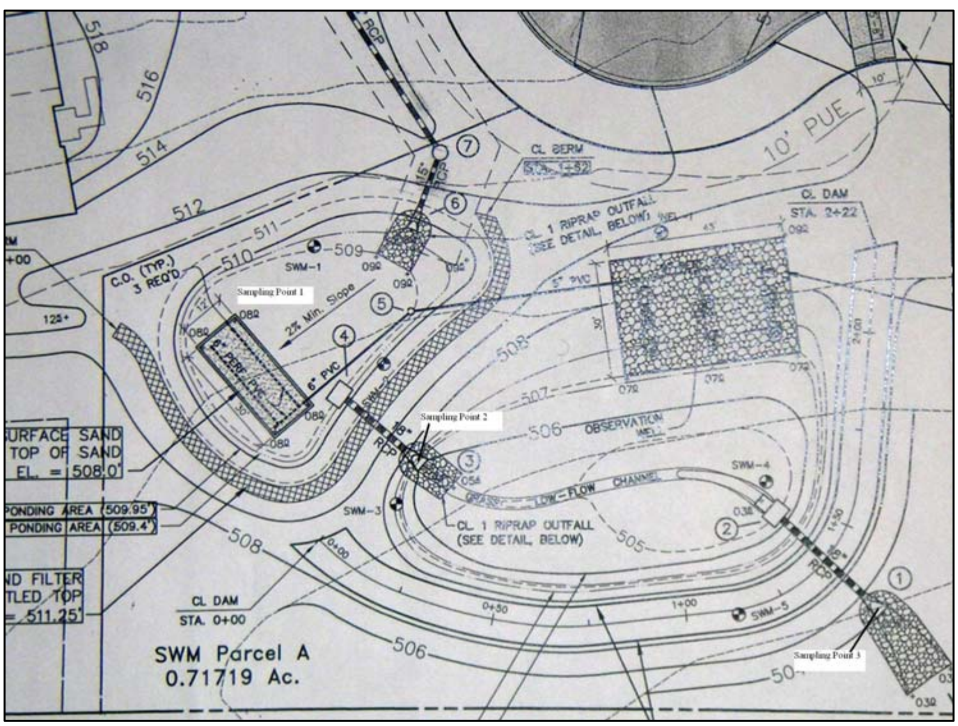


Figure TA-3.39. Plan view of Snider's Estates SWM with marked sampling locations (Jones & Schreiner 2008). The plan illustrates during construction / pre-conversion sampling points (3) and the discussed post-construction flow monitoring station (Sampling Point 2).

Table TA-3.34. Storm events measured for flow exiting Snider's Estates Sand filter in SWM Pond 1 treatment train.

Date	Rainfall Amount (In.)	Dry Time (Hr.)	Rainfall Duration (Hr.)	Elevated Flow Duration (Hr.)	Average Rainfall Rate (In./Hr.)	Return Interval (Yr.)	Maximum Flow Rate Exiting Sand Filter (CFS)	Expected Flow Exiting Treatment Train
12/23/2004	0.87	1	3.33	2.33	0.26	< 1	1.386	*
1/14/2005	1.99	1.83	6.83	6.67	0.29	1-2	4.554	0.1 - 0.8
3/23/2005	1.82	69.33	16.83	2	0.11	< 1	0.459	*
3/27/2005	1.00	1.17	8.5	6.83	0.12	< 1	1.678	*
4/1/2005	1.55	1.5	13.67	14.33	0.11	< 1	1.96	*
6/29/2005	1.35	10.17	3.83	1.17	0.35	< 1	0.133	*
7/7/2005	2.93	1	15.17	9.5	0.19	2	4.98	0.1 – 1.4
7/14/2005	1.49	6.5	8.83	10	0.17	< 1	2.621	*
7/16/2005	0.51	1.67	5.5	8.17	0.09	< 1	2.269	*
7/29/2005	1.17	41.67	4.17	0.67	0.28	< 1	0.271	*
10/7/2005	6.13	1	25.5	26.17	0.24	25	3.541	1.8-4.0
12/15/2005	1.25	122.5	10.25	3.17	0.12	< 1	0.298	*
6/25/2006	6.84	1.33	9.17	8.83	0.75	200	10.671	4.8 -13.7
6/13/2007	1.95	3.33	2.17	0.33	0.9	5	0.042	0.0 – 2.5
10/24/2007	4.38	101.67	77.33	22.33	0.06	2	0.011	0.2 – 2.5

* – Only storms with return intervals >1 analyzed.

Cloverly Safeway (Upper Paint Branch SPA) – 2008

The Stormceptor® (model 1800) functions as additional quality control in the stormwater treatment train utilized at the Cloverly Safeway (Fig. TA-3.40) in Paint Branch SPA. A diagram of Cloverly Safeway stormwater BMPs and sampling locations is provided (Fig. TA-3.41).

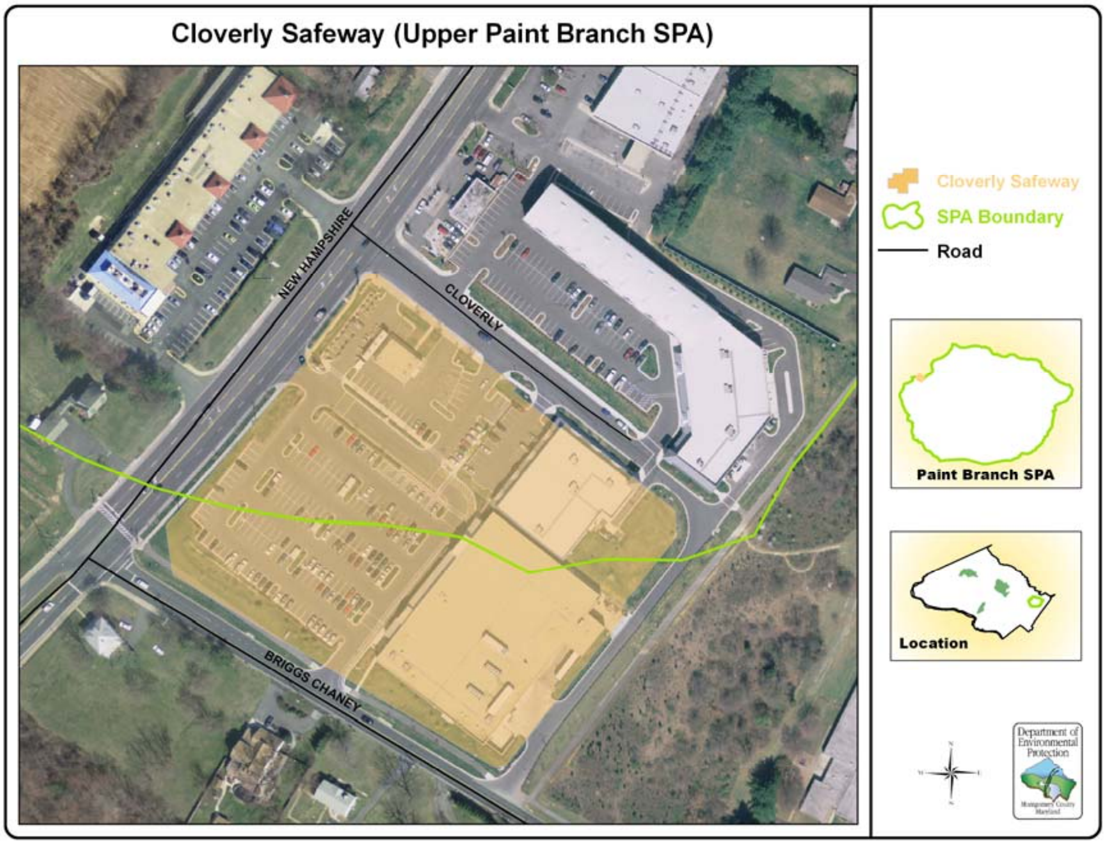


Figure TA-3.40. 2008 aerial image of Cloverly Safeway.

Post construction monitoring of stormwater chemistry as it passes through the device was conducted using automated sampling from November 2002 through June 2008. The first storm was collected in May 2003; the final in April 2008. First flush grab samples of total petroleum hydrocarbons (TPH) of influent and effluent as well as continuous monitoring of effluent temperature were also conducted.

Parameters and detection limits are provided in Table TA-3.35 (Jones 2008c). Eleven of the fifteen required storms have been captured; storm characteristics are provided in Table TA-3.36 and loading and concentration data in Table TA-3.37.

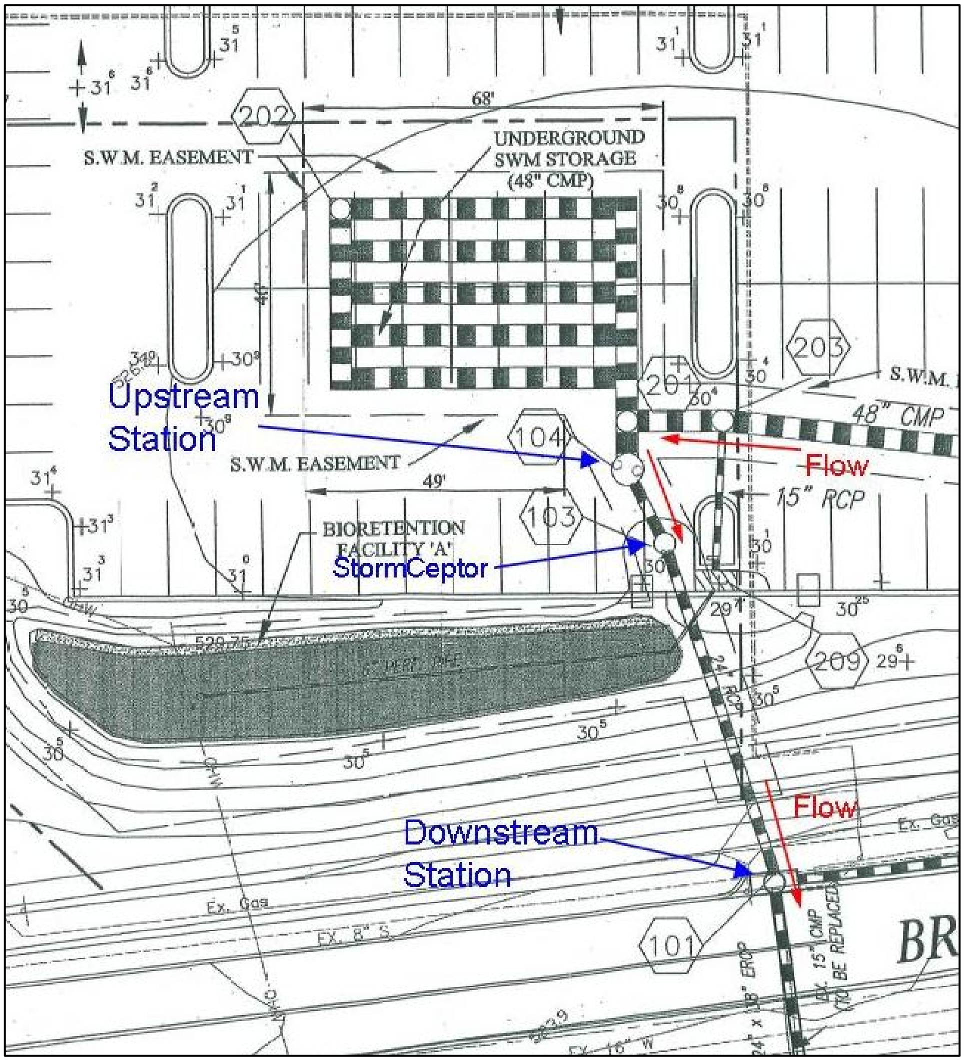


Figure TA-3.41. Diagram of Cloverly Safeway SWM BMPs with marked sampling locations (2) (Jones 2008c).

Table TA-3.35. Detection limits and Maryland water quality standards for chemicals monitored at the Cloverly Safeway Stormceptor®.

Parameter	EPA Method	Detection Limit (mg/L)	Maryland Freshwater Acute Criteria (mg/L)
Total Petroleum Hydrocarbons [a]	EPA 418.1	2	None
Cadmium	EPA 200.8	0.0005	0.002
Copper	EPA 200.8	0.002	0.013
Lead	EPA 200.8	0.002	0.065
Zinc	EPA 200.8	0.025 [b]	0.12
Total Suspended Solids [c]	EPA 160.2 & SM2540D	1	None

[a] Collected using grab sample method
[b] Zinc detection limit varies between 0.005 and 0.025 mg/L
[c] This parameter was added after the first five storms.

Table TA-3.36. Characteristics of captured storms and measured flow as part of Cloverly Safeway SPA BMP monitoring.

Storm Date	Rainfall Quantity (in.)	Rain duration (hr.)	Return interval (yr.)	Preceding drying time (h)	Effluent volume (m3) *
5/9/2003	0.31	2.0	< 1	23.5	137.2
7/28/2003	0.69	5.92	< 1	14.83	634.2
4/12/2004	1.17	12.0	< 1	107	947.7
9/28/2004	1.93	8.0	< 1	242.75	709.8
12/9/2004	0.56	7.5	< 1	38.75	550.1
5/23/2005	0.75	33.67	< 1	73	516.1
10/27/2006	1.55	31.17	< 1	159.83	1098
11/7/2006	1.66	26.5	< 1	131.33	958.3
11/15/2006	1.75	7.92	< 1	68.92	662.2
11/22/2006	1.17	27.67	< 1	140.33	701
12/22/2006	1.05	5.0	< 1	214.25	693
12/15/2007	0.99	13.5	< 1	42.5	786.8
3/4/2008	1.03	14.25	< 1	246.75	603.4
3/7/2008	0.72	28.0	< 1	54.25	357.8
4/3/2008	0.72	20.25	< 1	54.5	448.3

* - Flow was only recorded at the downstream station. The quantity of water leaving the Stormceptor© was assumed equal to the quantity entering (Jones 2009).

Table TA-3.37. Storm concentrations and loadings of chemicals sampled at the Cloverly Safeway Stormceptor®. Loadings were not calculated for total petroleum hydrocarbons (TPH) because this parameter was collected as a “first flush” grab sample. Total suspended solids (TSS) data was not available predating 5/23/2005.

Storm Event Date	TPH Inlet	TPH Outlet	Cadmium Inlet	Cadmium Outlet	Copper Inlet	Copper Outlet	Lead Inlet	Lead Outlet	Zinc Inlet	Zinc Outlet	TSS Inlet	TSS Outlet
Analytical Concentration (mg/L)												
5/9/2003	B.D.L.	B.D.L.	B.D.L.	B.D.L.	0.012	0.012	0.003	0.003	0.13 (†)	0.12 (†)	n.a.	n.a.
7/28/2003	B.D.L.	B.D.L.	0.0061(†)	0.005 (†)	0.011	0.013 (†)	0.01	0.161(†)	0.072	0.079	n.a.	n.a.
4/12/2004	B.D.L.	B.D.L.	B.D.L.	B.D.L.	0.008	0.008	0.003	0.002	0.068	0.057	n.a.	n.a.
9/28/2004	B.D.L.	B.D.L.	B.D.L.	B.D.L.	0.01	0.008	0.003	0.003	0.037	0.034	n.a.	n.a.
12/9/2004	3	3	B.D.L.	B.D.L.	0.008	0.006	B.D.L.	B.D.L.	0.039	0.029	n.a.	n.a.
5/23/2005	2	7	B.D.L.	0.0023 (†)	0.008	0.004	B.D.L.	B.D.L.	0.062	0.034	17	6
10/27/2006	n.s.	n.s.	B.D.L.	B.D.L.	0.016 (†)	0.006	0.004	B.D.L.	0.2 (†)	0.05	140	5
11/7/2006	n.s.	n.s.	B.D.L.	B.D.L.	0.006	0.005	B.D.L.	B.D.L.	0.057	0.074	9	7
11/15/2006	3	5	B.D.L.	B.D.L.	0.005	0.005	B.D.L.	B.D.L.	0.062	0.056	47	20
11/22/2006	n.s.	n.s.	B.D.L.	B.D.L.	0.005	0.004	B.D.L.	B.D.L.	0.071	0.057	8	8
12/22/2006	n.s.	n.s.	B.D.L.	B.D.L.	0.006	0.007	0.004	0.005	0.081	0.072	10	10
12/15/2007	n.s.	n.s.	B.D.L.	B.D.L.	0.0079	0.0074	B.D.L.	B.D.L.	0.04	0.03	8	8
3/4/2008	n.s.	n.s.	B.D.L.	B.D.L.	0.0041	0.005	B.D.L.	B.D.L.	0.041	0.037	16	20
3/7/2008	n.s.	n.s.	B.D.L.	B.D.L.	0.0047	0.0048	B.D.L.	B.D.L.	0.036	0.03	6	11
4/3/2008	n.s.	n.s.	B.D.L.	B.D.L.	0.0058	0.0048	B.D.L.	B.D.L.	0.035	0.024	3	3
Pollutant Loadings (g)												
5/9/2003	n.c.	n.c.	n.c.	n.c.	1.6	1.6	0.4	0.4	17.8	16.5	n.a.	n.a.
7/28/2003	n.c.	n.c.	3.9	3.2	7	8.2	6.3	102	45.7	50.1	n.a.	n.a.
4/12/2004	n.c.	n.c.	n.c.	n.c.	7.6	7.6	2.8	1.9	64.4	54	n.a.	n.a.
9/28/2004	n.c.	n.c.	n.c.	n.c.	7.1	5.7	2.1	2.1	26.3	24.1	n.a.	n.a.
12/9/2004	n.c.	n.c.	n.c.	n.c.	4.2	3.3	n.c.	n.c.	20.6	16	n.a.	n.a.
5/23/2005	n.c.	n.c.	n.c.	1.2	4.1	2.1	n.c.	n.c.	32	17.5	8773.1	3096.4
10/27/2006	n.s.	n.s.	n.c.	n.c.	17.6	6.6	4.4	n.c.	219.6	54.9	153724.9	5490.2
11/7/2006	n.s.	n.s.	n.c.	n.c.	5.8	4.8	1.9	n.c.	54.6	70.9	8625.1	6708.4
11/15/2006	n.c.	n.c.	n.c.	n.c.	3.3	3.3	n.c.	n.c.	41.1	37.1	31122.1	13243.4
11/22/2006	n.s.	n.s.	n.c.	n.c.	3.5	2.8	n.c.	n.c.	49.8	40	5607.9	5607.9
12/22/2006	n.s.	n.s.	n.c.	n.c.	4.2	4.9	2.8	3.5	56.1	49.9	6929.6	6929.6
12/15/2007	n.s.	n.s.	n.c.	n.c.	6.2	5.8	n.c.	n.c.	31.5	23.6	6294.4	6294.4
3/4/2008	n.s.	n.s.	n.c.	n.c.	2.5	3	n.c.	n.c.	24.7	22.3	9653.7	12067.1
3/7/2008	n.s.	n.s.	n.c.	n.c.	1.7	1.7	n.c.	n.c.	12.9	10.7	2147.0	3936.1
4/3/2008	n.s.	n.s.	n.c.	n.c.	2.6	2.2	n.c.	n.c.	15.7	10.8	1345.0	1345.0

B.D.L. - Below Detection Limit (Refer to Table TA-3.24)

(†) At or above acute criteria value (Refer to Table TA-3.24)

n.c. - Not Calculated (Loadings not calculated if concentration was below detectable limit and since TPH was collected as a "first flush" grab)

n.s. - Not Sampled

n.a. - Not Available

TA-3.5 Discussion of SPA BMP Effectiveness

There are no technical appendix materials for this section.

Note to Reader

For more information on Section 3 or technical appendix materials, please contact DEP at AskDEP@montgomerycountymd.gov, 240-777-7700.

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