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Special Protection Area Program Annual Report 2011

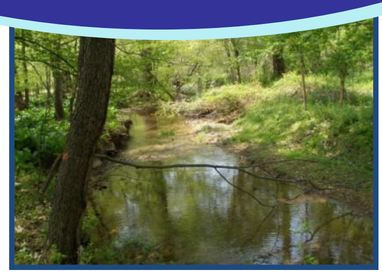
SPECIAL PROTECTION AREAS
MONTGOMERY COUNTY, MARYLAND




"The County Council finds that streams, rivers, wetlands, and other sensitive environmental features in Montgomery County constitute an important natural resource. ... Protection of fragile watershed areas will help restore and maintain the integrity of the Anacostia River, Potomac River, and Patuxent River within Montgomery County and the Chesapeake Bay."

Article V. Water Quality Review in Special Protection Areas, Sec. 19-60. Findings and purpose.






Prepared by the Montgomery County Department of Environmental Protection in Cooperation with the Department of Permitting Services and the Maryland-National Capital Park and Planning Commission

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Executive Summary

The Special Protection Area (SPA) program was initiated in 1994 by County law. According to the Montgomery County Code, Section 19-61(h), a Special Protection Area is defined as:

"a geographic area where:
(1) existing water resources, or other environmental features directly relating to those water resources are of high quality or unusually sensitive; and
(2) proposed land uses would threaten the quality or preservation of those resources or features in the absence of special water quality protection measures which are closely coordinated with appropriate land use controls."

SPA monitoring provides information to help evaluate: (1) the effectiveness of the SPA program in minimizing development-related impacts to sensitive streams; and, (2) the efficiency, performance, and effectiveness of best management practices (BMPs) in reducing pollutants. This Annual Report covers the 2011 monitoring year for the County's four SPAs.

This year's report focuses on comparing results from the 2011 monitoring year with general results from earlier years. All data used for this report and earlier years is available upon request from the Department of Environmental Protection (DEP). This report includes results for monitoring in all four SPAs but the majority of the results presented are for the Clarksburg SPA. This SPA has the greatest intensity of planned development and has had the greatest amount of land use change due to new development.

Best Management Practice Monitoring

There are a total of 52 best management practice (BMP) projects with ongoing or completed monitoring as of 2011. Twenty-seven projects are ongoing: 7 in the pre-construction phase, 12 in the during construction phase (8 active and 4 in-transition), and 8 in post-construction (Figure 3.1). Twenty-five projects satisfied monitoring requirements prior to 2011.

Current BMP monitoring utilizes automated samplers to evaluate pollutant removal efficiency by measuring the amount of pollutant entering a BMP versus the amount of pollutant exiting a BMP. The data from automated sampling at Erosion and Sediment Control (E&SC) BMPs show an increase in median removal efficiency over that reported previously using grab sample data. A limited amount of data is now available for the post construction monitoring conducted at several properties. The eight BMPs being monitored appear to perform as designed, although a wide range of efficiencies were reported, from negative removal to almost 100% efficiency. A conclusive evaluation of the effects of development cannot be completed until the watershed is built out and the land use change is stabilized.

Stream Characteristics

Changes in stream characteristics are linked to both changes in land-use and subsequent changes in hydrology (runoff pattern) and geomorphology (physical conditions). As flow regimes are altered through changes in drainage and run off patterns, the streams' geomorphology and response to rainfall also change. Results are shown from a paired watershed study for the Clarksburg SPA to compare changes between a test area undergoing development (Newcut Road Neighborhood tributary) and a control area experiencing minimal land-use change (Soper's Branch). Monitoring data since 2003 suggests that the Newcut Road Neighborhood tributary responds more rapidly to rainfall and shows more changes in its cross sections and a less stable stream system than in Soper's Branch.

Stream temperature is also affected by land-use change, particularly clearing of forest and other vegetated cover. Stream temperature was monitored in all four SPAs using continuous recording meters from early June through the end of September. No changes in patterns from previous years were observed in 2011. Stream temperature is further discussed in Section 3.

Biological Monitoring

In 2011, 10 out of 45 stations underwent a change in stream conditions across the four SPAs when compared to 2010 conditions. One station showed improvement, while 9 declined by at least one narrative category. In the Clarksburg SPA, a total of 5 out of 25 stations showed a decline in stream conditions. The Cabin Branch watershed had one out of four stations decline, going from excellent to fair. One of the two Town Center tributary stations declined from fair to poor. The most downstream station from the new construction in the Clarksburg Neighborhood declined from good to fair. In the Ten Mile Creek watershed, two stations changed from good to fair. All other Clarksburg SPA stations had no change in stream conditions.

In the Upper Paint Branch SPA, a total of 3 out of 11 stations declined in stream condition. Stream conditions declined by a narrative category in the Good Hope Tributary, while the upper Good Hope declined from good to fair and lower Good Hope declined from excellent to good. The lower Gum Springs declined from excellent to good. There was no change in narrative categories within the Right Fork where most of the development within the SPA took place. The upper Left Fork improved from fair to good.

In the Piney Branch SPA, one station out of 4 stations declined from fair to poor. There was no change in stream conditions within the Upper Rock Creek SPA stations.

Possible causes of the decline in stream conditions may be associated with stressors resulting from the development process. These stressors may include the conversion and compaction of parent soils, changes in natural drainage pathways, additions of impervious surfaces, grading and alteration of existing slopes and changes in stream hydrology. Changes within the specific SPAs and possible causes are further discussed in Section 4.

Introduction

Purpose

The 2011 SPA Report summarizes the monitoring conducted in streams and on BMPs within SPAs. The SPA reports are submitted to the County Executive and County Council with a copy to the Planning Board. The report is also available on the DEP website at http://www.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/spareports.asp.

This Report meets the requirements of Montgomery County Code Chapter 19, Article V (*Water Quality Review: Special Protection Areas*), Section 19-67. The Special Protection Area (SPA) program is implemented through Executive Regulation 29-95: *Water Quality Review for Development in Designated Special Protection Areas*.

Background

SPA Program

The SPA program was initiated in 1994 by County law. According to the Montgomery County Code, Section 19-61(h), a Special Protection Area is defined as:

"a geographic area where":
(1) existing water resources, or other environmental features directly relating to those water resources are of high quality or unusually sensitive; and
(2) proposed land uses would threaten the quality or preservation of those resources or features in the absence of special water quality protection measures which are closely coordinated with appropriate land use controls."

Four areas within Montgomery County are designated as SPAs (Figure 1.1), Clarksburg, Piney Branch, Upper Paint Branch, and Upper Rock Creek. All four SPAs have existing water resources or other environmental features that are of high quality or unusually sensitive.

The Piney Branch SPA and the Clarksburg SPA were created with very limited or no imperviousness caps for new development. In the Clarksburg Master Plan, there is a 15% impervious limit recommended for industrial sites on the west side of I-270. As the importance of minimizing imperviousness levels to maintain healthy stream conditions became better understood, the establishment of the Upper Paint Branch SPA was accompanied by an Environmental Overlay Zone, adopted in July 1997. The 1997 environmental overlay zone included a 10% impervious cap on new development, as well as restrictions on specific land uses that typically have significant adverse environmental impacts on sensitive natural resources. This Overlay Zone was amended in 2007 to revise the imperviousness limit for new development downwards to 8%. The Upper Rock Creek SPA designation was accompanied by an Environmental Overlay Zone on October 26, 2004, which designates an 8% imperviousness limit on new private residential subdivisions that are served by community sewer.

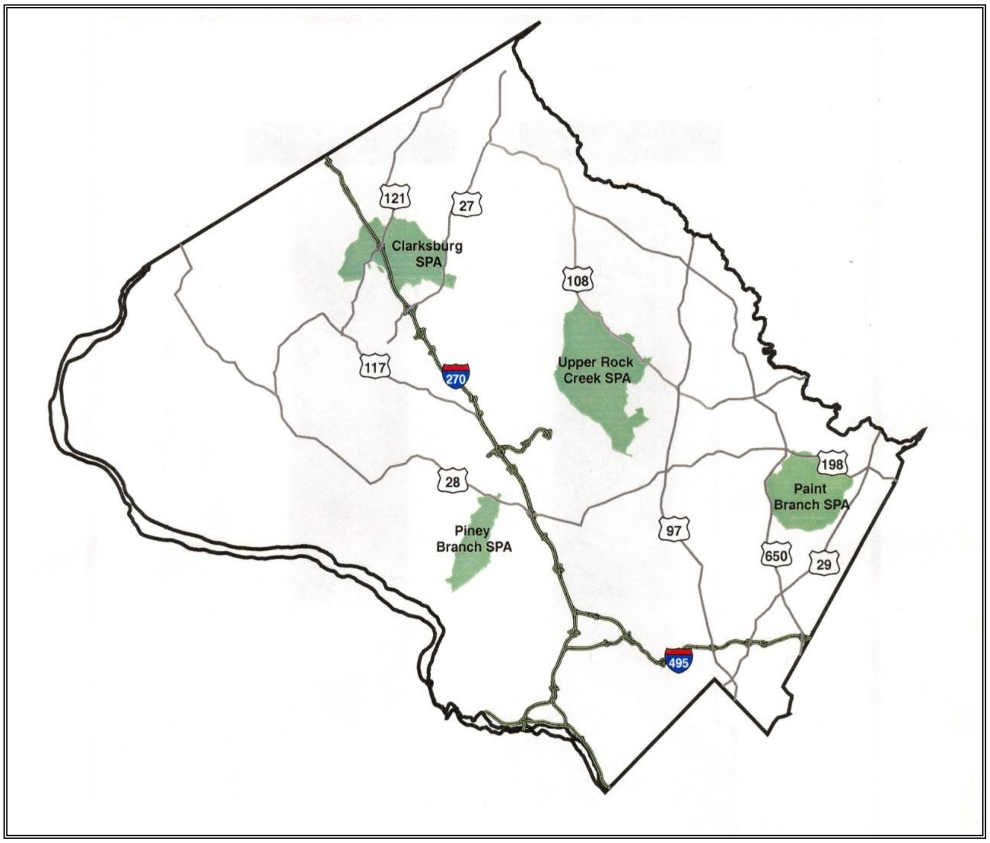


Figure 1.1. Location of Special Protection Areas in Montgomery County.

The SPA program requires the Montgomery County Departments of Permitting Services (DPS) and Environmental Protection and the Maryland-National Capital Park and Planning Commission (M-NCPPC) to work closely on SPA development projects.

Monitoring in Special Protection Areas

The SPA monitoring program requires developers to evaluate the ability of BMPs to minimize development impacts to the receiving streams. E&SC BMPs are installed on the construction site before initial land disturbing activities begin. They are designed to capture sediment-laden runoff generated during construction. After construction is complete and the site is stabilized, E&SC BMPs are converted to or replaced with stormwater management (SWM) BMPs. SWM BMPs are installed to attenuate storm flows (quantity control) and capture pollutants (quality control).

In conjunction with the monitoring performed by the developer, the DEP performs physical stream characteristic (Section 3) and biological stream monitoring (Section 4) assessments to study the cumulative effects of development in the watershed.

2.0 BMP Effectiveness

SPA BMP monitoring projects are evaluated based on BMP efficiency, performance, and effectiveness. Developers are responsible for funding the monitoring within their property's limits to document achievement of the SPA performance goals set as part of the Water Quality Review Process.

2011 SPA BMP Monitoring Status

BMP efficiency compares the amount of pollutant entering the BMP to the amount of pollutant leaving the BMP. Either pollutant concentrations from grab samples or loading values from flow-weighted samples collected by automated samples are used for this measure.

BMP performance evaluates how well the BMP is removing pollutants compared to literature values.

BMP effectiveness is the ability of the BMP and site design to meet one or more of the SPA program performance goals.

There are 52 ongoing or completed monitoring projects as of 2011. Twenty-seven projects are ongoing: 7 in the pre-construction phase, 12 in the during construction phase (8 active and 4 in-transition), and 8 in post-construction (Figure 2.1). Twenty-five projects satisfied monitoring requirements prior to 2011.

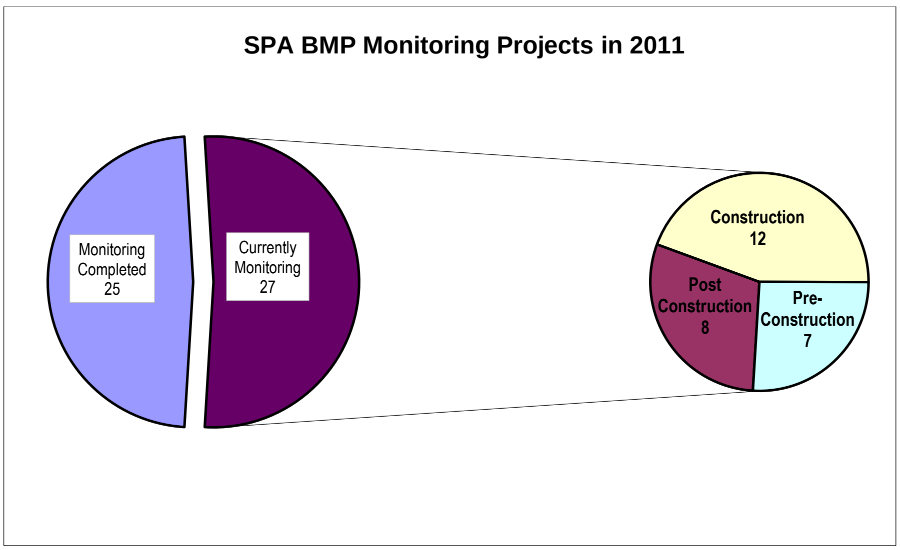


Figure 2.1. SPA BMP Monitoring Project Completion Status in 2011.

Clarksburg SPA Project Status

Figure 2.2 shows location and status of 22 monitoring projects in the Clarksburg SPA. Seven projects have completed monitoring as of 2011 (Numbers: 1, 3, 4, 5, 10, 17, and 21). Four projects in Clarksburg are in the pre-construction phase. Baseline data collection requirements for groundwater characteristics at the Goddard School (#12) were satisfied in 2011. Baseline monitoring requirements for the Cabin Branch (#2) development were satisfied in December 2009. Groundbreaking at these two projects is anticipated to take place in 2012. The Garnkirk (#9) and Tapestry (#20) developments continue to remain on hold.

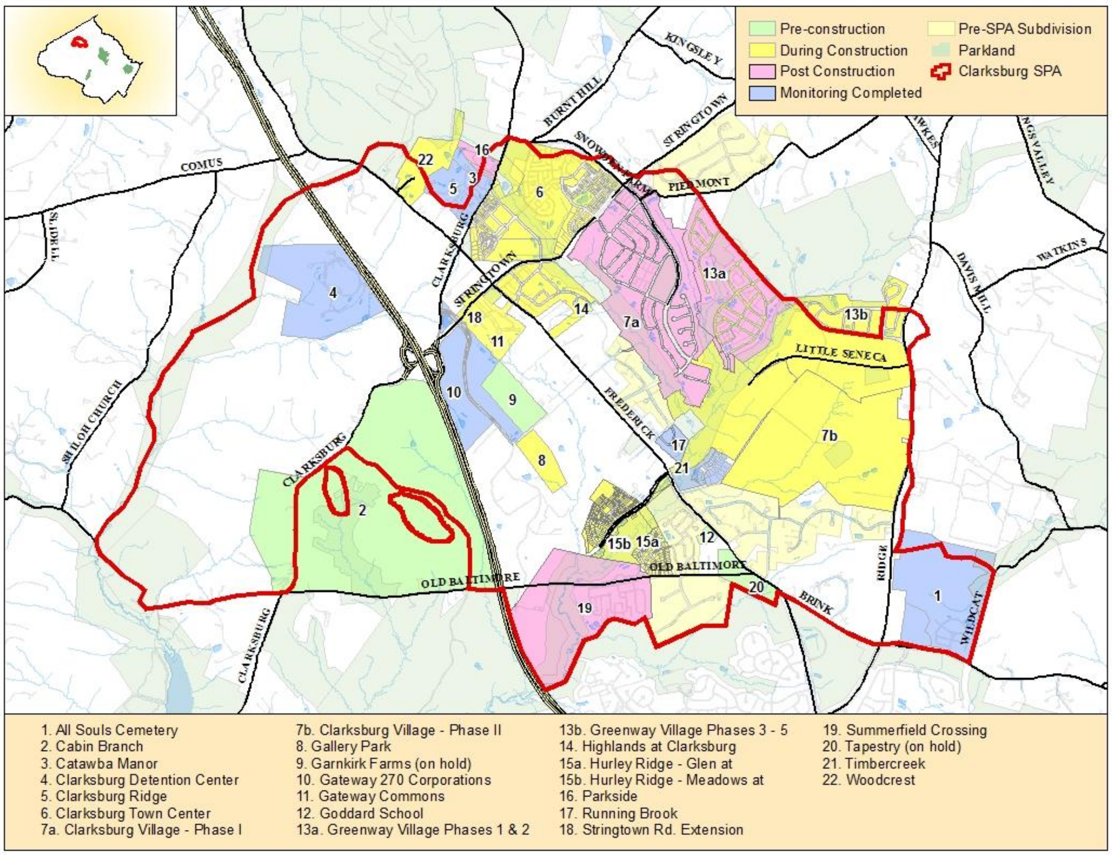


Figure 2.2. 2011 Status of Clarksburg SPA Monitoring Projects.

Nine projects in Clarksburg are in the during construction phase. Construction period monitoring on Clarksburg Village, Phase II (#7b) began in spring 2011. Construction on Gallery Park (#8) began in January 2010; TSS sampling was initiated in the third quarter of 2011. Construction period monitoring at Greenway Village Phases 3-5 (#13b), Gateway Commons (#11), and Woodcrest (#22) is ongoing. Four projects (Clarksburg Town Center-#6, Glen at Hurley Ridge-#15a, Highlands at Clarksburg-#14, and the Stringtown Road Extension-#18) are waiting for as-built approval and certification, and issuance of a post construction monitoring bond, to move into the post-construction monitoring phase.

Four projects in Clarksburg are in the post-construction monitoring phase. A temperature study at a sand filter BMP in Parkside (#16) in 2009 is ongoing. A Stormfilter® and a surface sand filter-dry pond treatment train are being monitored in the Summerfield Crossing (#19) development. Data on pollutant removal efficiency was successfully collected for three storms. A temperature study to determine impacts to Little Seneca Creek from the Summerfield Crossing project has also been underway since 2003. Two biofilters are being monitored at Greenway Village Phases 1 & 2 (#13a). Data on pollutant removal efficiency was successfully collected at one biofilter for two storm events. Clarksburg Village Phase I (#7a) BMP efficiency monitoring is anticipated to begin in 2012.

Upper Paint Branch SPA Project Status

Nine projects in the Upper Paint Branch SPA have completed monitoring (Figure 2.3).

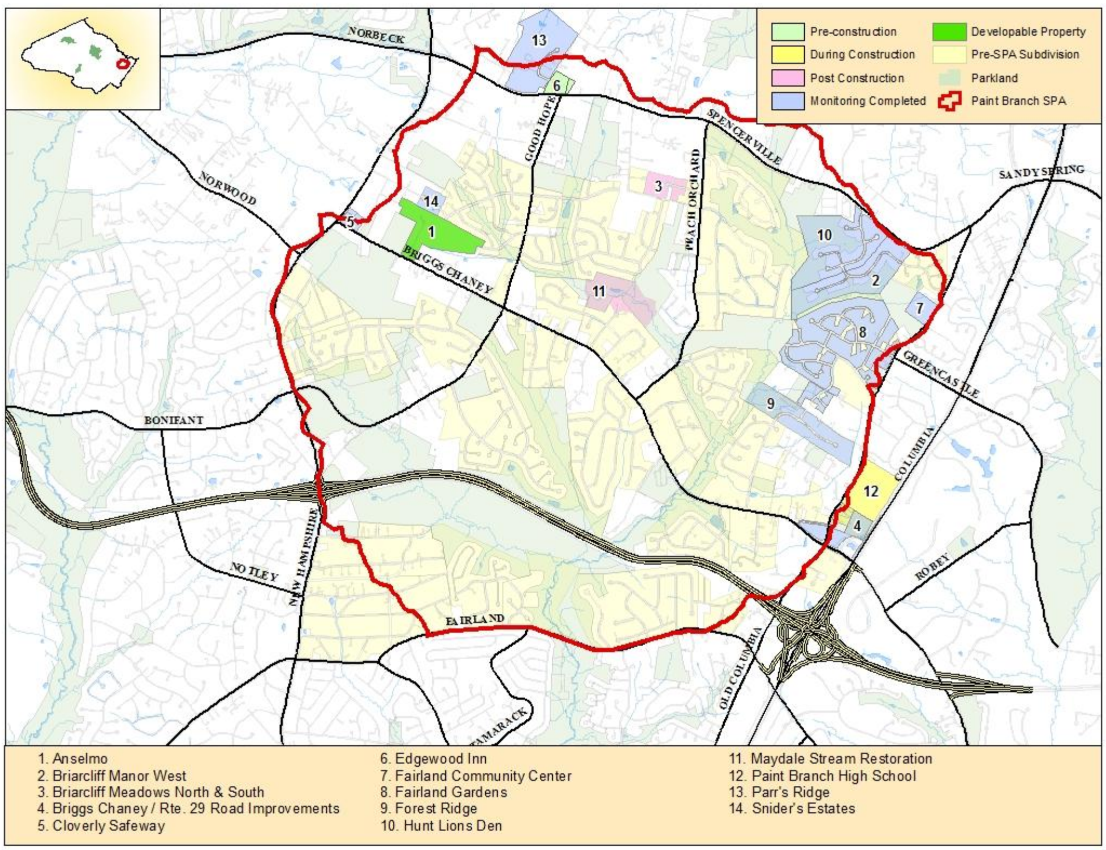


Figure 2.3. 2011 Status of Upper Paint Branch SPA Monitoring Projects.

No projects are currently in the pre-construction phase. The Anselmo property (#1) is one of the last large developable parcels. In 2011, the development application process was underway but preconstruction monitoring had not been initiated. All other recent development applications have been for small construction activities. In 2011, during construction TSS monitoring was conducted at Paint Branch High School (#12) at one structural BMP for the portion of the site lying in the SPA (2.75 acres).

Two projects are in the post-construction monitoring phase. A stream restoration project at the Maydale Nature Center (#11) located on the Left Fork of Paint Branch was completed October 2010. The project involved removal of fish blockages and other stream and riparian habitat improvement measures such as bank stabilization and wetland enhancement and protection. The first year of post construction monitoring was initiated in 2011. This project will be monitored in 2013 and 2015, three and five years post construction, respectively. A sand filter and a biofilter were monitored for pollutant removal efficiency at Briarcliff Meadows North & South (#3) starting in 2009. In 2011, data on pollutant removal efficiency was successfully collected for three qualifying storm events.

Piney Branch SPA Project Status

The Piney Branch SPA is near the maximum build out allowed under the current Master Plan. The only monitoring projects still active in the Piney Branch SPA are Traville (#8) and Traville-Human Genome Sciences (#7) (Figure 2.4). Both projects are in post construction. Two sand filters are currently being monitored at the Traville property. Water chemistry and groundwater recharge monitoring at Traville-Human Genome Sciences were scheduled to begin in July 2012.

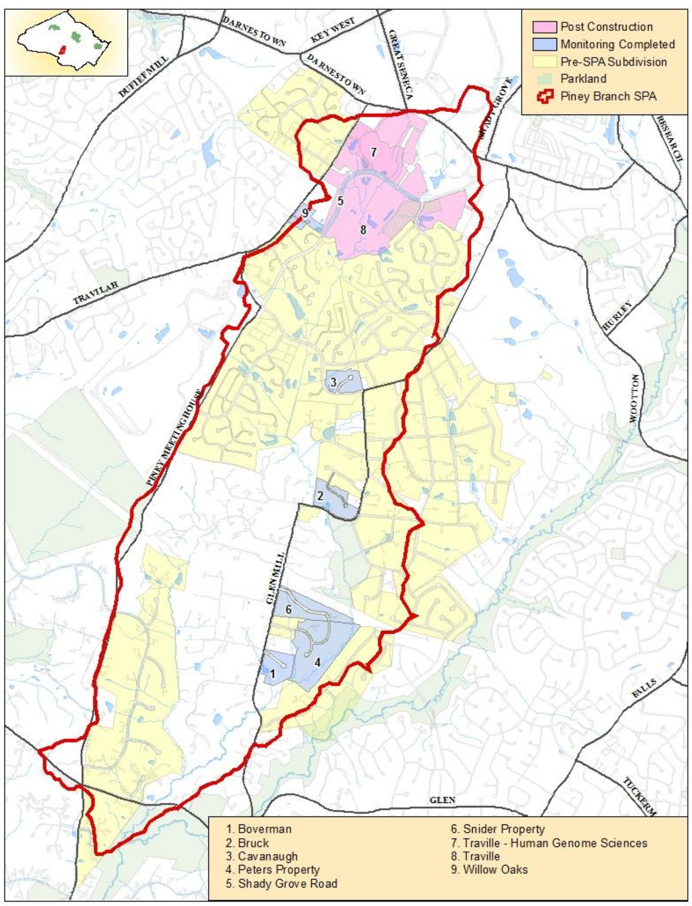


Figure 2.4. 2011 Status of Piney Branch SPA Monitoring Projects.

Upper Rock Creek SPA Project Status

Two projects are in the preconstruction phase- the Laytonia Recreational Park and the Montgomery County Animal Shelter Hill (#3) (Figure 2.5). A plan for the Laytonia Recreational Park was approved in 2001 (prior to the creation of the SPA) with a total imperviousness of over 18% for the 49-acre parcel. Revised plans were submitted in 2009 to set aside seven acres for construction of a new Montgomery County Animal Shelter and to reduce the original planned impervious levels. To meet master plan and facility needs, the final site layout is anticipated to be around 10% impervious, so will still exceed the 8% impervious limit for this SPA.

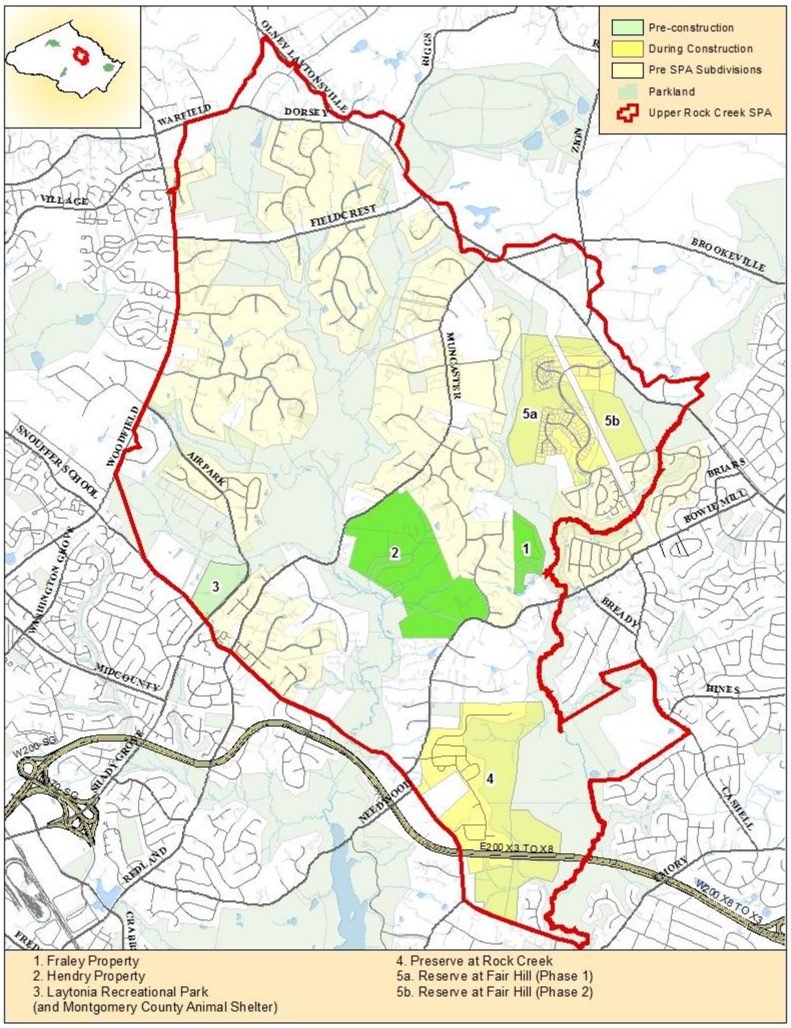


Figure 2.5. 2011 Status of Upper Rock Creek SPA Monitoring Projects.

Baseline data collection on groundwater elevations and chemistry for the recreation park portion of the parcel were satisfied in 2010. The Montgomery County Animal Shelter will drain primarily away from the SPA into Mill Creek. No pre-construction on-site monitoring requirements were set for the Animal Shelter. The Fraley property (#1) and the Hendry property (#2) are two of the last large developable parcels remaining in Upper Rock Creek.

Two projects are in the during-construction monitoring phase. The Preserve at Rock Creek (#4) broke ground in 2011. The Reserve at Fair Hill Phase 1 and Phase 2 (#5a and #5b) began monitoring during construction conditions in May 2007. No sediment basin TSS removal efficiency monitoring was required at either project.

Water quality monitoring data are also being collected in Upper Rock Creek for SWM BMPs along the Inter County Connector (ICC). This includes both biological monitoring and water temperature measurements. The ICC opened during late 2011 and data analysis is deferred until the SWM structures are online for a minimum of one year.

BMP Monitoring

BMP monitoring prior to 2001 evaluated BMP effectiveness based on stream and hydrological conditions as well as water quality parameters. Stations for BMP monitoring were established where the stormwater for the site discharged via outfall into the receiving stream. BMP monitoring after 2001 paired data collection on the stream's physical characteristics with the performance of specific structural BMPs in the drainage area to that stream. Current BMP monitoring evaluates pollutant removal efficiency by comparing the amount of pollutant entering a BMP to the amount of pollutant being discharged from that BMP.

BMP performance is evaluated by comparing the amount of pollutant in the runoff entering the BMP to the amount of pollutant leaving the BMP. Information on evaluating BMP efficiency using percent removal is provided in the 2010 SPA Report (DEP 2012). The removal efficiency can be calculated from results of either grab sampling or from automated samplers that collect storm flow entering and leaving BMPs. Results of grab and automated sampling cannot be directly compared.

Flow-weighted composite BMP sampling can be reported using several different methods (Strecker et al. 1999). Individual storm load efficiency was the method selected to analyze the SPA monitoring results. Load efficiency of a structure is considered more accurate than examining efficiency independent of water volume, as is the case for grab samples. Automated flow-weighted composite sampling better represents pollutant concentrations over the duration of a storm event and the pollutant loadings delivered to receiving streams.

Beginning in 2004, automated samplers were required for both E&SC and SWM BMP monitoring. They are used to collect stormwater samples at time or flow intervals based on the estimated duration of the storm event. Following the event, samples are manually composited based on amount of stormflow to characterize the quality of stormwater discharge. Load reduction and BMP percent removal efficiencies are calculated by comparing inflow to outflow loads, that is, how much total pollutant enters the BMP compared to how much pollutant is leaving the structure.

Erosion and Sediment Control (E&SC) BMP Monitoring

Performance of an E&SC BMP is evaluated during construction by measuring the removal efficiency of total suspended solids (TSS).

There are very little data and scientific literature available for evaluating the efficiency of E&SC BMPs at capturing TSS. More research is needed to reveal factors that cause E&SC BMPs to function well or poorly.

Several variables have been identified as sources of disparity (CWP 2007), including:

- the amount and type of sediment disturbing activities occurring at the site at the time of sampling
- the number of storms sampled and the characteristics of each (i.e. rainfall and accumulation, duration, flow rate, particle size of each)
- the monitoring technique employed
- the internal geometry and storage volume and design features of the structure
- the size and land use of the contributing catchment

Grab Sampling for TSS

The last project, which used grab sampling for E&SC BMP effectiveness, began monitoring in 2004. That project satisfactorily met during-construction monitoring requirements in 2010. Data collected via the grab sample method can be used to provide a general assessment of pollutant removal efficiency by comparing the difference (expressed as a percentage) between the concentrations of pollutants entering the BMP (influent) versus the concentration leaving the BMP (effluent) at a discreet point in time, but is not representative of the entire storm event. Concentrations of TSS may vary throughout a storm event and grab sampling may not always capture the first concentrated flush at the inlet.

As documented in the 2010 SPA report (DEP 2012), grab sampling of TSS at E&SC BMPs showed that sample events where concentrations of sediment entering the BMP exceeded 100mg/l generally resulted in greater percent reduction in sediment concentrations than when sediment concentrations entering the facility were below 100mg/l. Additionally, it was shown that higher outfall concentrations are observed late in the construction process. This was unexpected because at this phase there is less exposed earth on a site than during construction. More sediment may be leaving the structure than entering in stormwater due to the re-suspension of fine clays and silts already accumulated in the sediment basin. These findings have prompted DPS and DEP to push for conversion from E&SC to SWM BMPs in developments when the disturbance to the majority of the drainage area to the BMP has ceased and any residual construction and sediment control can be attained by individual “on lot” controls. E&SC BMPs are designed to slow and remove sediment. They are not designed to provide treatment of stormwater quantity or quality nor to release the stormwater at the rate required for long-term protection of instream physical conditions. They will work very effectively as long as they are maintained but maintenance of these ‘temporary’ structures is very costly.

Flow-weighted Composite TSS Sampling

Automated sampling data from 34 storm events are now available from five E&SC BMPs in Clarksburg and one in Paint Branch. TSS loading reductions were calculated for 25 storms (Figure 2.6). Generally, reported TSS removal efficiency was very high. As of 2011, median and average efficiency was greater than 85% overall (Figure 2.7). There were only three instances where loadings were reduced by less than 50%, two of which resulted in negative percent removal (-44% and -200%).

The high TSS loading reductions were attributed to redundancy measures (dual cell basins) and over-sized basins. For instance, Gateway Commons had an average TSS loading reduction of 95%, but recent data shows evidence that the first cell is declining in performance- causing an overall decline in performance. However, despite experiencing a decline in performance, the redundancy measure of two cells continues to reduce TSS loadings to protect the receiving streams. As with grab samples, generally the lowest net reductions, including the negative reductions, were observed when TSS loads entering the facility were minimal. The greatest negative percent reduction (-200% at Greenway Village) resulted in only a net loss of less than seven pounds of sediment during that storm event.

In 2011, sampling was conducted at two projects, Gallery Park and Paint Branch High School, producing TSS loadings reduction data from two storm events. Data showed that TSS was being effectively reduced at the two E&SC BMPs. The Gallery Park BMP had an overall TSS loading reduction of 62% for the one storm that was monitored and the Paint Branch High School BMP had an overall TSS loading reduction of 90% for the two monitored storms. The relatively low reduction observed at Gallery Park may be result of an intense storm (2.31 inches of rain in two hours) coupled with the relatively large and heavily disturbed drainage area (16.1 acres).

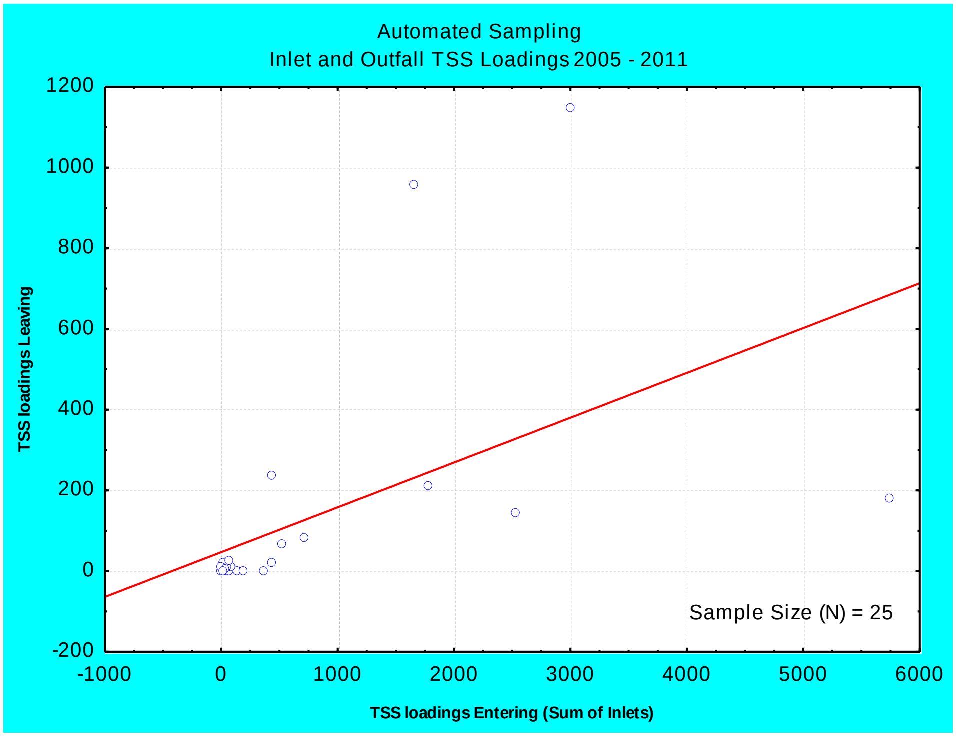


Figure 2.6. TSS Loadings, in Pounds, Entering Versus Leaving for Five Erosion and Sediment Control BMPs in Clarksburg and One in Paint Branch for 25 storm events.

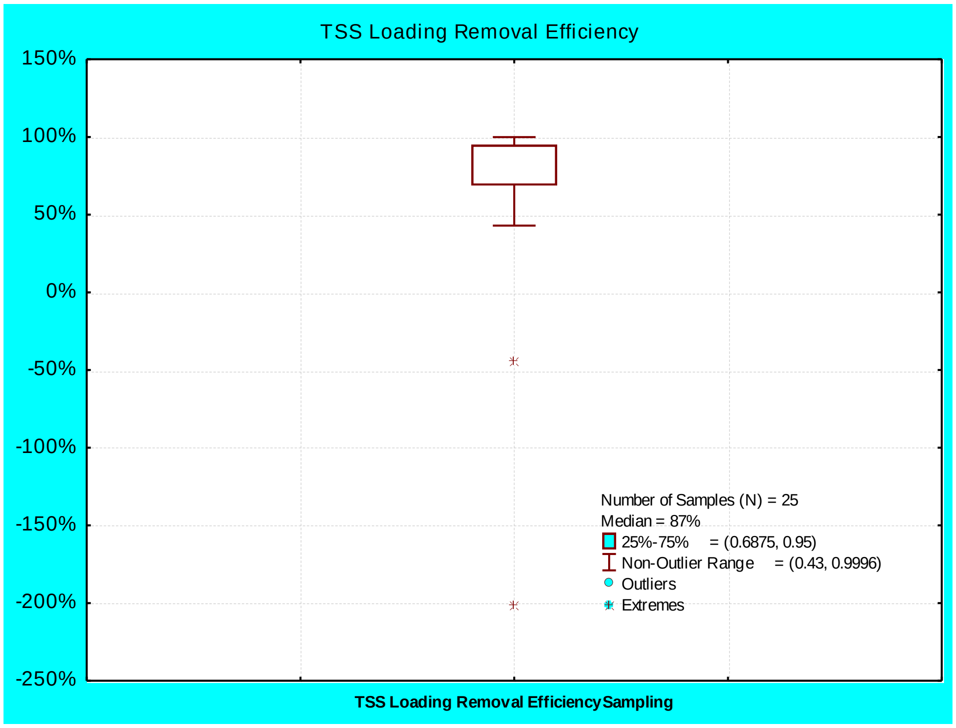


Figure 2.7. Average, Maximum, Minimum, and Median TSS Loading Removal Efficiencies for monitored E&SC BMPs through 2011 (Automated Sampling Data).

Stormwater Management (SWM) BMP Monitoring

Post construction BMP monitoring evaluates the efficiency of SWM BMPs in reducing pollutant loadings and the effectiveness of BMPs at achieving site performance goals. Post construction monitoring cannot begin until the construction on the property is complete, the site is stabilized, and the E&SC BMPs are converted to SWM BMPs. The developer posts a post construction monitoring bond and the DPS issues a monitoring permit. Monitoring can extend up to five years post construction. Data are collected by using automated samplers to collect flow-weighted composite storm samples. Although monitoring SWM BMPs is not as difficult as monitoring E&SC BMPs, it is still quite challenging. Ponding or backwater issues, equipment failure, or flow measurement distortion have continued to limit the amount of available flow-weighted composite data that can be evaluated for efficiency of SWM BMPs.

An increasing number of projects are beginning to collect SWM BMP monitoring data. Many projects are early in the process and the dataset is further limited by sampling challenges. Monitoring consultants are required to submit quarterly progress reports detailing whether monitoring is on schedule and list what problems have been encountered. The DEP and DPS have also continued to promote meetings and planning prior to the commencement of monitoring. Establishment of a separate post construction monitoring bond is an important measure in keeping developers, and their hired monitoring consultants, accountable and ensuring that monitoring requirements are being fulfilled.

In 2011, SWM BMP monitoring occurred at six properties. BMPs monitored in the Clarksburg SPA include two biofilters at Greenway Village, and a StormFilter® and a SWM treatment train consisting of two sand filters and a dry pond at Summerfield Crossing. A temperature study on the surface sand filter at Parkside began June 2009. BMPs monitored in the Piney Branch SPA include a dual-cell sand filter and a single cell sand filter with biofiltration at the Traville properties. BMPs monitored in the Upper Paint Branch SPA include a "side-by-side" comparison of a sand filter and a biofilter at Briarcliff Meadows, formerly referred to as Briarcliff Meadows North and South. A summary of the monitored BMPs is provided in Table 2.1.

Table 2.1. Characteristics of SPA BMPs Monitored During 2011.

SPA	**Project**	**Design**	**Pretreatment**	**Capacity** (cubic feet (cf))	**Drainage Area** (acres)	**# of Reported Storm Monitoring Attempts ****
Clarksburg	Parkside	Two sand filters in series	None	19,109	9.7	n/a*
	Summerfield Crossing	Two sand filters in parallel (flow splitter)	Vegetated swale, Bay Saver	138,761	39.8	2
		StormFilter	Vegetated Swale, Bay Saver	4,842	3.5	3
	Greenway Village	Biofilter	None	2,780	0.94	2
Piney Branch	Traville	Single Cell sand filter w/biofiltration	Bay Saver, Storm Scepter	Not provided	26	4
		Single Cell sand filter	Storm Scepter	10,890	4.7	4
Upper Paint Branch	Briarcliff Meadows	Single Cell sand filter	Vegetated Swales	3,206	3.8	3
		Biofilter	Vegetated Swales	2,222	1.75	3

* - The sand filter at Parkside is being monitored for continuous temperature from June through September, annually.
** - Monitoring attempts may not necessarily produce sampling data or results.

Sand filters have a range of removal efficiencies and are generally effective at removing total suspended solids, with removal efficiencies of 66% to 95% (CWP; EPA 1996). Removal efficiencies have been calculated for twenty-two storm events at three structures with differing designs. Generally, efficiencies were in agreement with the published rate of removal for TSS, although removal rates were markedly diminished (or even resulted in negative removal rates) during larger storm events. Nutrient removal rates generally ranged from 9% to 100%, with a median removal rate of 67%. Metal removal rates generally ranged from 15% to 100%, with a median removal rate of 89%. Nitrite, Cadmium, and Lead were typically present in levels too low to detect.

Biofilters also have a range of removal efficiency (CWP; EPA 1996). A limited amount of data for two structures is now available. Calculated loading reductions for ten storm events indicate that overall the biofilters are performing within the expected range of efficiency. In several instances, the removal efficiency exceeds the expected range, due to no flow leaving the facility. Where flow was observed leaving the facility, the biofilters appear to be performing at the lower end of the expected range for nutrient and TSS reduction. Negative loading reductions for nitrate and phosphate were regularly observed at one facility (Briarcliff Meadows). Generally, biofilters exhibited lower loading reduction rates for TSS during larger storm events. The sand filters and biofilters monitored were only designed to treat the first one-inch of runoff over the contributing impervious areas. It is possible that this contributes to their reduced efficiency during storm events greater than one inch.

SPA BMP Effectiveness Summary

Completed Monitoring Projects in 2011

Completed projects allow the evaluation of onsite conditions throughout the development process. Monitoring is completed at 25 SPA projects and ongoing at 27. The majority of ongoing monitoring projects continue to be in the during construction phase, although approximately half of these projects are approaching build out. Six projects were collecting data on post construction conditions in 2011, five of these projects have been in post construction since 2009, and one project transitioned to post construction early in 2011. No projects fulfilled monitoring requirements in 2011. No projects are anticipated to fulfill monitoring requirements in 2012.

Conclusions

The DEP and DPS continue to strive towards improving consultant success at collecting automated flow-weighted composite samples at E&SC and SWM BMPs and to help minimize impacts through the development process. Generating this data is important for providing a long-term assessment of stream conditions throughout the development process. The data produced from automated sampling at E&SC BMPs shows an increase in median removal efficiency over that reported previously using grab sample data. Although the two methods cannot be directly compared, this is an indication that automated sampling is providing a more accurate measure of TSS removal efficiency.

In addition, a limited amount of useable data is now available for the post construction monitoring conducted at several properties. Generally, the SWM BMPs appear to be performing as designed, although a wide range of loading reductions have been reported; from negative removal to almost 100% efficiency. Some of the factors that may be responsible for the broad range of removal efficiencies include, but are not limited to the following observations: presence of groundwater, limited storage capacities, antecedent dry times, lack of scheduled maintenance, and varied storm intensities. As more data from the post-construction period becomes available, DEP hopes to gain a clearer understanding of the reduction potential for these devices.

With the exception of the Clarksburg SPA, all the other SPAs were fairly well developed prior to being adopted as a SPA, making it difficult to separate the effects of additional development from those areas already developed. Ultimately, a conclusive evaluation of the effects of development cannot be completed until the watershed is built out.

3.0 Stream Characteristics

Clarksburg SPA

The hydrological and physical characteristics of streams and the associated stream habitats may be altered during and after land use changes (2010 SPA Report). These physical changes may alter the biology and affect the overall water quality of the stream. This section continues to build on the hydrological and morphological stream analysis first reported in the 2007 SPA Annual Report and continued in the 2008, 2009, and 2010 SPA Annual Reports. The same terms and analysis are used to maintain consistency with prior reports.

Rain gages at Black Hill Regional Park and Little Bennett Regional Park have produced records of rainfall totals that allow the calculation of a number of useful statistics including storm durations, storm mean intensity, and storm peak intensity.

From 2004 to 2011, United States Geological Survey (USGS) stream gage data has been collected at 5 stations in the Clarksburg SPA. Another USGS stream gage was started in the Ten Mile Creek in 2010. All gages are in streams draining very small catchment areas. These headwater streams tend to respond rapidly to rainfall and the 5 minute recording interval is necessary to capture their response. The flow data is used to calculate several useful measures of flow response to runoff. The measures are used by the USGS Baltimore District in describing flow responses in similar small streams (Doheny et al., 2006, Doheny pers. comm. 2008).

In order to study the effect of changes in hydrological and physical characteristics of streams during and after land use change, a paired study design was developed and used within the Clarksburg SPA. Data from two of the 5 USGS gages has been used for this comparison since 2007. The study design involved annual monitoring of the flow and geomorphology of a control area (Soper’s Branch) that is relatively unaffected by development and comparing the results to that from a test area (Newcut Road Neighborhood Tributary) where the majority of the drainage area is undergoing land use conversion and development.

The USGS gage in Soper's Branch is 01643395 and measures stream flow from the generally forested Little Bennett Regional Park. The gage used in the Newcut Road Neighborhood Tributary is 01644371, with much of the watershed built out but with projects in various phases of construction and with the SWM not fully on-line in 2011.

The 2011 USGS Water Data Report for the two stream gages is available at: http://wdr.water.usgs.gov/wy2011/pdfs/01643395.2011.pdf (Soper's Branch control area) and http://wdr.water.usgs.gov/wy2011/pdfs/01644371.2011.pdf (Newcut Road Neighborhood Tributary test area).

For the Newcut Road Neighborhood Tributary, the stream flow data is used to quantify the changes in base and peak flows that occur during and after conversion from agricultural to high density residential and /commercial land uses.

Construction and development can alter a stream by the following:

1. altering existing channels and changing the pattern of flow to the stream
2. destroying spring seeps that recharge baseflow
3. exposing sediment that is likely to run off in the stream
4. increasing impervious surface, which increases the rate water reaches the stream (flashiness)
5. removing vegetation which would normally uptake runoff and provide shading to help lower and stabilize stream temperatures

Stream characteristics such as infiltration, annual flow, and temperature are used in conjunction with geomorphic surveys to document changes over time. Comparing results from the undeveloped control area with those in the test area will document the effectiveness of BMP's in the protection of the stream channel. Protection of the stream channel is key to maintaining stream biological health.

3.1 Hydrology

In order to study the effect of changes in hydrological and physical characteristics of streams during and after land use change, a paired study design was developed and used within the Clarksburg SPA. The changes in the land use continue to affect the test watershed (Newcut Road Neighborhood Tributary watershed). Annual flow in the Newcut Road Neighborhood Tributary has greatly increased as compared to the control watershed (Soper's Branch). Less water is infiltrating into the soil or into the atmosphere through evaporation in the test watershed. The increase in stream flow in the test watershed coincides with an increase in stream channel downcutting and widening. The streambed material has also decreased in size in the test watershed.

Changes in land use will affect the amount of precipitation entering the ground by infiltration and the amount of runoff reaching the stream. The average monthly rainfall in Maryland varies slightly overall throughout the year but spring and summer thunderstorms can cause significant variations in precipitation depending on specific location (Doheny et al. 2006; James 1986). For the purposes of this report the average annual precipitations for the Baltimore-Washington area is 42 inches (NWS 2008).

Annual runoff for the test and control USGS gages (01644371, 01643395) was used to determine how much average annual precipitation either infiltrated into the groundwater or was released into the atmosphere through evapotransporation within the drainage areas of the gages. Annual runoff (in inches) is subtracted from the average annual precipitation for the Baltimore-Washington area. The remainder is the amount of precipitation that did not runoff in the stream and that would either have infiltrated into the ground or would have returned to the atmosphere through evapotransporation.

The control area (Soper's Branch) showed about 50% of the average annual precipitation either infiltrating into the ground or lost to evapotransporation during the 2011water year (Figure 3.1). Soper's Branch continues to have a higher percent of precipitation that does not immediately runoff into the stream. Infiltration and evapotransporation in the catchment undergoing land-use change (test area) has steadily declined since 2005, being 35% in 2011. One possible cause of this lower percentage this year may be the number of back-to-back storms in the month of September. Approximately one third of the yearly precipitation occurred in 12 days during this month.

Since 2006, infiltration/ evapotransporation at Soper's Branch remain consistently higher than that in the Newcut Road Neighborhood Tributary (Figure 3.1).

The overall amount of precipitation that directly entered the Newcut Road Neighborhood Tributary increased over this same time period (Figure 3.2, blue line). Annual flows were adjusted for the differing drainage areas of the two gages to normalize the annual runoff amounts and to allow for comparison. Since 2005, about three times as much rainfall is running directly into the Newcut Road Neighborhood Tributary as compared to the control stream, Soper's Branch. This may be due in large part to the alterations to the landscape that occurred during the cut and fill grading operations necessary to prepare the land for the development despite the fact that the E&SC structures are sized to treat an inch over the drainage area and safely pass the 10 yr. storm. The increased imperviousness from the subsequent development in the test area may have also contributed to the runoff differences.

Stream Flashiness

Stream flashiness refers to the stream flow-response to storms. Conversion of watersheds to more urban land uses may lead to more rapid hydrologic responses to storm events (Farahmand et al. 2007) as shown by a quick rise, peak and drop in stream height (Doheny et al. 2006). Flashiness is defined as the ratio between the instantaneous peak discharge (maximum flow) and the daily mean discharge (average amount of stream flow per unit time) for a storm event. The resulting number is used as an index for flashiness. This number can range from a minimum of 0 (instantaneous peak discharge = daily mean discharge) to a maximum that is only limited by the amount of peak discharge.

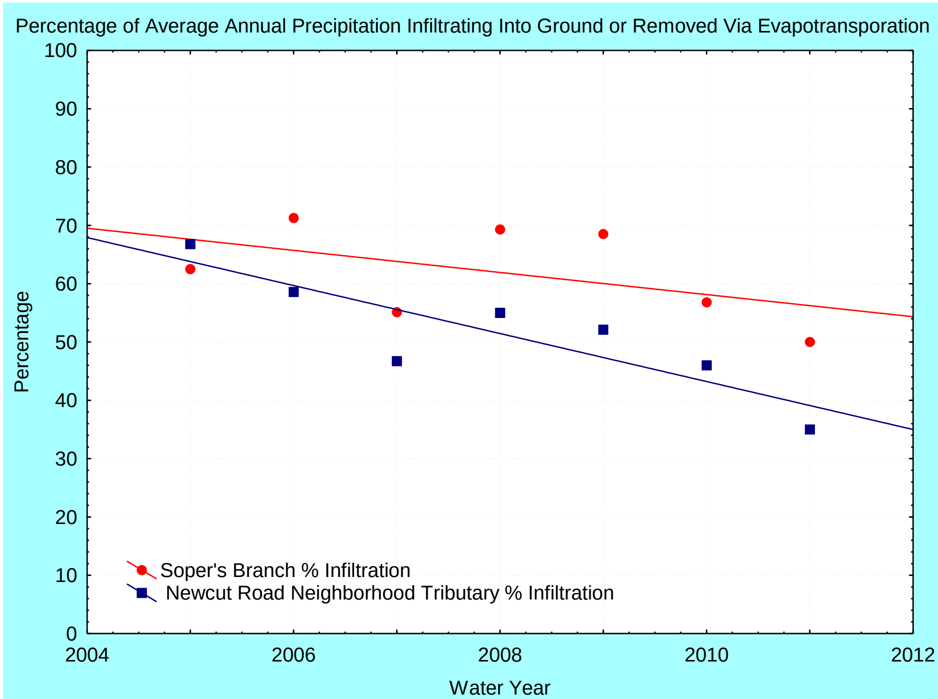


Figure 3.1. Percentage of Average Annual Precipitation Infiltrating into the Ground or Removed via Evapotransporation.

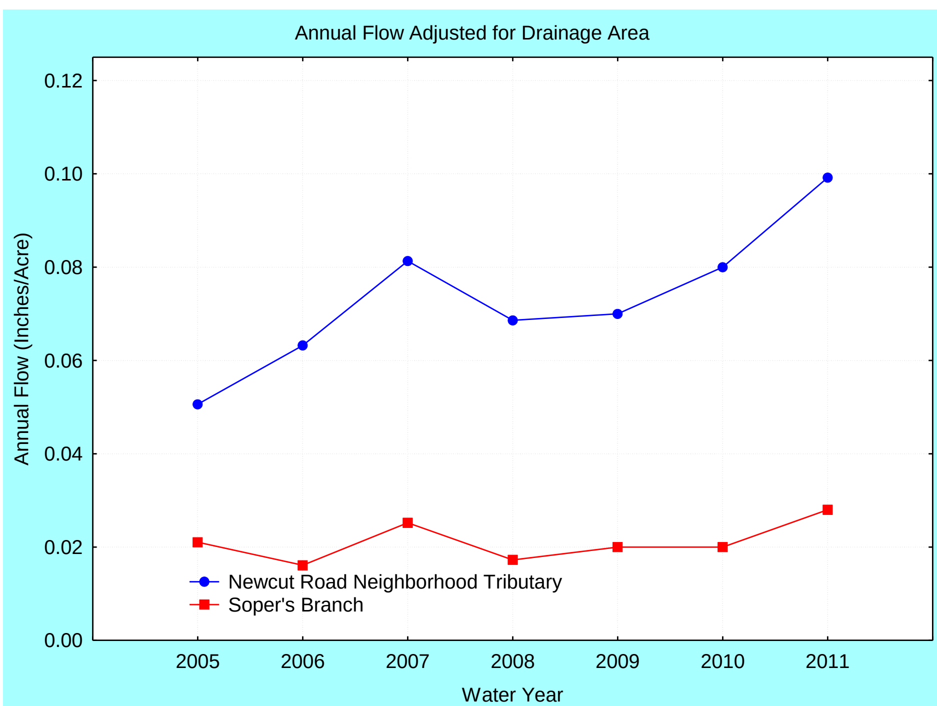


Figure 3.2. Annual Flow (Adjusted for Drainage Area) from 2005 through 2011.

During the study period (2004 to 2011), the Newcut Road Neighborhood Tributary was on average flashier than the Soper's Branch. This trend continued in 2011. However, the margin was narrowed. The average flashiness index for 10 storm events in 2011 was 3.60 for Newcut Road Neighborhood Tributary and 3.02 for Soper's Branch. Two storms showed similar flashiness indices for both sites. These storm events had approximately 0.2" of precipitation and low maximum storm intensities. The one storm, which resulted in a noticeably higher flashiness index at Soper's Branch, had total rainfall of 1.62". In 2009, limited SWM BMPs began to function. Post-construction monitoring should begin within the Newcut Road Neighborhood Tributary drainage area during 2012 and will provide data to compare flashiness during construction with that during the post-construction phase.

Time of Concentration

Time of concentration is defined as the difference in time between the start of rainfall and when discharge begins to increase at the gaging station (Doheny et al. 2006). This parameter is useful in understanding the stream response to clearing and grading and subsequent land use changes and increasing imperviousness. When less area for precipitation to infiltrate is available, runoff reaches the stream in a shorter amount of time. The Maryland E&SC requirements attempt to moderate this during construction by providing storage for 1" of rainfall from the site undergoing construction. However, local site constraints and weather patterns may not allow for storage of 1" of rainfall from the site for every storm. For example, the storms may be back-to-back storms or an unexpected condition discovered such as the BMP being located so that the local groundwater was intercepted.

During the construction period (October 1, 2007 thru September 30, 2011), the TOC was evaluated at the Soper's Branch control area stream gage (LSLB101) and at the Little Seneca Creek test area stream gage (LSLS104). On average, the Little Seneca Creek test area tributary responded twice as fast as the Soper's Branch control area for the same range of storms exceeding ½" of rainfall (Figure 3.3).

For the 2011 water year, the mean TOC at Soper's Branch was 288 minutes with a maximum of 1160 minutes. At the Newcut Road Neighborhood Tributary, the mean TOC was 104 minutes with a maximum of 290 minutes. In 2011, the Newcut Road Neighborhood Tributary, as in previous years, generally responded two times faster than Soper's Branch.

Conclusions

The trends observed in prior years of construction in the study areas remain unchanged for 2011. The changes in the land use continue to affect the Newcut Road Neighborhood Tributary watershed. More runoff is entering Newcut Road Neighborhood Tributary in a shorter amount of time compared to Soper's Branch. Flashiness indices have improved slightly for 2011. However, flow is still more concentrated during storms at Newcut Road Neighborhood Tributary. This slight improvement may be a result of limited SWM BMP becoming functional. Comparisons will continue as the developments progress through post construction.

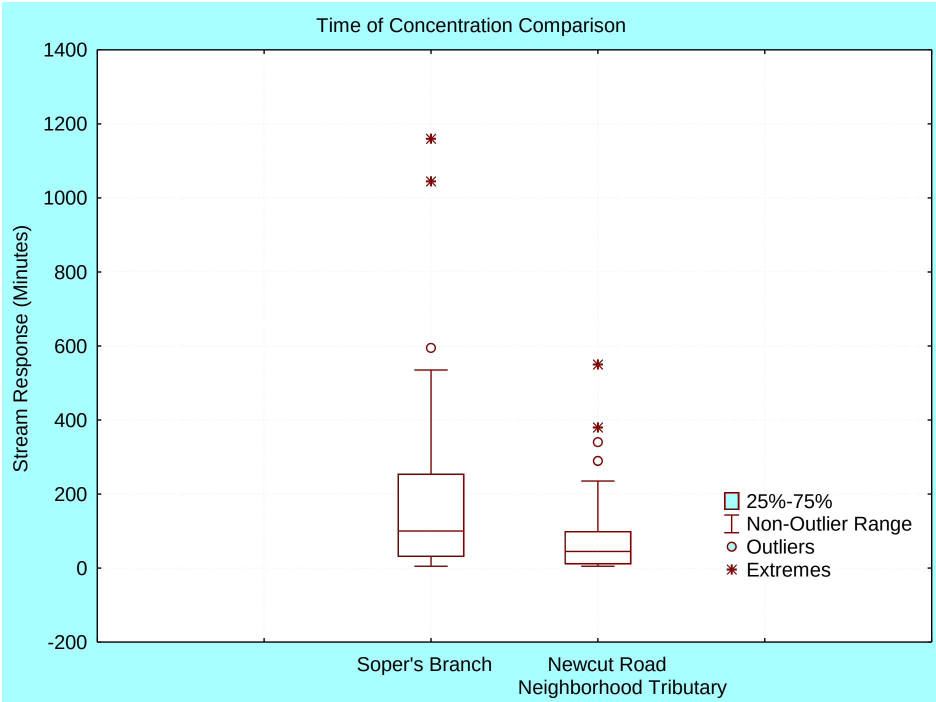


Figure 3.3. Time of Concentration Differences 2008 through 2011.

3.2 Geomorphology

For information on study design, data collection and test area details refer to the 2010 SPA report.

On average, cross sections from the Newcut Road Neighborhood Tributary experienced channel aggradation corresponding to the most active years of construction (2004 thru 2006), and then channel degradation and some widening from 2007 to 2011 as this area nears final elevations and stabilization. In 2011, a DEP cross section closest to the USGS stream gage in the Newcut Road Neighborhood Tributary continued to change. After filling in during the construction period, noticeable scouring has taken place. The shallowest depth was observed in 2003, just after the start of construction (0.8 ft); and the deepest recorded depth for the study period (2.6 ft) was observed in 2011. The right bank also continues to erode. In contrast, the Soper's Branch cross sections show little yearly change (Figure. 3.5).

Changes in cross sections are more obvious below the one year storm elevation height, corresponding to levels that frequent storms would impact. Surface hydrology analysis of the Newcut Road Neighborhood Tributary has shown that the amount of annual runoff has increased (Figure 3.2) and there has been an increased response to storms. These changes to surface hydrology would cause the stream to move more sands and gravels in the channel and aggrade

(Paul and Meyer 2001). Even though the E&SC BMPs on the development sites were functioning as designed, they are not 100% effective in removing fines.

Evaluation of sinuosity over time documents a difference between the test and control stations. The sinuosity index (SI) is the ratio between the length of the stream and the corresponding length of the stream valley. A sinuosity index of 1.0 would indicate a very straight and often channelized stream. Sinuosity indices for the Newcut Road Neighborhood Tributary demonstrate that the stream straightened over time. From 2003 to 2006, sinuosity indices went from 1.4 to 1.0 (Table 3.1). This would be consistent with the increased annual runoff to the Newcut Road Neighborhood Tributary. After SWM began to be functional in late 2008, the ratio has begun to increase slightly, and is currently at 1.2. The sinuosity of the Soper's Branch channel has remained fairly consistent throughout the test period.

Table 3.1 Sinuosity indices Newcut Road Neighborhood Tributary test area, Little Bennett Soper's Branch control area, and Germantown Crystal Rock control area

	Sinuosity Index (SI)							
Year	'03	'04	'05	'06	'07	'09	'10	'11
LSLS104 A4	1.4	1.4	1.3	1.0	1.0	1.2	1.3	1.2
LBSB201 A4	1.1	1.1	1.0	1.2	1.2	1.1	1.2	1.4
LSCR201 A2	1.2	1.4	1.2	1.3	1.2	1.1	1.4	1.2

Changes in stream morphology are largely a result of the changes in stream hydrology. An increase in runoff rate results in higher peak flows resulting in an increased scouring of the stream channel. From 2006 through 2010, the average particle size in the Newcut Road Neighborhood Tributary increased at the most downstream study area (Table 3.2). This may signify that increased runoff rates were flushing the finer particles downstream, while the coarser aggregates that characterize the parent material of the stream channel were left in place. The channel depth and channel width at the downstream study area increased in response to changes in hydrology.

Table 3.2. Average bankfull channel particle size (D50) for Newcut Road Neighborhood Tributary test area, and Little Bennett Soper's Branch control area.

	D50 (mm)							
Year	'03	'04	'05	'06	'07	'09	'10	'11
LSLS104 A4	8.2	5.7	5.7	7.1	8.5	14	20	0.062
LBSB201 A4	16	0.062	8.7	14	9.2	0.062	0.062	0.062

As shown in Figure 3.4, cross section number one (in a riffle/run) has scoured since 2005, as seen in the increase of the maximum depth from 0.97ft to 2.6 ft. Cross section number three has been more stable, possibly due to the less confined channel. As the channel becomes less confined in the study area, fine sediment may be able to settle out more. The particle size for 2011 was 0.062 (Table 3.2). This is the lowest noted for the most downstream study area for the Newcut Road Neighborhood Tributary. Increased deposition has also been noted in the Snowden Farm Parkway culvert. This culvert is approximately five meters downstream of the Newcut Road Neighborhood Tributary stream gage. Many deep pools (>2 ft) were installed within the culvert as part of a fish passage design. These pools have now filled in to a more natural level. There are many comparison studies yet to be done between the test and control areas to evaluate the effectiveness of stormwater BMPs. Results presented herein are preliminary and will be compared to future data. However, from the preliminary results it appears that the construction phase of development has impacted the Newcut Road Neighborhood Tributary channel morphology due to straightening, down-cutting, and enlargement of the channel.

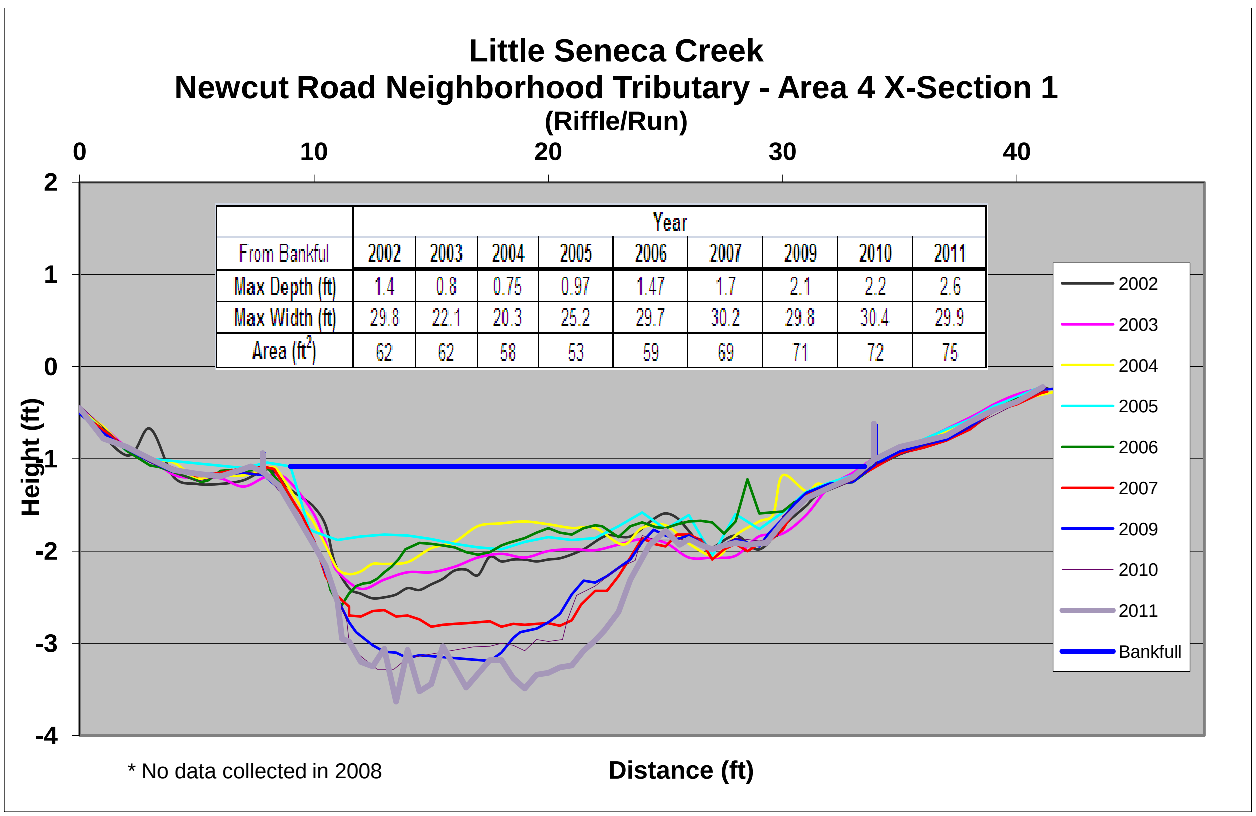
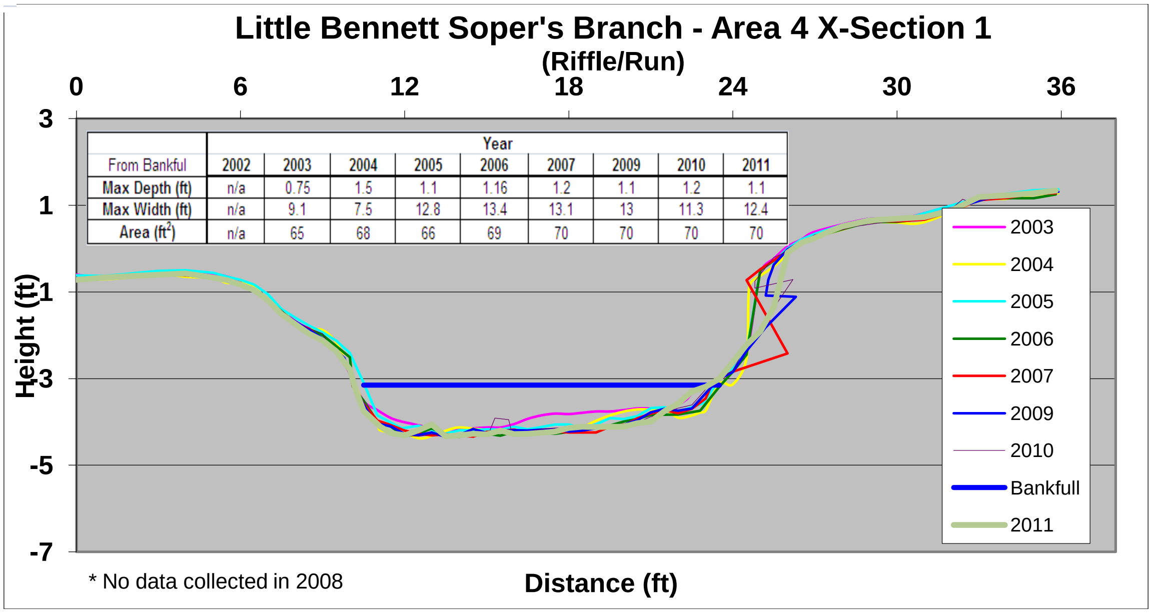


Figure 3.4. Representative cross sections from Newcut Road Neighborhood, Little Seneca 104 Tributary test location, Area 4. Cross section is measured in a Riffle/run feature.



From Bankful	Year 2002	2003	2004	2005	2006	2007	2009	2010	2011
Max Depth (ft)	n/a	0.75	1.5	1.1	1.16	1.2	1.1	1.2	1.1
Max Width (ft)	n/a	9.1	7.5	12.8	13.4	13.1	13	11.3	12.4
Area (ft^2)	n/a	65	68	66	69	70	70	70	70

Figure 3.5. Representative cross sections from Little Bennett Creek, Soper's Branch control location, Area 4. Cross section is measured in a Riffle/run feature.

3.3 Special Protection Area (SPA) Stream Temperature Monitoring

Monitoring stream temperature in the SPA project sites illustrates the effectiveness of SPA site design and BMP's in minimizing water temperature disturbance as the surrounding land-use changes. Thermal pollution causing high stream temperatures prevents sensitive species from surviving in streams.

Methods

Stream temperatures were collected using continuous recording meters from early June through the end of September. The maximum temperature was recorded for every 24-minute interval during the monitoring period. Temperature data for test stations was collected prior to, during, and after construction and were then compared to data collected for control stations. Control stations did not undergo development over the same time interval. Some temperature data was unavailable due to loggers that were lost, malfunctioned, or dewatered.

Results

<u>Stream Temperature Summary-temporal trends; 1997 – 2011 - Clarksburg SPA</u>

Maximum annual stream temperature at the test stations increased between 3-5 °C from pre-construction to post construction. Maximum annual stream temperature from 1997 through 2011 for test and control station data are presented in Figure 3.6. Stream temperatures were very similar between test and control stations for most of the monitored years but showed the greatest differences from the year 2004 through 2008. The differences between stations were not consistent. In years 2004 and 2007, maximum temperature was lower at the control stations, but for years 2006 and 2008, maximum temperature was lower at the test stations. There was an apparent slight increase in maximum stream temperature at both stations over this time. Maximum temperatures diverged slightly again in 2011, with the control stations being about 3 °C cooler. A linear regression shows maximum stream temperature in the Clarksburg SPA increasing in both test and control stations. Test stations are increasing at a rate of .93 degrees C per year (R^2=.59) and control stations are increasing at a slightly lower rate of .85 degrees C per year (R^2=.53).

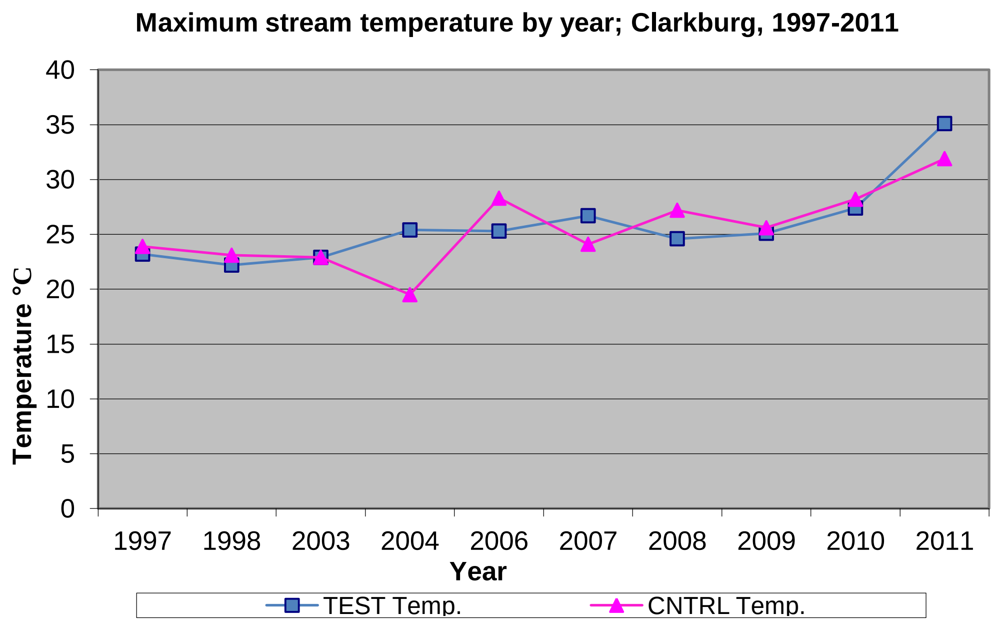


Figure 3.6. Maximum stream temperature for test and control stations within the Clarksburg SPA from 1997 through 2010.

Stream Temperature Summary-Temporal Trends; 1998 – 2011 – Paint Branch SPA

Annual maximum stream temperature trend data from the test and control stations in Paint Branch are displayed in Figure 3.7. A small divergence in maximum stream temperature between the test and control stations is shown during 2000, 2003, and 2011with a higher maximum stream temperature exhibited in the test stations. Fluctuations in maximum temperature at the test stations from year to year are apparent. Both the test and control stations are trending towards increased maximum temperatures. When fitted with a linear regression maximum stream temperatures are increasing by .28 degrees per year for controls stations (R^2= 0.90) and .30 degrees per year for test stations (R^2= 0.34).

The differences in maximum stream temperature between the Good Hope control station and the Right Fork test stations are minor**.** Development within the Right Fork of the Paint Branch watershed is low density because of the eight percent impervious cap within the Paint Branch watershed. This factor appears to be correlated with the small difference in stream water temperature for the test and control stations. No stream temperature data is available for the control station from 2005 through 2009.

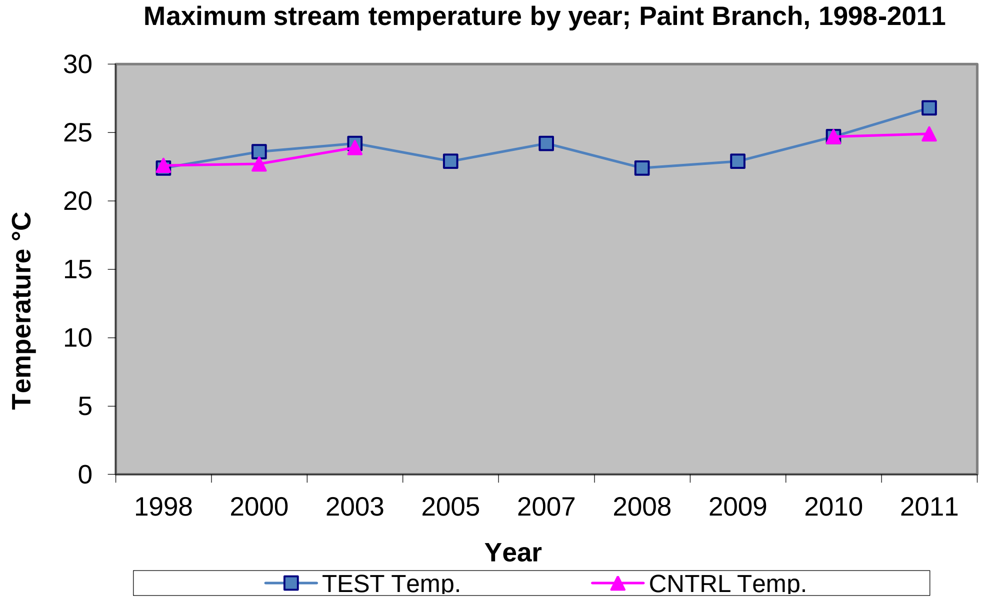


Figure 3.7. Yearly maximum stream temperature for test and control stations within the Paint Branch SPA from 1998 through 2011.

Stream Temperature Summary-temporal trends; 1995 – 2011 – Piney Branch SPA

Annual maximum stream temperatures were different between test and control stations from 1998 through 2010. The maximum temperature is 2-5 °C higher at the test stations than at the western tributary control station (Figure 3.8). In 2011, the maximum stream temperature is similar between the test and control stations.

The response of stream temperature to development within the Piney Branch SPA show the test area stream temperatures higher than the control area until 2011 when the water temperatures are similar. Unlike stream temperatures in Clarksburg and Paint Branch SPAs, Piney Branch does not show a long-term trend of either increasing or decreasing stream temperatures.

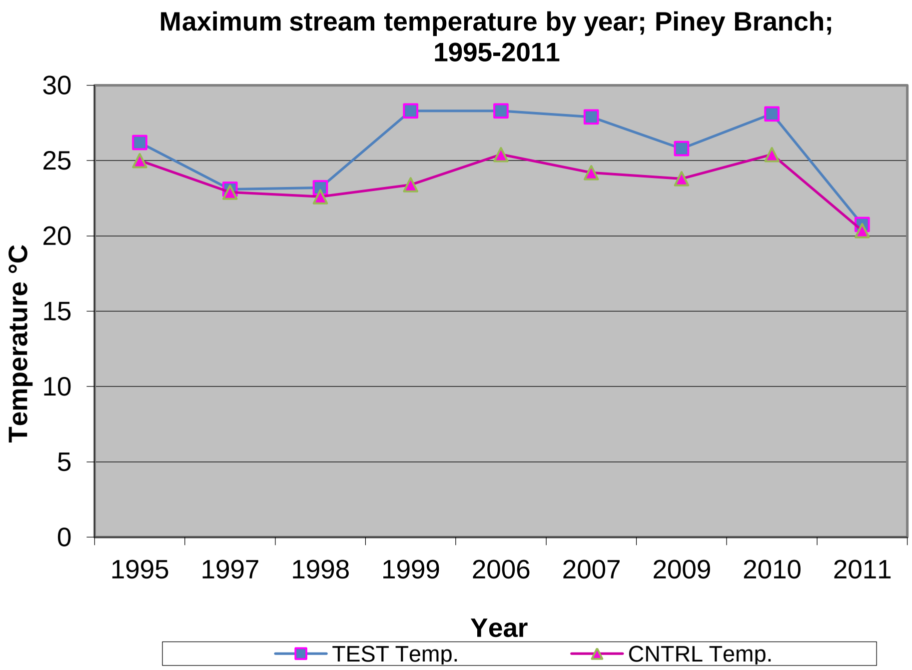


Figure 3.8. Yearly trend of maximum stream temperature for test and control stations within the Piney Branch SPA from 1995 through 2011.

Stream Temperature Summary-Temporal Trends; 2009 – 2011 – Upper Rock Creek SPA

With three years of data, annual stream temperatures have remained consistent. There has been minimal development within the Upper Rock Creek SPA so comparison between test and control stations is inappropriate. More data are required before a trend in stream temperatures can be established (Figure 3.9).

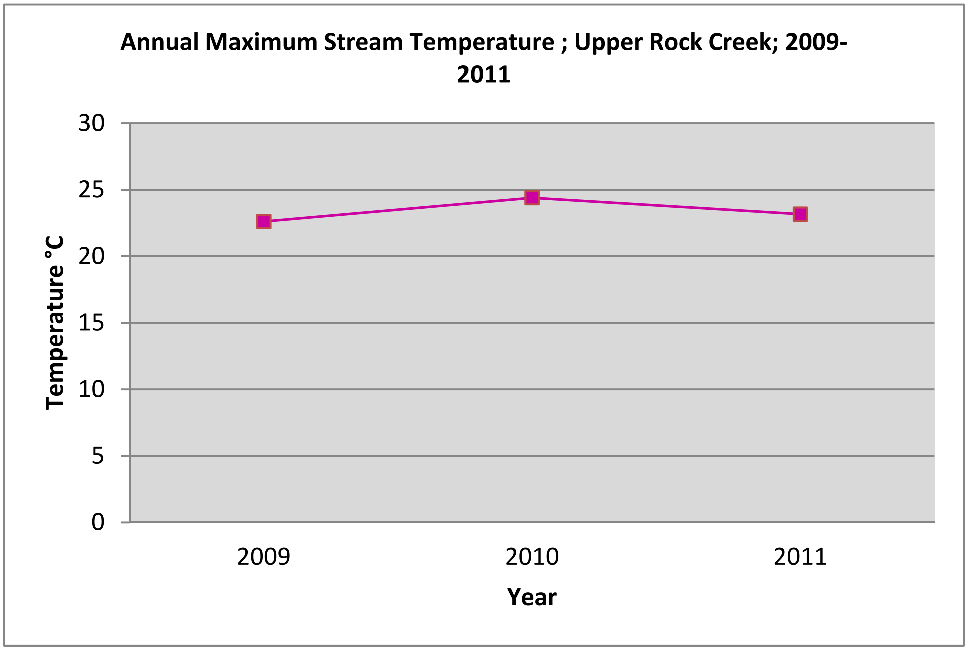


Figure 3.9. Yearly trend of maximum stream temperature for test and control stations within the Upper Rock Creek SPA from 2009 through 2011.

4.0 Biological Stream Monitoring

During 2011, a total of 45 stream stations were monitored within the four SPA's. These included 25 stations within the Clarksburg Master Plan SPA area, 11 stations within the upper Paint Branch SPA and upstream of Fairland Road; three stations within the Piney Branch SPA and tributary of Watts Branch, and six within the Upper Rock Creek SPA.

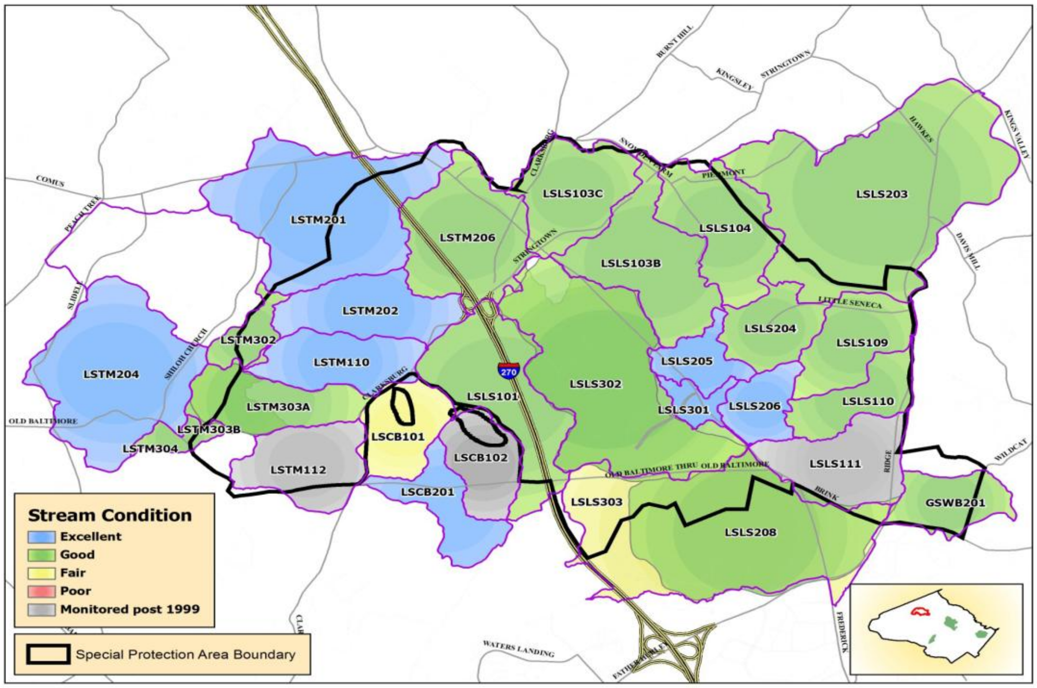
Both fish and benthic macroinvertebrates are used as indicators of stream conditions. The number and type of fish and macroinvertebrates were used to derive an Index of Biotic Integrity (IBI) score that is then converted to a percent score, with 100% being the best attainable score. There are four narrative categories: excellent, good, fair, and poor. Fish were not used as indicators for the small first order streams since frequently there is limited fish habitat in these types of streams. Twenty-two (22)% (10) of the stations changed in stream condition narrative category, with 20% (9) showing a decline and 2% (1) showing improvement in stream condition.

Assessment of Stream Conditions within the Clarksburg SPA

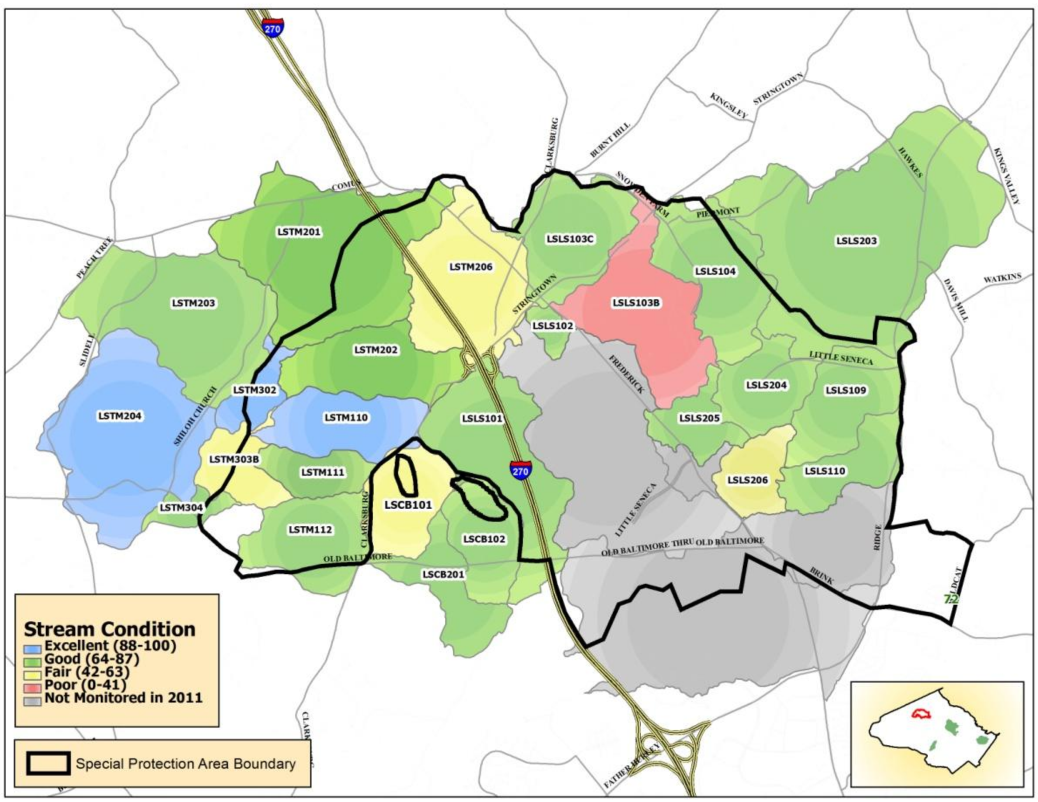
(*Little Seneca Creek, Cabin Branch, Ten Mile Creek*)

Clarksburg SPA stream conditions were predominantly good to excellent before development occurred (Figure 4.1). Of the 25 stations monitored, 5 (20%) showed a change in stream condition between 2010 and 2011 with the stream condition declining. Of the two stations that declined the most, both drainage areas were experiencing land-use changes. Upper Cabin Branch began groundbreaking for the installation of E &SC structures and limited grading starting in 2011. The Town Center Tributary to Little Seneca Creek had continuing development and the lower station declined from fair to poor. This stream varied substantially since development began prior to 2006. Between 2010 and 2011, the Town Center Tributary to Little Seneca Creek dropped in stream condition by 20%. After reviewing the available aerial imagery of the Town Center Tributary in 2006, 2008, 2010, and 2011, a number of factors contributing to the significant decline seen between 2010 and 2011 were found. In the 2010 aerial imagery, continued clearing and grading was visible accounting for less than 10% of the area draining to the Town Center Tributary biological monitoring station. Much of the area also appears to remain in erosion and sediment control (E&SC). With much of the drainage area built out, E&SC does not properly manage storm water. Additionally, a bridge was installed ~150m upstream from our biological monitoring station no more than a few weeks prior to the sampling of that station. The nearly direct impact of the installation of the bridge along with the continued development of the drainage is likely correlated to the decline observed between 2010 and 2011.

These two areas represent the only declines in stream condition that were greater than 10%. Three other stream conditions changed from good to fair. One station a tributary to Ten Mile Creek near the Montgomery County Detention Center had a small decline in the benthic IBI caused by a reduced number of shredders and EPT (Mayflies, Stoneflies, and Caddisflies). These specialized benthic macroinvertebrates are very sensitive to anthropomorphic stressors and could have declined as a result of a small amount of construction occurring in the headwaters of that watershed. The other station which showed a decline in stream condition, was the Ten Mile Creek mainstem just upstream from West Old Baltimore Road. The Benthic IBI condition was stable between 2010 and 2011, but the Fish IBI declined. When this station was sampled in the summer of 2011, it was very low and near drought conditions within the station. These conditions likely caused the reduced Fish IBI recorded in 2011. The third station, located near the intersection of Frederick Road (Route 355) and New Cut Road, is immediately downstream of the new construction associated with the final phases of the New Cut Road Neighborhood development.



1994-1998 (*prior* to initiation of development)

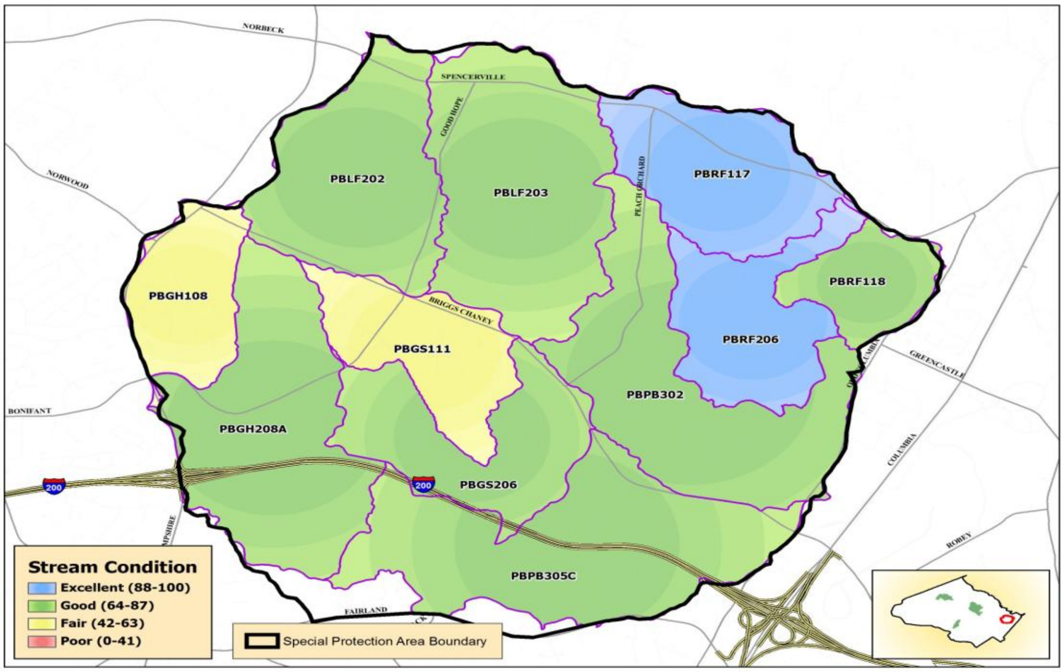


2011 (*after* initiation of development)

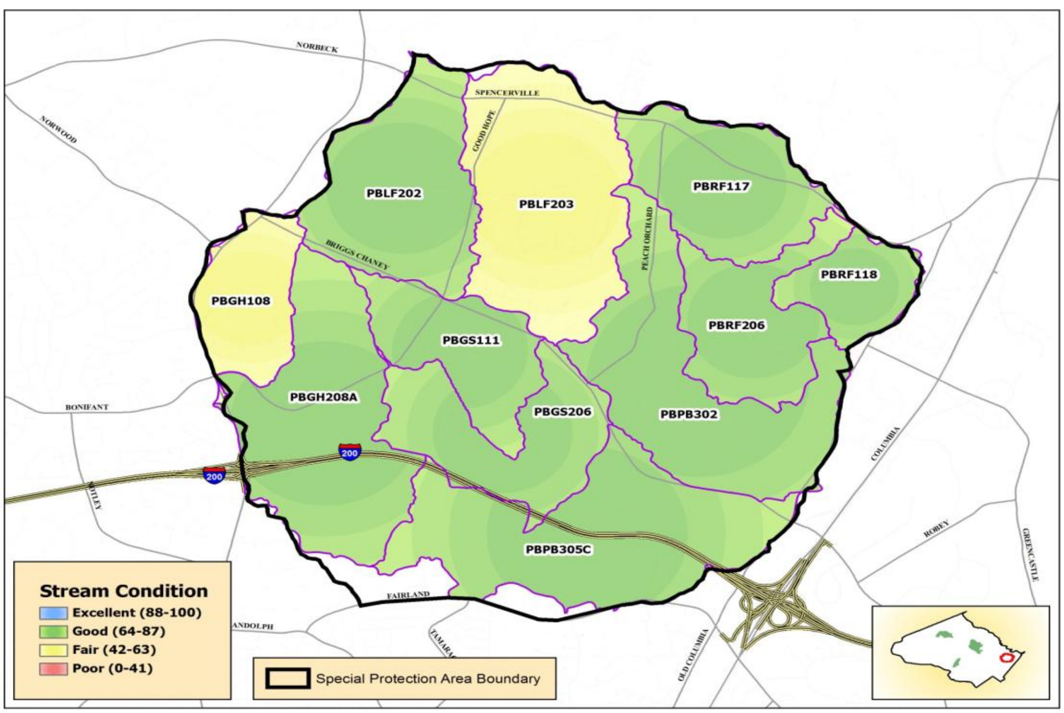
Figure 4.1. Stream condition assessment within the Clarksburg Special Protection Area (SPA) prior to the initiation of development (1994-1998) and during 2011.

Assessment of Stream Conditions within the Paint Branch SPA

Paint Branch stream conditions were predominantly good to excellent prior to development (Figure 4.2(1)). Of the 11 stations monitored, 4 (36%) showed change in stream resource conditions between 2010 and 2011. Stream condition declined at 3 (27%) of the stations and improved at 1 (9%) of the stations. Between 2010 and 2011, stream conditions in the Right Fork tributaries remained in good condition. The upper Left Fork improved from fair to good. Most of the SPA development has occurred in the watershed of the Right Fork of the Upper Paint Branch. The lower Gum Springs station declined from excellent to good. Both Good Hope stations declined between 2010 and 2011. The upper Good Hope station declined from good to fair. The lower Good Hope stations declined from excellent to good. The only major land-use changes that occurred in the Gum Springs and Good Hope drainages during this time was the construction of the InterCounty Connector highway. This construction corresponded in time with the observed decline in stream condition, however, stream condition also declined in the upper Good Hope tributary upstream of the ICC and without any recent changes in land-use. The Benthic IBI in the upper Good Hope Tributary decline was small and a result of the loss of specialized benthic macroinvertebrate taxa from the sample. The sample had fewer scrapers, EPT (Mayflies, Stoneflies, and Caddisflies), and shredders than in previous years. These specialized taxa represent some of the more sensitive benthic macroinvertebrates and their continued absence in future years would be a cause for concern.



1994-1998 (*prior* to initiation of development)



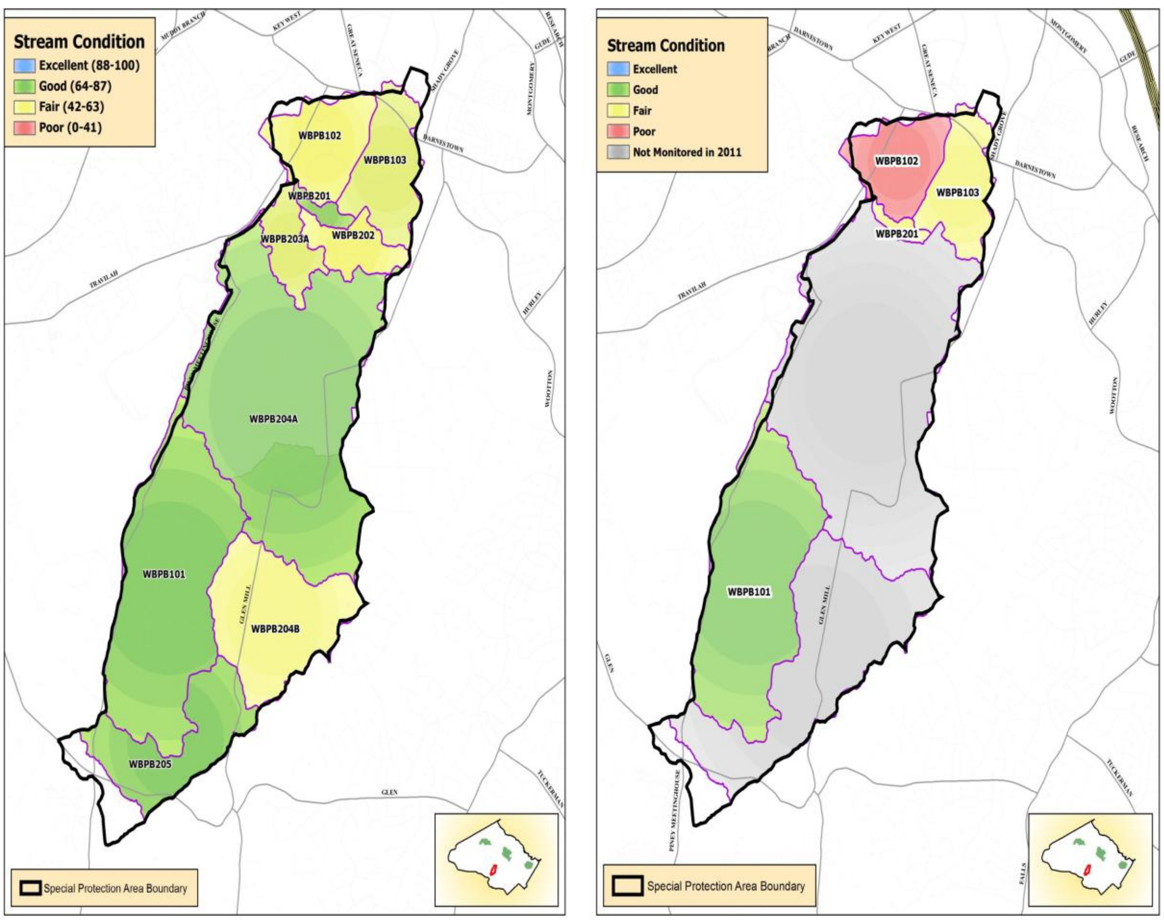
2011 (*after* initiation of development)

Figure 4.2. Stream condition assessment within the Paint Branch Special Protection Area (SPA) prior to the initiation of development (1994-1998) and during 2011.

Assessment of Stream Conditions within the Piney Branch SPA

(a *tributary of Watts Branch)*

Stream conditions within the Piney Branch watershed were predominately fair to good from 1994 to 1998, prior to the start of intensive development in the watershed. In 2010 and 2011, biological monitoring was limited to the headwater streams and one western tributary because development had been completed in the rest of the watershed and the majority of new development was in the headwaters of Piney Branch (the Traville development). Conditions were similar for two of the three monitored subwatersheds for both years but declined from fair to poor in the Western Travilah portion of Piney Branch (Figure 4.3). This is more representative of the long-term monitoring for this subwatershed, with poor stream conditions from monitoring in 2008 and 2009. The decline since 1998 is likely the result of intensive development in that portion of the watershed. Conversely, the western tributary with low density residential has experienced no development since 1994 and stream resource condition has little changed over time.



1995-1998
(*prior* to initiation of intensive development)

2011
(*after* initiation of development)

Figure 4.3. Stream condition assessment within the Piney Branch Special Protection Area (SPA) prior to the initiation of development and during 2011.

Assessment of Stream Conditions within the Upper Rock Creek SPA

Stream conditions were predominantly Good to Excellent from 2004-2007 prior to the initiation of development (Figure 4.4). Stream conditions for monitored subwatersheds in 2011 were unchanged from 2010. Two subwatersheds that were monitored in 2010 were not monitored in 2011 because DEP had to monitor the Pope Farm Tributary in preparation for the development of the Laytonia Recreation Park and monitor the Fraley Farm Tributary because of the need to have baseline conditions in this tributary. The 2 stations that were not monitored in 2011 will be monitored in 2012. The Fraley Farm tributary in the eastern portion of the watershed has a fair stream condition. This area is undeveloped, but has been heavily influenced by agriculture, possibly explaining the somewhat degraded stream condition. The Pope Farm Tributary is in good stream condition.

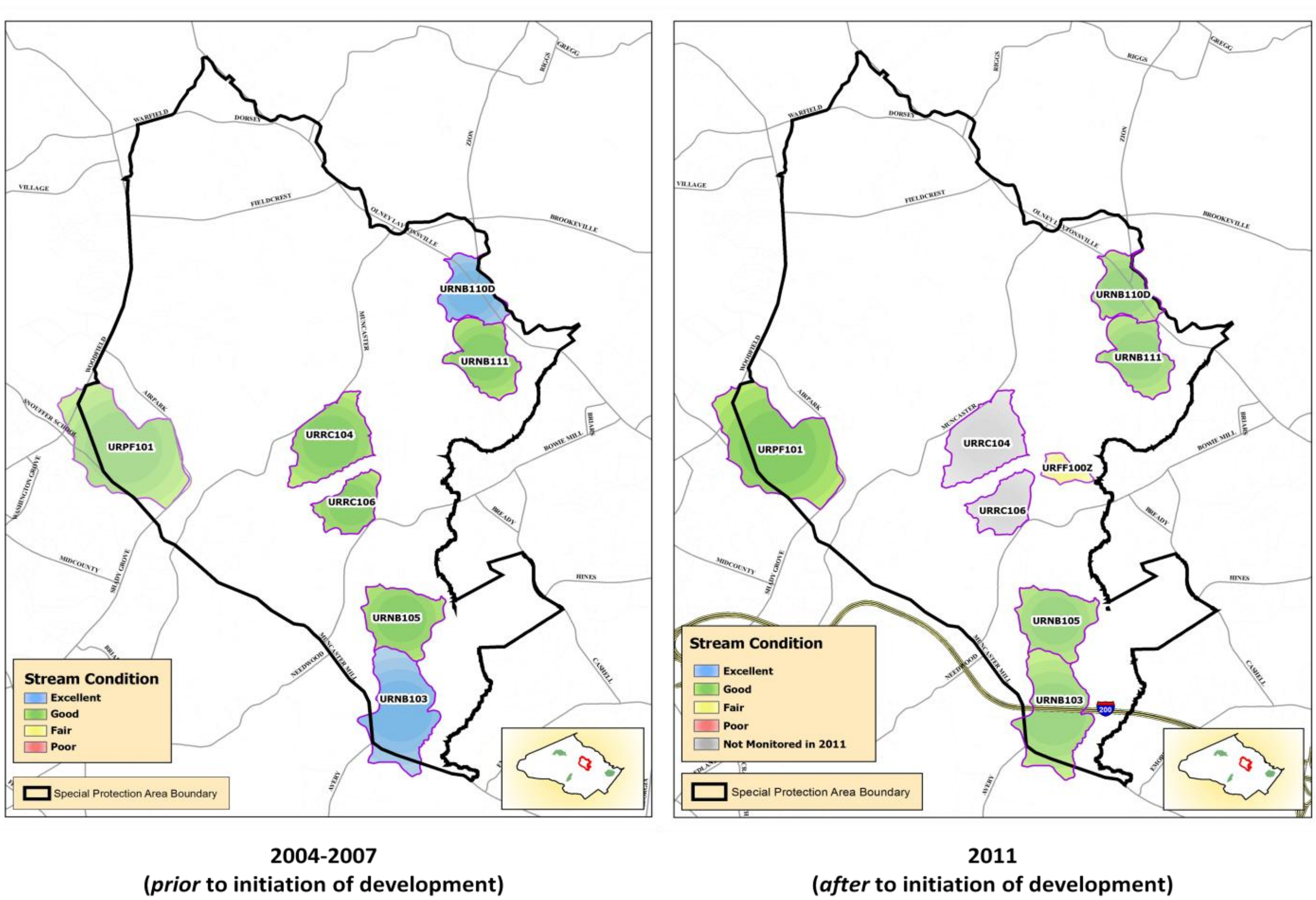


Figure 4.4. Stream condition assessment within the Upper Rock Creek Special Protection Area (SPA) prior to the initiation of development and during 2011.

5.0 Discussion

BMP Monitoring

A limited amount of useable data is now available for the post construction monitoring conducted at several properties. Generally, the SWM BMPs do appear to be performing as designed, although a wide range loading reductions have been reported; from negative removal to almost 100% efficiency. As more data from the post-construction period becomes available, DEP hopes to gain a clearer understanding of the reduction potential for these devices. BMP monitoring continues to demonstrate that the sequential and redundant features used in reducing stormwater runoff and decreasing pollutant loadings have been more effective than the use of individual structures. BMP feature placement in the treatment train is also an important consideration in optimizing BMP performance and mitigating impacts to receiving streams.

With the exception of the Clarksburg SPA, all the other SPAs were fairly well developed prior to being adopted as a SPA, making it difficult to separate the effects of additional development from those areas already developed. Completed development projects in the Clarksburg SPA will provide the clearest evaluation of the effects of development on sensitive streams but will not be completed until the watershed is built out.

Stream Characteristics

The trends observed in prior years of construction in the study areas remain unchanged for 2011. The changes in the land use continue to affect the Newcut Road Neighborhood Tributary watershed. More runoff is entering Newcut Road Neighborhood Tributary in a shorter amount of time compared to Soper's Branch. Flow is still more concentrated during storms at Newcut Road Neighborhood Tributary. Comparisons will continue as the developments progress through post construction. The amount of flow during baseflow periods is higher in the Newcut Road Neighborhood Tributary than Soper's Branch while the amount from the same storm events is smaller. This could be from the increased number of SWM BMPs in the Newcut Road Neighborhood Tributary coming online.

Changes in stream morphology are largely a result of the changes in stream hydrology. From 2006 through 2010, the average particle size in the Newcut Road Neighborhood Tributary increased at the most downstream study area (Table 3.2). This may signify that increased runoff rates were flushing the finer particles downstream, while the coarser aggregates that characterize the parent material of the stream channel were left in place. The channel depth and channel width at the downstream study area increased in response to changes in hydrology. Results presented herein are preliminary and will be compared to future data. However, from the preliminary results it appears that the construction phase of development has impacted the Newcut Road Neighborhood Tributary channel morphology due to straightening, down-cutting, and enlargement of the channel.

Stream Monitoring

During 2011, a total of 45 stream stations were monitored within the four SPA's. These included 25 stations within the Clarksburg Master Plan SPA area, 11 stations within the upper Paint Branch SPA and upstream of Fairland Road; three stations within the Piney Branch SPA and tributary of Watts Branch, and six within the Upper Rock Creek SPA. Twenty-two (22)% (10) of the stations monitored in 2011 had a change in stream condition narrative category, with 20% (9) showing a decline and 2% (1) showing improvement in stream condition.

The monitoring of SWM BMPs has highlighted an issue that, while obvious to some, still needs to be emphasized in this report. SWM BMPs will continue to function as designed only if they are regularly cleaned and maintained. With the current emphasis on smaller structures, the maintenance of these many small structures will become an important factor in how well the structures perform over time. Current structural maintenance is done once a year; other jurisdictions perform structural maintenance every 3 years.

6.0 Future of the SPA Program

The SPA Program has been in place since 1994. For a geographic area to be designated as a Special Protection Area, the County Council must find that a geographic area has:

(1) existing water resources, or other environmental features directly relating to those water resources are of high quality or unusually sensitive; and
(2) proposed land uses would threaten the quality or preservation of those resources or features in the absence of special water quality protection measures which are closely coordinated with appropriate land use controls."

The Council must find that both requirements are met for an area to be designated as an SPA. To date, four watershed areas have met the requirements and have been designated as an SPA: Clarksburg Master Plan Area, Piney Branch, Upper Paint Branch, and Upper Rock Creek.

Over the 18 years of the program, E&SC and SWM BMPs provided for a 'special' level of water quality protection measures that were coordinated with appropriate land use controls.

At the same time, SPA monitoring provides information to help evaluate: (1) the effectiveness of the SPA program in minimizing development-related impacts to sensitive streams; and, (2) the efficiency, performance, and effectiveness of BMPs in reducing pollutants. This monitoring is only done in the SPAs.

Since the inception of the SPA program, DPS has consistently refined BMP design plans and reduced the size of the area draining to individual BMPs to improve pollutant removal efficiency and mitigate development impacts. At the same time, the Maryland Department of the Environment has issued 3 different SWM laws with accompanying changes to regulations and guidance documents. The most recent being the Stormwater Management Act of 2007. This Act requires that Environmental Site Design (ESD), through the use of nonstructural best management practices and other better site design techniques, be implemented to the maximum extent practicable.

E&SC laws have been revised with the establishment of the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control. Published in January 2012, the new law requires that a maximum 20-acre grading unit for most construction sites be established to limit sediment pollution from a site. New stabilization requirements include that at a minimum, all perimeter controls (e.g., earth berms, sediment traps) and slopes steeper than 3:1 require stabilization within three calendar days and all other disturbed areas within seven calendar days.

While it is true that the E&SC and SWM BMPs approved for many existing SPA developments cannot be used anymore under the new laws, it is still not known how well they have functioned in minimizing impacts to sensitive water resources. It has taken much longer than expected for the developments to be built to a stage where the SWM BMPs are now online and functioning.

There have been recent concerns raised related to the new SWM and E&SC laws and the unlikely availability of special protection measures for the SPA's that are not now required everywhere else in Montgomery County. Questions have been raised about the relevancy of the SPA program given these newer, more stringent regulatory requirements.

There are two primary requirements that an area must meet to be considered as an SPA. There must be high quality or unusually sensitive water resources, or other environmental features directly relating to those water resources. The proposed land uses that would threaten the quality or preservation of these resources or features are still present. These two conditions still exist within the SPAs.

There is the expectation that the new and more stringent SWM and E&SC laws are the best and most 'special' to mitigate impacts to the sensitive resources, but there is almost no actual data demonstrating this. The SPA monitoring program is necessary to evaluate if these 'special' water quality protection measures will meet this expectation.

In addition to the monitoring, the SPA program is critical to provide a systematic approach through the stormwater management planning and review process for protecting high quality water resources from land cover changes. The County's approach is one that identifies the specific factors that affect, or may affect, those resources and which can result in measures other than those currently required that may be needed to further minimize impacts from those proposed land uses and associated infrastructure needs.

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U.S. EPA National Risk Management Research Laboratory, Cincinnati, OH
U.S. EPA Office of Research and Development, Atlanta, GA
U.S. EPA Environmental Science Center, Ft. Meade, MD

RELATED DOCUMENTS:

- SPA Annual Report, 2010
- SPA Annual Report, 2009
- SPA Annual Report, 2008
- SPA Annual Report, 2007
- SPA Annual Report, 2006
- SPA Annual Report, 2005
- SPA Annual Report, 2004
- SPA Annual Report, 2003
- SPA Annual Report, 2002
- SPA Annual Report, 2001
- SPA Annual Report, 2000
- SPA Annual Report, 1999
- SPA Annual Report, 1998
- Clarksburg Conservation Plan
- Piney Branch Conservation Plan
- Upper Paint Branch Conservation Plan

All of the documents cited above are available online in PDF format on our website: http://www.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/spareports.asp.
In addition, the Department of Environmental Protection maintains an extensive collection of annual, technical, and general reports, public information factsheets, and related publications. Many are available in both PDF and HTML format, and in some cases, print copies of documents are available. Please contact us for more information.

Department of Environmental Protection/ Montgomery County, Maryland
255 Rockville Pike, Suite 120, Rockville, MD 20850
240-777-0311
Email: dep.askdep@montgomerycountymd.gov