Field Findings

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Subject: Pollution Detection & Elimination in Sligo Creek, Montgomery County, MD

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CENTER FOR WATERSHED PROTECTION

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Introduction

The Center for Watershed Protection (CWP) and other researchers have found illicit discharge detection and elimination (IDDE) to be an important best management practice (BMP) for eliminating systemic sources of contamination in water resources. IDDE has been shown to provide quantifiable pollutant load reduction benefits for water quality and IDDE can be listed alongside other BMPs (e.g., bioretention) in a jurisdiction's Watershed Planning tool box. For example, during field work in the City of Baltimore, CWP found that the pollutant reductions associated with the removal of one of the illicit discharges discovered would be equivalent to building over 140 bioretention facilities (each treating a 1/2 acre of impervious cover) at a conservative cost of over $1.7 million dollars.

Despite significant quantifiable pollution reduction benefits, IDDE is an under-utilized practice by local jurisdictions for meeting their water quality goals. To this end, CWP has been holding trainings and workshops in communities throughout the United States promoting and advancing IDDE programs. The methods used in the CWP's IDDE program have been research-tested to effectively isolate pollution sources and particularly useful for detecting sources of wastewater contamination, which carry large amounts of nutrients as well as bacteria containing potentially harmful pathogens (Brown et al, 2004). Adoption of the comprehensive methods presented in the CWP's IDDE program will be especially important as local jurisdictions begin developing Watershed Implementation Plans for meeting local and the Chesapeake Bay Total Maximum Daily Loads (TMDLs).

Funding for this project from the National Fish & Wildlife Foundation's Chesapeake Small Watershed Grant Program was used by the CWP to meet the following goals.
Primary goals:

- Work with three communities in Maryland to use IDDE as a BMP for nutrient and bacteria reduction;
- Train staff of local jurisdictions and watershed groups in IDDE techniques using CWP guidance materials;
- Find and fix illicit discharges;
- Determine practices for reducing wastewater contamination in a community with combined sewer overflows (City of Cumberland);

Secondary goals:

- Calculate pollutant loadings associated with detected illicit discharges;
- Refine methods for coastal plain communities; and
- Determine extent of illicit discharge problems in areas of Maryland outside of Baltimore, including a Phase I MS4 (Montgomery County), Phase II MS4 (City of Salisbury) and an unregulated municipal separate storm sewer system (MS4) communities (City of Cambridge).

One of the four communities that CWP worked with on this project was Montgomery County, MD in the Sligo Creek watershed (Figure 1). Montgomery County's current program is typical of many Phase I and II communities. This project enabled CWP to compare a traditional IDDE program exemplified by the EPA and other states throughout the country with the methods outlined in Brown et al (2004). Results of this study continue to reinforce conclusions that illicit discharges are an overlooked source of nutrient and bacteria pollution to local streams and the Chesapeake Bay. By promoting effective IDDE programs as a BMP to jurisdictions throughout the Bay, the potential exists to make significant strides toward meeting local and Bay TMDLs.

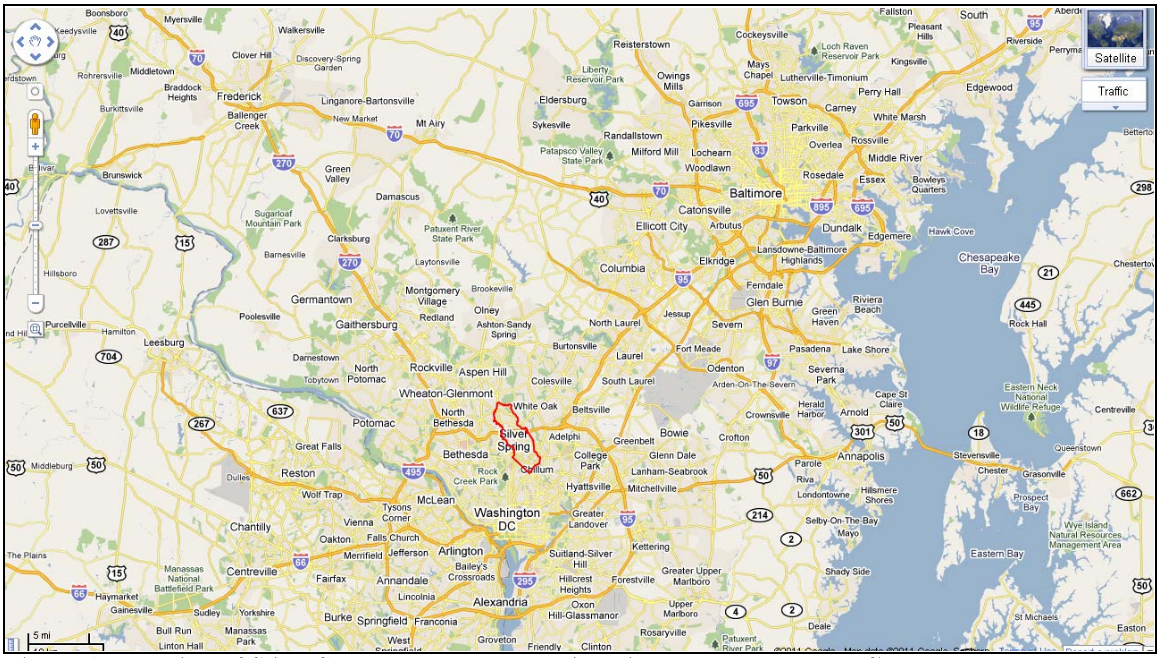

Figure 1. Location of Sligo Creek Watershed, outlined in red, Montgomery County, MD.

Major conclusions drawn from the work in Sligo Creek include the following:

- Outfall surveys involved walking almost the entire Montgomery County portion of the Sligo Creek watershed (~10 miles of stream). Field verification of the County's GIS layer for stormwater outfalls revealed that only 21% of outfalls were originally mapped in the County's GIS system. Of flowing outfalls identified, 74% of the outfalls were not originally mapped meaning that if the County were to continue its current IDDE program strategy of only visiting pre-identified outfalls, then these outfalls would never have been visited as part of IDDE outfall screening program. The majority of these unmapped outfalls exceeded illicit discharge indicator thresholds and they represent 37% of the total phosphorus load and 63% of the total nitrogen load coming from the outfalls in Sligo Creek.
- Drainage area investigations were conducted for 23 of the outfalls that exceeded illicit discharge indicators. These investigations are conducted to isolate the sources of contamination, nutrients and high bacteria found during the outfall screening. During the investigations, insufficient GIS mapping was found to impede progress and decrease the efficiency of isolating pollution sources. The County will need to invest significant resources to update its stormwater mapping in order to effectively and efficiently use staff resources to isolate problems as per the County's MS4permit.
- Staff charged with conducting outfall screening and investigating illicit discharges are also responsible for following up with violations of County codes and ordinances that are non-MS4 permit related. These other investigations comprise the majority of

staff's time and illicit discharge investigations do not seem to be a priority. About 85% of an IDDE program is staff time and dedicated IDDE staff are needed in order for a program to be effective. The County should consider dedicating staff to the IDDE program in order to achieve cleaner waters within its boundaries.

- Outfalls, especially outfalls that exceed one or more illicit discharge indicator parameters, comprise the majority of the in-stream load from grab samples taken during the outfall surveys in Sligo Creek. In addition, outfalls exceeding illicit discharge indicator thresholds have significantly higher average bacteria concentrations. A logical conclusion that can be drawn from this data is that by eliminating illicit discharge sources of contamination in the outfalls, significant nutrient and bacteria reduction in the stream can be achieved.
- The indicators used in an IDDE program can make a significant difference in the number of detections that a jurisdiction finds as well as the resultant pollutant reduction after their elimination. By adding ammonia, potassium, fluoride and bacteria as indicators to Montgomery County's IDDE program, the County may be able to detect over 20% more illicit discharges resulting in 17-68% more reduction in total phosphorus and 50-200% more reduction in total nitrogen. It should be kept in mind that although the IDDE program satisfies conditions set forth in the MS4 permit, achieving these reductions also helps to meet local and Bay TMDLs for nutrients and bacteria.
- Transitory discharges such as dumping of grease or other materials is a frequent problem in the County. The County should consider investing in a targeted education and outreach program to potential generating sites, esp. in drainage areas where a history of problems exist (e.g. Bennington outfall, Maple Ave. outfall).
- Large drainage areas such as those draining to Bennington and Maple Ave outfalls have a history of transitory discharges as described in the previous bullet. However, these outfalls also show indications based on water quality data of continuous sources of contamination such as from sewage sources. It is important that the County keep in mind the nature of these different types of discharges (transitory vs. continuous) and that each will require a different type of investigation to eliminate. Continuous or intermittent sewage discharges will require a potentially significant investment of staff time, water quality monitoring and special tools and techniques (e.g. dye or video) in order to isolate the problem.
- Teams conducting drainage area investigations had several occasions where sump pumps appeared to be directly connected to laundry machines, either through water quality testing or anecdotal evidence from neighbors of suds flowing down the street. The extent of this problem in Montgomery County should be reviewed and enforcement / education efforts increased, if needed.

Section 2. Field and Lab Methods

Field Preparation

Montgomery County provided CWP with the following GIS layers that were used in the field:

- Streams
- Sligo Creek watershed boundary
- Roads
- Stormwater infrastructure including pipes, outfalls and manholes
- County boundary
- Aerial imagery
- Location of piped streams

CWP used this information to develop detailed maps for conducting outfall surveys (Figure 2 & 3).

Field Sampling

Four field teams conducted outfall screening along approximately 10 miles of stream in Sligo Creek, almost the entire stream length in the watershed. A total of 225 outfalls were assessed during the initial screening. Each team was composed of one CWP staff person, one Montgomery County staff person and typically one or more volunteers. The sampling took place over four days from 1/10/11-1/11/11 and from 1/24/11-1/25/11. Entire stream reaches were walked and all outfalls that were encountered were sampled when dry weather flow was found. Outfalls with no flow were assessed for physical indicators such as pipe benthic growth, corrosion, algae, and so on. All outfalls were marked in the field with a "CWP ID" (Figure 4). The DEP ID was also noted, where present. Photos were taken at each outfall, location marked with a GPS point and latitude/longitude noted on the field form.

Outfalls observed to have flow were investigated using the outfall reconnaissance inventory (ORI) technique described in Brown et al (2004) and screened for a number of illicit discharge indicators including flow, physical indicators and ammonia. Four samples were collected from each flowing outfall and analyzed as indicated in Table 3. Ammonia was measured in the field and the remaining parameters were analyzed in a lab setting (Figure 5). A threshold greater than 0.1 mg/L for ammonia was used as an action level for further drainage area investigation. The investigations are presented in Section 4. Montgomery County DEP also collected a series of measurements for their MS4 permit including air and water temperature, pH, phenols, copper, chlorine, conductivity and detergents. When dry weather flow was observed, water quality testing was conducted using both CWP and Montgomery County illicit discharge parameters.

Four in-stream measurements were collected in the upper (Sligo Creek and Dennis Ave & mouth of Wheaton Branch), middle (Sligo Creek and Piney Branch Rd), and lower watershed (Sligo Creek and New Hampshire Ave). At these sites, discharge was measured using a pygmy meter and a sample was collected and analyzed for total nitrogen and total phosphorus.

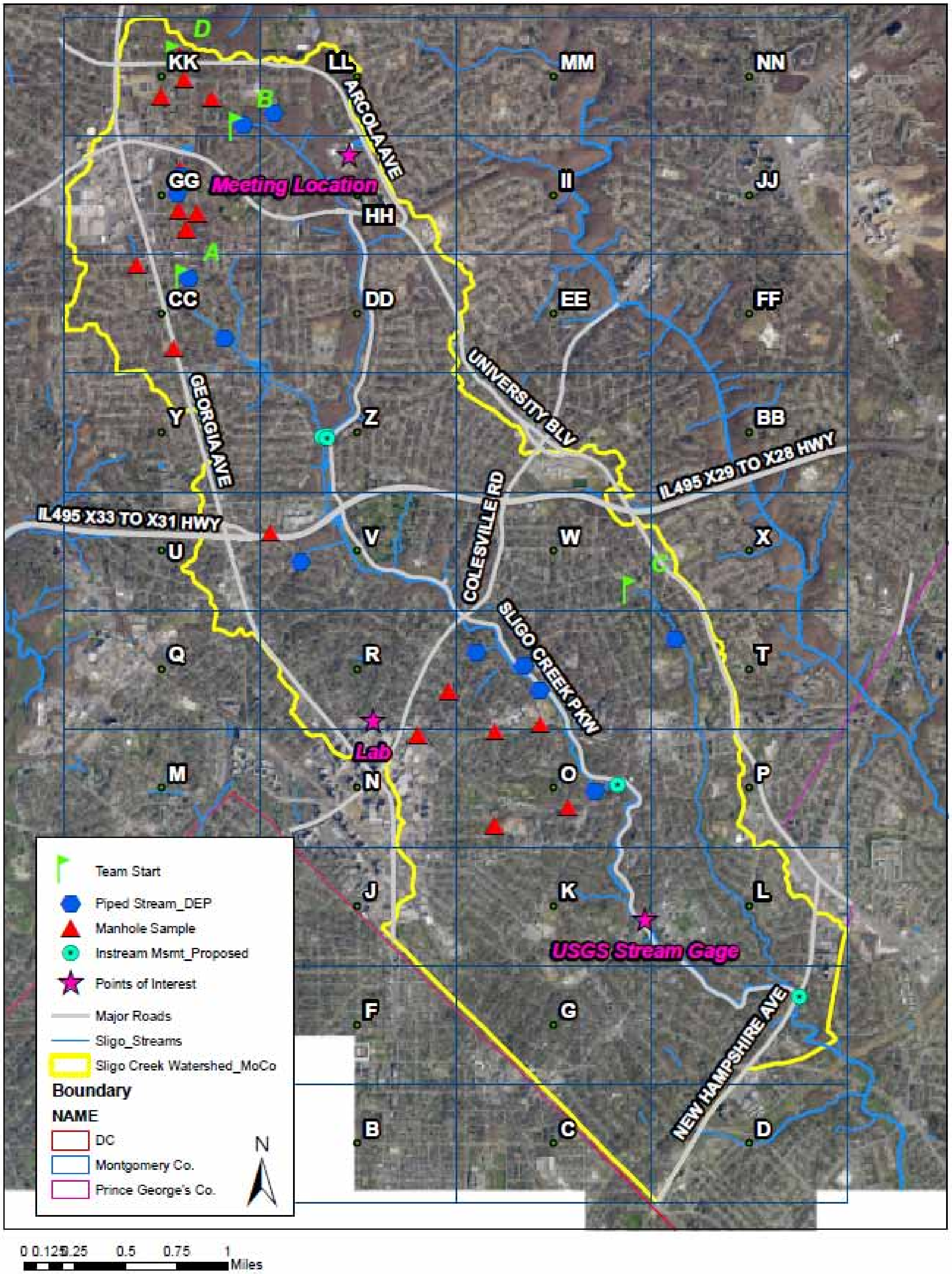

Figure 2. Locator map used for IDDE outfall surveys in Sligo Creek.

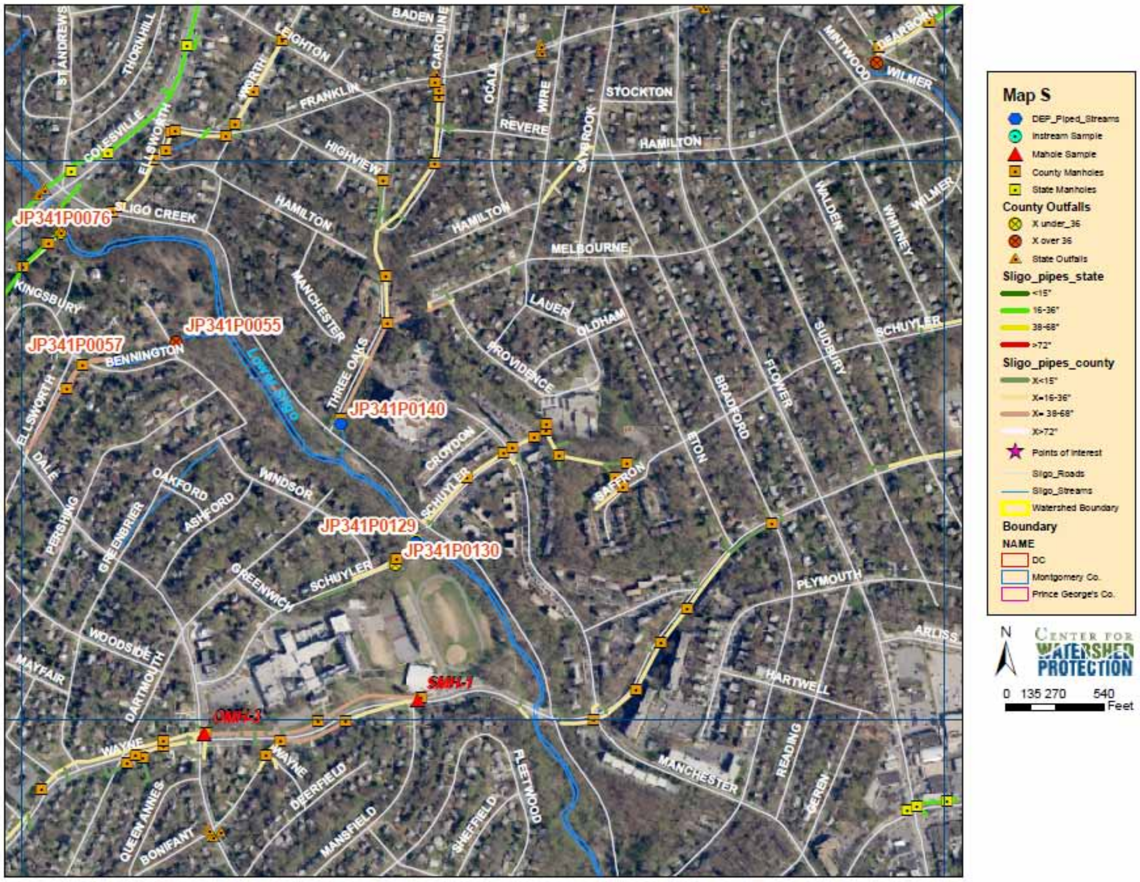

Figure 3. Detailed map used for IDDE surveys in Sligo Creek.

Figure 4. Outfall CCA20 marked in the field.

(a) (b) (c)

Figure 5. (a) Analysis in the lab; (b) Preparing to plate bacteria samples; and (c) spectrophotometer with "over range" sample shown in the green sample cuvet and a "blank" in the yellow sample cuvet.

Background on Water Quality Parameters

A variation of the Flow Chart Method (Brown et al, 2004, Figure 6) was used to distinguish between three major types of illicit discharges: wastewater, washwater and tap water discharges from groundwater, which is not considered to be an illicit discharge.

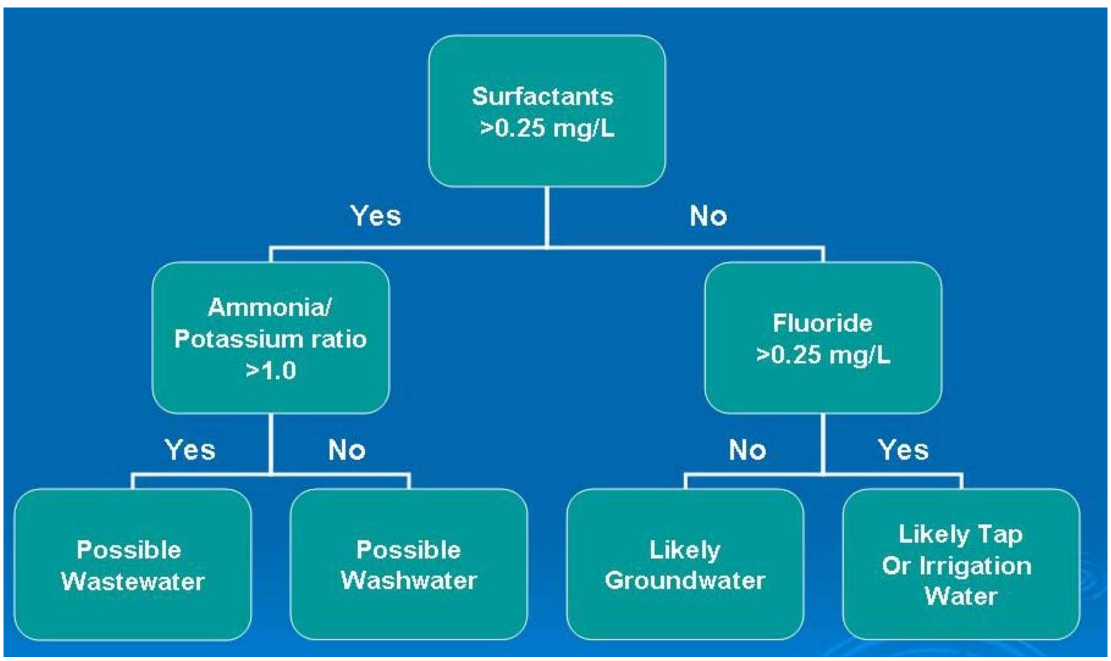

Figure 6. Flow chart method used to distinguish potential illicit discharges (Brown et al, 2004).

Additional detail regarding the particular parameters utilized is provided below.

Ammonia

Ammonia is a good indicator of sewage (typical value > 1.0 mg/L) since it has a significantly higher concentration compared to groundwater (~0.0 mg/L) or tap water (~0.0 mg/L). High ammonia concentrations may also indicate liquid wastes from some industrial sites. Ammonia is relatively simple and safe to analyze. Some challenges include the tendency for ammonia to volatilize (i.e., turn into a gas and become non-conservative) and its potential generation from non-human sources, such as pets or wildlife.

Ammonia was measured in the field for this study using a field photometer and is used as an initial screening parameter. The photometer works best at moderate temperature and may display false negatives or false positives during cold temperatures. Temperatures were near freezing during the field work in Sligo Creek and some discrepancies with the meter did occur as verified by samples that were analyzed later in the lab with Hach DR 2010 spectrophotometer and for ammonium at the Horns Point Lab (Table 1). Not all samples were lab verified due to budget constraints. Note that 1) ammonia and ammonium will not be equal to one another as their proportion is dependent on pH but results should be comparable and relatively proportional assuming similar pH, 2) the meters have an accuracy of ± 0.1 mg/L.

Table 1. Comparison of field vs. lab-tested ammonia/ammonium

Site-ID	Field Ammonia (mg/L)[1]	Lab Ammonia (mg/l)[2]	Horn Point Lab Ammonium-N (mg/L)[3]	Notes
B10	0.35	0.2	n/a	
CCA25	1.33	n/a	0.93	
CCA8	3.62	n/a	3.696	
LC29	1.5	OR	n/a	
OC7	0.68	0.02	n/a	False positive
PC2	0	0.01	n/a	
PC13	0.39	0.07	n/a	False positive
SA10	1.25	n/a	0.062	False positive
TC1	0	0	n/a	
VA10	0.31	0.19	n/a	
VA14	0.56	0.27	n/a	
VA15	0	0.03	n/a	
VA21	0	0.05	n/a	
VA30	0.13	0	0.018	False positive
ZA4	0.48	0.16	n/a	

[1]Using a Hanna HI96715 or Milwaukee Instruments MI405 medium range photometer

[2]Hach DR/2010 spectrophotometer

[3]Cambridge, MD

Fluoride

Fluoride is a good indicator of tap water in communities where potable water is fluorinated. Generally, a concentration > 0.25 mg/l indicates a potable water source. Fluoride was measured in this study using a Hannah photometer with a range of 0-2.00 mg/L, resolution of 0.01 mg/L and precision of ± 0.03 mg/L at 1.00 mg/L.

Chlorine is often used as an indicator in IDDE programs nationally because of its widespread use to disinfect tap water. Unfortunately, chlorine is extremely volatile, and even moderate levels of organic materials can cause chlorine levels to drop below detection levels. Chlorine is non-conservative and as such it is not a reliable indicator. However, if very high chlorine levels are measured (e.g. > 1.0 mg/l), there is a strong indication of a water line break, swimming pool discharge, or industrial discharge from a chlorine bleaching process. Therefore, fluoride is a preferred indicator over chlorine where it is being used in the jurisdiction's drinking water treatment system.

Potassium

Potassium is found at relatively high concentrations in sewage (≥7 mg/L based on data collection efforts by CWP in Baltimore), and extremely high concentrations in many industrial process waters (≥ 20 mg/L). Consequently, potassium can act as a good first screen for industrial wastes, and can also be used in combination with ammonia to distinguish washwaters from sanitary wastes in freshwater.

Potassium was measured immediately after field work in the lab in this study using a compact ion meter with a range of 0 – 99 x 100 ppm and a resolution of 1.0 ppm (0 – 99 ppm), 100 ppm (10 – 99 x 10 ppm), and 100 ppm (10 – 99 x 100 ppm). A two-point calibration was conducted before each set of sample readings where the meter was standardized first to 20 x 100 ppm and then to 15 x 10 ppm. Aferwards, the sample water is placed on the optical sensor of the meter to determine concentration.

Anionic Surfactants/Detergents

Most illicit discharges have elevated concentration of detergents. Sewage and washwater discharges contain detergents used to clean clothes or dishes, whereas liquid wastes contain detergents from industrial or commercial cleansers. The nearly universal presence of detergents in illicit discharges, combined with their absence in natural waters or tap water, makes them an excellent indicator.

Anionic surfactants were measured in this study for freshwater samples using Chemterics test kits by Montgomery County in their lab facilities. The procedure uses a 3-minute extraction technique to measure anionic detergents in the 0-3 ppm (mg/L) range.

Optical Brighteners

Optical Brighteners are fluorescent white dyes that are added to almost all laundry soaps. When optical brighteners are applied to cotton fabrics, they absorb ultraviolet rays in sunlight and release them as blue rays. These blue rays then interact with the yellowish color naturally occurring in cotton to give the garment the appearance of being "whiter than white." Because the main commercial use of these dyes is in laundry detergents and textile finishing, optical brightener dyes are generally found in domestic waste waters that have a component of laundry effluent.

The fluorescence of optical brighteners can be detected quantitatively using a fluorometer. Another method that detects the presence or absence of optical brighteners is by shining a 4-6 watt fluorescent ultraviolet (U.V.) light ("black" light) on unbleached cotton pads treated with sample water and determining a "hit" by the presence of a glow. Optical brighteners were assessed in this study using the UV method, however, the method was not very successful due to difficulties in determining a "hit" after visual inspection of the cotton pad. Montgomery County may want to consider using a fluorometer for illicit discharge tracking. However, this method allows for obtaining instantaneous results which is an important attribute for tracking problems.

E. coli

E. coli, and other bacteria such as fecal coliform and enterococcus, are found at very high concentrations in sewage compared to other flow types such as tap water and groundwater[i], and is a good indicator of sewage or septage discharges, unless pet or wildlife sources exist in the subwatershed that may confound illicit discharge detection. Overall, bacteria are good supplemental indicators and can be used to find "problem" streams or outfalls that exceed public health standards.

In this study, 100 mL of sample was collected in a sterile bottle and a 1- mL of subsample was used and plated onto an inoculant that grows E. coli as "blue" colonies and total coliforms as "red" colonies. The colonies of each are counted, multiplied by 100 and reported as colony forming units, or CFUs, per 100 mL.

Total Nitrogen and Total Phosphorus

Total nitrogen and total phosphorus concentrations will be higher in sewage compared to other flow types. Monitoring for nutrients can help to determine "hotspots" in a watershed. Nutrient monitoring along with bacteria monitoring can assist in prioritizing actions as well as quantifying the benefit of eliminating a problem. For this study, 50 mL of sample was collected at each site and analyzed by the Horns Point lab for total nitrogen and total phosphorus.

Threshold levels for illicit discharge screening parameters are defined in Table 2.

Table 2. Threshold levels for screening parameters used in Sligo Creek illicit discharge surveys

Parameter	Threshold	Source
Ammonia	>0.1 mg/L	Brown et al (2004)
E. coli	235 CFU/100 ml (grab sample)	EPA (2006)
Total coliform	235 CFU/100 ml (grab sample)	No threshold for surface waters; same threshold for E. coli utilized.
Fluoride	0.25 mg/L	Brown et al (2004)
Detergents	0.25 mg/L	Brown et al (2004)
Potassium	5 ppm	Guidance extrapolated from Lilly and Sturm (2010)

A total of 213 outfalls were screened for the illicit discharge survey, which was the majority of the outfalls in the watershed. Outfalls with dry weather flow were tested using methods presented in Brown et al (2004) as well as using Montgomery County DEP's established IDDE protocol.

[i] The confirmed swage discharge in this study had an E. coli concentration of 15,000 CFU/100 ml.

Table 3. IDDE Analysis

	Parameters Analyzed	Equipment	Method	Location	Notes
Field Measurement	Ammonia	Hannah HI 93715 or Milwaukee Mi405	Nessler method	Field	>0.1 mg/L action level for investigation
Sample 1	Conductivity	Chemetrics Conductivity meter I-1200 (0-1990µs)	Not specified	MNCPPC lab by CWP staff	Samples processed no more than 6 hours after collection
	Fluoride	Hannah HI 93729 Low Range Photometer	Adaptation of the SPADNS method		
	Anionic Surfactants	Chemetrics Detergent Kit	USEPA Methods for Chemical Analysis of Water and Wastes, Method 425.1 (1983)		
	Potassium	Horiba Cardy Compact Ion Meter C-131	Nitrate ion electrode method		
Sample 2	Total Nitrogen	--	Alkaline Persulfate Digestion of Nitrogen to Nitrate and Measured Using Enzyme Catalyzed Reduction[ii]	Contracted to Horns Point lab for analysis	Samples frozen at end of field day
	Total Phosphorus	--	Alkaline Persulfate Digestion of Phosphorus to Orthophosphate[iii]		

[ii] USEPA. 1979. Method No. 353.2 *in* Methods for chemical analysis of water and wastes. United States Environmental Protection Agency, Office of Research and Development. Cincinnati, Ohio. Report No. EPA-600/4-79-020 March 1979. 460pp.

[iii] USEPA. 1979. Method No. 353.2 *in* Methods for chemical analysis of water and wastes. United States Environmental Protection Agency, Office of Research and Development. Cincinnati, Ohio. Report No. EPA-600/4-79-020 March 1979. 460pp.

Table 3. IDDE Analysis					
	Parameters Analyzed	**Equipment**	**Method**	**Location**	**Notes**
Sample 3	E. coli and Total coliform	3M Petrifilm plates	Incubated at 35° C[iv] for 24 h ± 1 h; red and blue colonies with gas enumerated manually or with a 3M Plate Reader	CWP office in Ellicott City, MD	Samples plated no more than 6 hours after collection
Sample 4	Optical Brightener	Unbleached cotton pad	Sargent and Castonguay (2006)	CWP office, Ellicott City, MD	Sample collected, placed in Ziploc bag and then in to a black plastic bag. Sample hung to dry in a dark room and read 48 hours later with a UV light using an untreated cotton pad as a control

Flow Measurements and Load Estimates

Outfall flow was measured in one of three ways. These are listed in priority of collection below.

1. Volume-based – a 1-liter container jug is filled and the time taken to fill it is recorded with a stopwatch. Flow is obtained by converting liters to cubic feet and then dividing volume by time;
2. Weir equation – average depth of flow and wetted width are collected at the outfall and the results are plugged into this equation: =3.1 * wetted width (feet) * depth (feet) ^1.5. Note that this method should only be used with a free-flowing outfall (i.e. water drops out of the pipe and falls to the streambed) and when the depth of flow is relatively uniform; and
3. Rate and cross-sectional area – the cross-sectional area of the water is obtained by collecting the wetted width and average depth of water and multiplying the results. Velocity is obtained by using a stopwatch to measure the time it takes for a ping pong ball to flow over a known distance. The velocity measurement is repeated 3-5 times and the results averaged. Flow is obtained multiplying cross-sectional area by velocity.

Load estimates were made from grab samples and assumed to remain constant over an entire year. The estimates were also made using a conservative approach whereby a "background level" was subtracted from the original concentration. Background nutrient concentrations in surface waters were determined as 0.02 mg/L for total phosphorus (TP) and 1.0 mg/L for total nitrogen (TN). This background level was determined from nutrient data collected by the USGS National Water-Quality Assessment (NAWQA) program for nutrients in "natural watersheds[v]" as well as data collected by CWP from "clean" outfalls in Baltimore, MD, that is, those outfalls that did not

[iv] Temperature on 12/6 was closer to 32ºC.
[v] http://water.usgs.gov/nawqa/nutrients/pubs/awra_v36_no4/

exceed any of the identified parameters. A range of values reported from 50-150% to reflect the diurnal nature that is often observed with these flows.

Section 3. Illicit Discharge Survey Results and Summary

The results of the illicit discharge survey conducted in Sligo Creek are presented in Table 4. A map of the stream reaches walked for the outfall surveys is shown in Figure 7. A larger map showing outfall locations can be found in Appendix B. It was found that 27% of the outfalls assessed had dry weather flow and only 20% of the outfalls were mapped. Ammonia, fluoride, anionic surfactants and E.coli were used in this initial screening to test for the presence of illicit discharges. A summary of samples that exceeded the thresholds defined above can be found in Table 5.

Table 4. Field Site Summary	
	No.
Total outfalls assessed	213
Outfalls with dry weather flow	58 (27%)
Mapped outfalls	45 (21%)
In-stream samples	4
Drainage area investigations	23

Table 5. Illicit Discharge Summary for Flowing Outfalls (n=58)	
No. of discharges with potential wastewater or other discharge of unknown origin (ammonia >0.1 mg/L)	35 (60%)
No. of potential tap water discharges (Fl >0.25 mg/L)	17 (29%)
No. of potential washwater discharges (anionic surfactants >0.25 mg/L)	24 (41%)
Outfalls with E. coli above EPA threshold for contact recreation (>235 CFU/100 ml)	14 (24%)

The screening tests demonstrate the effectiveness of using IDDE to identify source area contributions to in-stream pollutant loads. Highlights of the IDDE screening tests are provided with full results for each outfall in Appendix A. For example, it was determined that sewage contamination was present at outfall CCA8 based on concentrations of ammonia, detergents, and *E. Coli* that exceeded typical benchmark values as well as on the presence of gross physical indicators at the outfall. Two outfalls were confirmed water main breaks (Outfall CCD1 and Outfall OC7). Discharges at thirteen outfalls were suspected of sewage discharges based on high concentrations of both ammonia and detergents (B11, B13, B14, HA5, KE02, KB14, PC13, PC14, SA10, SA4, SB37, SB42, SB43, and VA24). Additional discharges were of concern due to elevated concentrations of one or more of the following indicators: ammonia, potassium, fluoride, detergents, bacteria, total nitrogen and/or total phosphorus (B10, CCA20, CCA21, CCA25, CCD1, H1, LC29, OB30, OC7, PC1, SA11, SA6, TC7, VA14, VA21, WC2, and ZA4).

Nutrient loads were summed for all of the outfalls and compared to the downstream in-stream load. Loads from all outfalls were nearly equivalent to those seen in-stream for both nitrogen and phosphorus (Figure 8). In addition, the nutrient load for outfalls can be broken down further into those outfalls that exceed one or more illicit discharge criteria – therefore assumed to be an illicit discharge – with outfalls that did not exceed any illicit discharge criteria – assumed to be "clean" outfalls. Figure 8 shows that, given the stated assumptions, the majority of the nutrient load in the stream itself comes from outfalls with illicit discharges. In addition, higher average bacteria concentrations were observed from outfalls that exceeded one or more illicit discharge criteria compared to "clean" outfalls (Figure 9). This data points to illicit discharge outfalls as major nutrient and bacteria polluters in Sligo Creek when viewed from this "snapshot" perspective. It stands to reason that by isolating sources and eliminating contamination from these outfalls, significant reductions in nutrients and bacteria may be achieved.

A summary of in-stream measurements can be found in Table 6. Instantaneous nitrogen and phosphorus loads show marked increases from upstream to downstream locations, up to nine times higher for nitrogen and six times higher for phosphorus. Examination of outfall loads, and the cumulative effect of each outfall, is shown from upstream to downstream in Figure 10. "Hotspots" become apparent when viewed from this perspective. Outfall CCA8 is responsible for the first "jump" in the graph; this outfall was linked to the broken sewer line under Georgia Ave. The second jump is from outfall SB37; this investigation is still underway (see Outfall SB37 under Section 4 below).

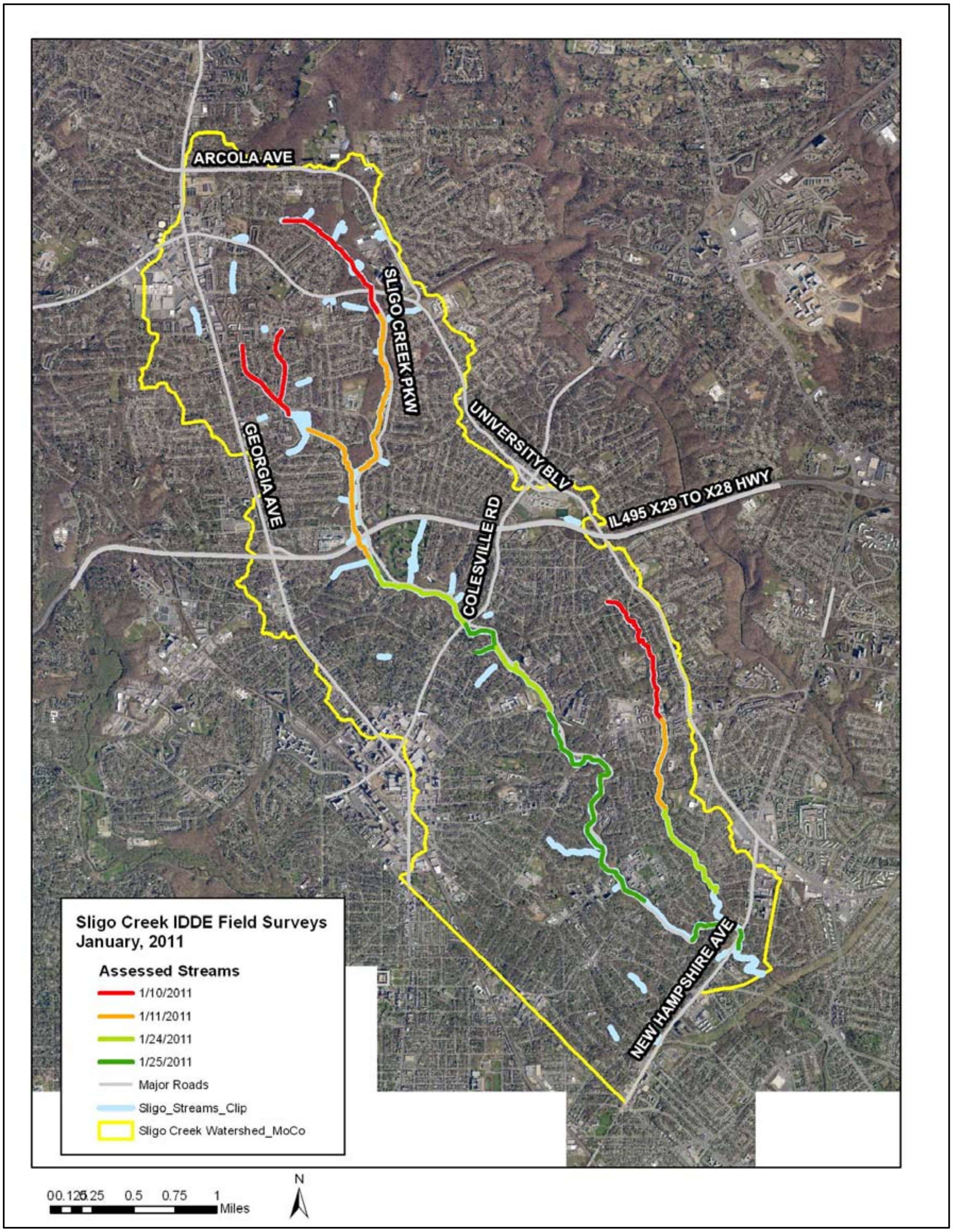

Figure 7. Surveyed reaches for illicit discharge outfall surveys in Sligo Creek.

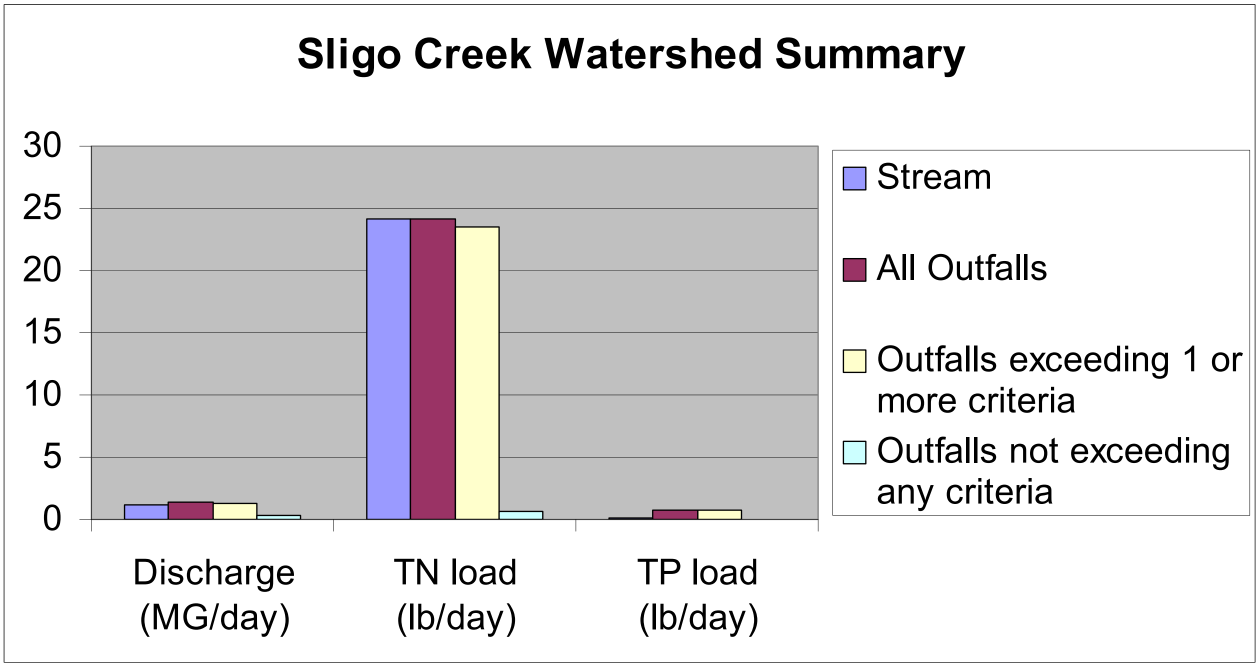

Figure 8. Nutrient load from outfalls compared to in-stream load.

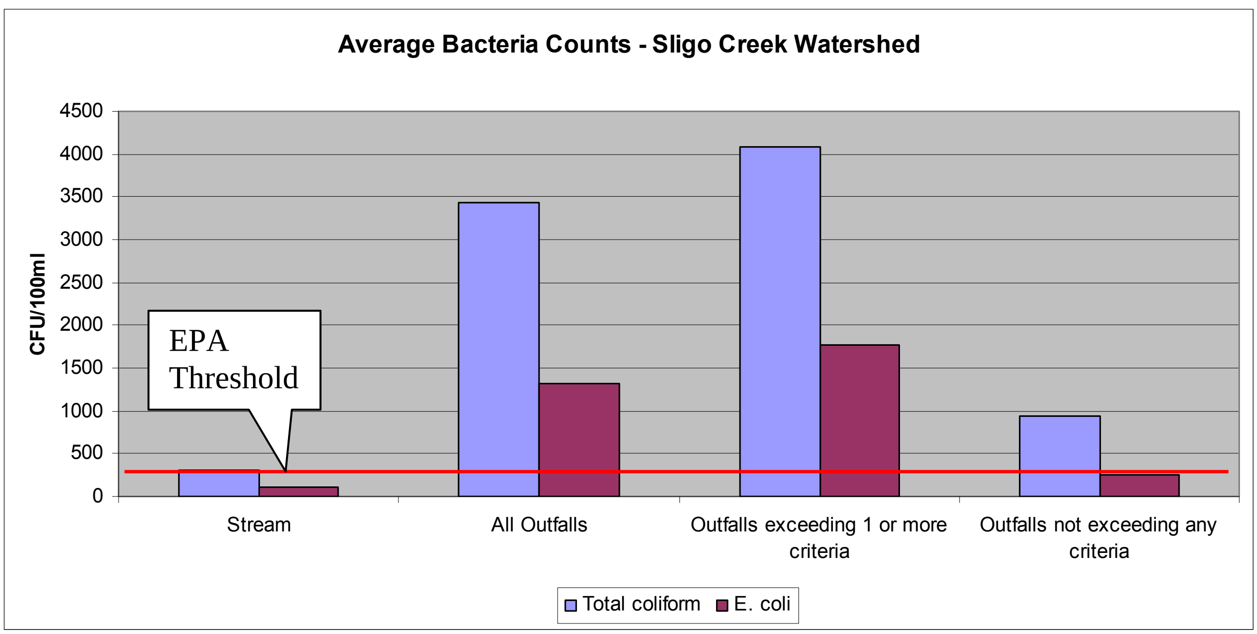

Figure 8. Average E. coli and total coliform concentrations from in-stream Sligo Creek and outfalls. EPA threshold (235 CFU/100 ml) is represented by the red line.

Table 6. In-stream Sample Summary[vi]				
	Upper Sligo (Z_ISWest)	**Upper Wheaton Branch (Z_ISEast)**	**Middle Piney Branch Rd. (O_IS)**	**Lower –New Hampshire Ave. (H_IS)**
Ammonia (mg/L)	0.17	0.0	N/a	N/a
Potassium (ppm)	11	2	6	5
Fluoride (mg/L)	0.39	0.25	0.16	0.17
Detergents (mg/L)	N/a	N/a	N/a	N/a
Conductivity (µS)	1760	540	980	9700
E. coli (CFU/100 ml)	0	0	200	100
Total coliform (CFU/100 ml)	100	200	2900	300
Discharge (cfs)	0.2131	0.2238	1.4141	1.8657
Total Nitrogen (mg/L)	2.366	2.24	2.646	2.408
Instantaneous TN Load (lb/day)	**2.72**	**2.70**	**20.18**	**24.23**
Total Phosphorus (mg/L)	0.0240	0.005	0.023	0.016
Instantaneous TP Load (lb/day)	**0.0257**	**0.0056**	**0.1631**	**0.1497**

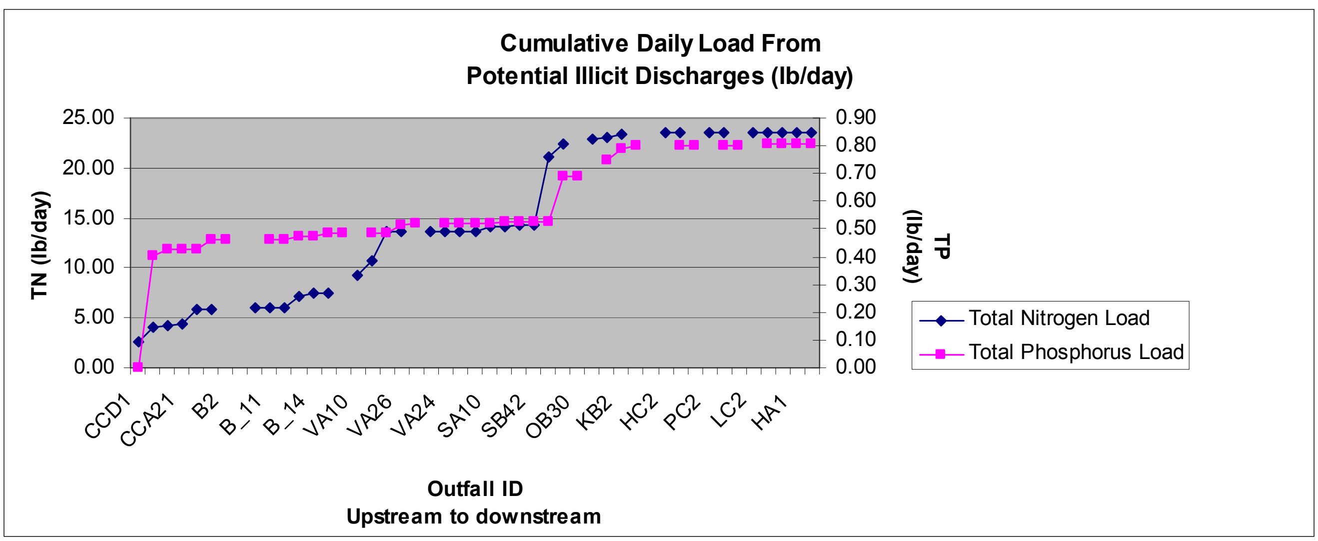

Figure 10. Cumulative daily load from outfalls with potential illicit discharges (exceeding one or more criteria) in Sligo Creek watershed.

A comparison between the CWP and Montgomery County set of parameters for illicit discharge detection resulted in 20% more hits by CWP compared to the County (Figure 11). The additional 20% of outfalls detected as potential illicit discharges using CWP parameters had a combined nitrogen load of 11.74 lb/day and combined phosphorus load of 0.2 lb/day.

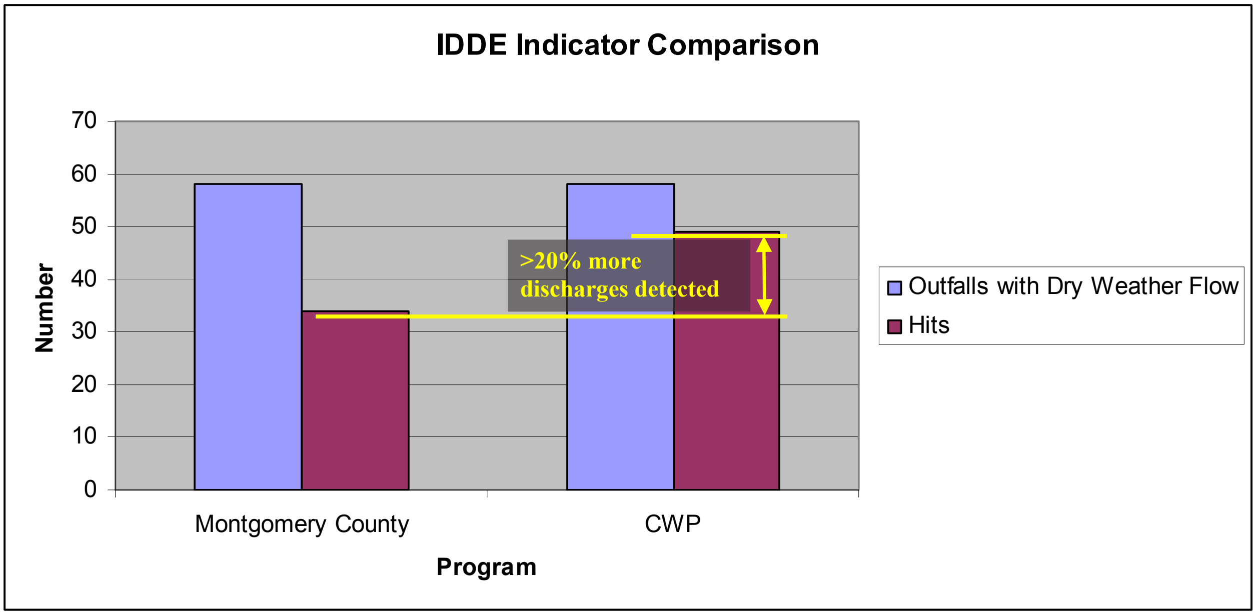

Figure 11. Montgomery County and CWP comparison of IDDE indicators.

Section 4. Drainage Area Investigations

CWP and Montgomery County staff conducted drainage area investigations of outfalls with potential illicit discharges identified during the outfall surveys. The primary goal of the investigations was to isolate the source of the contaminated discharges as much as possible using indicator monitoring, primarily with ammonia, and physical characteristics such as flow or odor. Investigations are described in detail below and include overall conclusions and potential next steps that Montgomery County should take to confirm the source or follow-up.

1/10/2011-1/11/2011 Investigations
Team: Deb Caraco (CWP) and Sue Allen / Dan McCann (DEP)

Outfall CCA8 (JP123P5000)
Location: Etna and Sligo Creek

- Results of initial screening found high ammonia, potassium, detergents, bacteria and total nitrogen at the outfall.
- Team investigated up-pipe on the afternoon of the 10th, and again on the morning of the 11th. Manholes up the trunk were first investigated, starting with CCA8-1. This was an “off line” manhole and was dry.
- Team moved up the trunk to CCA8-2, which was impossible to open on both dates, even with an axe. However, the team could smell a strong odor from this location. Manholes up and down the street and on the east side of Georgia Avenue were dry and not connected to the main line.
- On the 11th, the team returned to manhole CCA8-3 and gathered a sample which was tested in the field for both ammonia and detergents. The sample from this site had a very high ammonia reading (0.7 mg/l), and detergents of between 0.5 ppm and 0.75 ppm.
- Across the highway, the team sampled from manhole CCA8-4 on both dates. On the 10th, the sample was returned to the lab (recorded as manhole number CCMH-3), and lab results indicated a low ammonia reading. On the 11th, the sample from this site had an ammonia field reading of 0, and detergents at about 0.25 ppm (limit of detection). While there was a sewage smell at this outfall, the analytical data suggests that the discharge is downstream (i.e., east) of this site, and likely originates under Georgia Avenue.
- On June 13th, the team returned to CCA8. Both the left and right box culverts inside the CCA8 outfall yielded high ammonia readings (1.83 mg/l on the right side and 1.4 mg/l on the left. It was discovered that these pipes run parallel toward Georgia Avenue. Underneath Georgia Avenue they combine into one large box, but split into parallel pipes again upstream of Georgia Avenue. Upstream of Georgia Avenue, flow is only present in the right pipe. Underneath Georgia Avenue, the flow splits between the two pipes. This explains why high ammonia readings were recorded downstream of Georgia Avenue on January 11th, but not upstream. The upstream sample must have been taken from the left pipe only.
- Flow in the right pipe was tracked upstream and sampled periodically. CCA8-6, at Plyers Mill and Douglas Avenue had an ammonia reading of 2.16 mg/L. Upstream of this point, the pipes no longer run parallel, and the flowing pipe continues up Douglas Avenue.
- Upstream of Windham Lane, the pipe collects flow from a small stream. The ammonia reading in the stream at this point (CCA8-7) was 2.50 mg/L.

- The stream was tracked upstream to a flowing outfall with visual indications of illicit discharge. From this point, the pipe appears to continue under the Bally Total Fitness Parking lot, but a corresponding manhole could not be located. Several manholes in the Bally Total Fitness parking lot were opened, but appeared to be related to the parking lot detention system, rather than the pipe in question. Other manholes in the parking lot and Veirs Mill Road could not be opened due to parked cars and traffic concerns.
- According to the drainage system map, the next manhole for this pipe appears to be located in the north end of the Bally Total Fitness parking lot, or just outside the parking lot on Veirs Mill Road. From there, the connections continue in both directions along Veirs Mill Road.
- Further investigation should begin at the Bally Total Fitness parking lot, preferably with parking spaces with manholes in or near them blocked off, and the opportunity for safe access of the storm drains on Veirs Mill Road.

Conclusions:

- o The illicit discharge appears to originate either at the Bally Total Fitness property, or farther upstream on Veirs Mill Road. Further field investigation is necessary to pinpoint the location.

<u>Outfall CCD1</u> (JP123P0617)
Location: Windham and Bucknell

- A “hit” for chlorine in the Montgomery County sample was detected on 1/10, and a corresponding high value for fluoride in the CWP sample. This outfall also had low level detergents and high total phosphorus.
- On 1/11, the team followed up at this site, continuing up-pipe and sampling for chlorine. At manholes CCD1-1 through CCD1-4, the team found significant flow and high chlorine values.
- Manhole CCD1-4 was at a juncture, and it appeared that the flow originated from the due north, but the team did open manhole CCD1-5 (to the northeast), and confirmed that there was no flow in this manhole.
- At CCD1-6, the flow smelled strongly of chlorine and still had significant flow, which appeared to originate directly from the west. The team opened the nearest manhole (CCD1-7). There was no flow at this manhole.
- The mapping was incomplete at this location, and it was not clear if the manhole at CCD1-7 actually connected directly to CCD1-6. Consequently, the team narrowed the possible source to 1) a broken water line near CCD1-6 or (less likely) 2) a possible pool discharge from a health club at the corner of Pritchard and Georgia. The second possibility was determined to be unlikely because of the volume of water needed to produce the continuous (continuing overnight) and high flow observed at the outfall.

Conclusions:

- o The most probable source for this discharge was a broken water line near CCD1-6, and this was later confirmed to be the case by Montgomery County DEP.
- o This outfall should be re-sampled due to presence of detergent and high total phosphorus indicating potentially more than one problem.

Outfall TC7

Location: North of Piney Branch Rd on Long Branch

- Results of initial screening found high field ammonia and bacteria at the outfall on 1/10.
- On 1/11, the team revisited the outfall, which had a very slight flow (trickle) and a lot of debris built up at the outfall, but high (0.5) field ammonia.
- There was no mapping, so the team walked up into the courtyard above the outfall and opened several manholes, and could find no flowing pipes.

Conclusions:

- o This outfall has either an intermittent discharge, or perhaps the high ammonia is simply a result of the debris at the outfall. High bacteria measured at the outfall suggests the former.

Outfall ZA4

Location: Across from 1505 Woodman St.

- This outfall had a high field ammonia and elevated lab ammonia value.
- Late that day, the team investigated the site, and found no flow at the manhole immediately above the outfall (ZA4-1).

Conclusions:

- o It is possible that this is an intermittent discharge from a nearby residence.

1/24/2011 Investigations

Team: Chris Swann (CWP) and Sue Allen (DEP)

Outfall PC14A (JN563P0028)

Location: End of Forston Street, East of stream

- Results of initial screening found ammonia, detergents and bacteria hits at this outfall.
- Checked manholes leading from outfall up Forston Street.
- Small amount of flow detected in first manhole up the pipe from the outfall; too small to sample.
- No flow in any manholes further up the line.
- Returned to outfall and confirmed that flow still present. Pulled sample for lab test and reading was 0.05 mg/L.

Conclusions:

- o Flow starts from under Barron Street. Could be intermittent source from either infiltration or inflow (I/I), sewer leak, or cross connection with residential sumps.
- o Conduct dye testing or video surveillance to determine if a cross-connection exists.

Outfall PC13

Location: End of Clayborn Avenue, West of the Stream

- Results of initial screening found high ammonia, detergents and bacteria at this outfall.
- Checked manholes leading from outfall up Clayborn Avenue.
- No flow in any manholes on Garland Avenue, Haddon Drive, or Clayborn Avenue north of traffic circle.

- Manhole with no ID located in traffic circle where roads come together. No indication whether sanitary or storm sewer. Pulled cover and observed large amount of steady flow. Observed what was believed to be toilet paper in flow, so did not pull sample for lab test as it was assumed this was sanitary sewer line.
- Returned to outfall and confirmed that flow still present. Only small amount of flow, not equivalent to the amount of flow seen in manhole at traffic circle.

Conclusions:

- Further investigation and dye test may be necessary to identify possible leak location.
- Lack of flow from manholes up the line from outfall suggests that cross connection with a residential household may be the cause of flow.

<u>Outfall B11</u> (JP343P0051)
Location: Tenbrook Drive and Whitehall Street, East of the Stream

- Results of initial screening found high ammonia, detergents, bacteria and total nitrogen at this outfall.
- Checked manholes leading from outfall at intersection of Tenbrook and Whitehall.
- Small amount of flow in first manhole up the pipe from the outfall west of Tenbrook. Field reading of flow for ammonia indicated 0.09 mg/l.
- Checked next set of manholes up-pipe on both Tenbrook and Whitehall. No flow in any manholes further up the line.

Conclusions:

- Further investigation and dye test may be necessary to identify possible leak location.
- Lack of flow from manholes up the line from outfall suggests that cross connection with a residential household may be the cause of flow.
- Another possible cause could be I /I.

<u>Outfall B10</u>
Location: Windham Road, West of the Stream

- Results of initial screening found elevated field and lab ammonia as well as bacteria.
- Checked manholes leading from end of Windham Lane where road meets stream to intersection with Jewett Street.
- Flow was found in all the manholes (total of five) on Windham Lane. Flow was shallow but a water sample was obtained at the intersection of Windham Lane and Malone Street. However, the ammonia field meter gave a reading of “insufficient light” for s successful field test. Lab tested ammonia was over the maximum range for the instrument (>0.5 mg/L).
- Checked for manholes on Inwood Avenue and Windham Lane up-pipe of last flowing outfall. Could not find any storm sewer manholes.
- Team was approached by two different neighborhood residents who indicated that flow was a problem on Windham Lane. The first reported seeing sump discharges into the gutter from houses at the top of the hill, sometimes with bubbles suggesting soap in the discharge. Observed large amount of ice in front of one home, and second resident indicated that sump discharges from the home to the gutter happen often.

Conclusions:

- Further investigation and dye test may be necessary to identify possible leak location.
- There was a fire hydrant located just up from the last flowing outfall that might indicate that the hydrant has a leak that is entering the storm drain system.
- Anecdotal evidence from residents suggests that some sumps discharges to the street and then enters the storm drain, and that some connection with equipment like wash machines may be possible.

<u>Outfall SB37</u>
Location: Wayne Avenue and Sligo Creek Parkway, West of stream

- Results of initial screening found high ammonia, fluoride, detergents and very high bacteria at this outfall.
- Team walked the grounds of the International School looking for manholes with flow.
- No accessible manholes could be found on the grounds of the school. Walked track and basketball courts located between school and stream but no indicators of possible source of flow.
- Checked manholes along Wayne Avenue in from of school but no flow indicated.
- Conclusion was made that the flow was likely an illicit connection coming from the International School.

Additional investigation on 4/4/2011, 4/14/2011 & 6/13/2011 by Lori Lilly (CWP), Steve Martin, Dan McCann and Alex Torella (DEP)

- High ammonia and detergents detected again at the outfall on both days.
- On 4/14, team dropped dye in an adjacent line but did not confirm presence at the outfall.
- Team met Montgomery County Public School officials on site and conducted video surveillance from a yard inlet behind the school but was not able to confirm any sources.
- Team accessed school and dropped dye in kitchen drains and toilets in the cafeteria after seeing what appeared to be toilet paper or napkins and maybe food waste coming from the outfall. Dye was not confirmed at the outfall.
- Team observed a fine sediment plume discharging continuously from the outfall for a couple of hours at mid-day. Team also noted the presence of cherry flower petals, despite having searched on the street for flow in street inlets. Continued investigation found a previously unobserved manhole near the school that was ¾ buried under turf. The manhole was marked sewer but did not have an odor or other evidence of sewage. Team dropped dye and confirmed that the outlet for the manhole was the original problem storm drain outfall.
- Two sources of flow were observed in the buried manhole, one was the cloudy flow observed at the outfall and another flow was coming from the residential neighborhoods across Wayne Ave. An ammonia reading could not be obtained from the cloudy flow because it was too turbid and a sample could not be obtained from the other flow at all.
- The team tracked the cloudy flow up Wayne Ave to the next manhole, which was labeled sewer. Again, a lateral flow was observed coming from the other side of Wayne Ave and the main turbid flow was directly under Wayne Ave. This same scenario was observed again at the next outfall, which was labeled storm drain.
- The cloudy discharge was suspected to be coming from a construction project around Bonifant and Cedar where a contractor was replacing potable water lines.

- On 6/13, the team re-visited the site and sampled from a manhole Wayne that received flow from west to east on Wayne and from south to north on Mansfield. Both flows were high or ammonia and detergents although sampling was difficult due to the depth so some mixing of the two flows may have occurred.
- Flow on Wayne at and above Dale were clean.
- The contaminated flow appears to be coming from two locations: from Mansfield and between Mansfield and Dale on Wayne.
- Dye was placed in a sanitary line on Mansfield but did not show up in the manhole or at the outfall.

Conclusions:

  - The cloudy discharge was likely isolated to the construction project and Montgomery County was to follow-up with a site visit the next day.
  - The stormwater drains should be inspected with a camera to determine from where the contaminated flows are coming.

1/25/2011 Investigations
Team: Paul Sturm (CWP) and Alex Torella (DEP)

<u>Outfall SB42 </u>(JP341P0140)
Location: Three Oaks and Sligo Creek Parkway

- Results of initial screening found high ammonia, detergents, fluoride and bacteria at the outfall.
- Traced flow to junction box for Pepco at Parkside Plaza, however, it couldn't be opened.

Conclusions:

  - Potential illicit connection to the Parkside Plaza building.
  - Conduct dye testing to confirm.

<u>Outfall H1</u>
Location: Carroll and Niagara Ct.

- Results of initial screening reported to investigation team for outfall LC29 (Carroll St & Long Branch) found very high ammonia (1.5 mg/l) at the outfall in the field as well as a lab ammonia reading that was over range for the instrument (>0.5 mg/L). High bacteria also present. Team investigated wrong outfall and went to Carroll St and Niagara Ct.
- Investigation team found high ammonia readings at an outfall near Carroll and Niagara Ct Pkwy.
- Tracked discharge using ammonia to a rehabilitation center, 0.87 mg/l at last manhole.
- Additional flow detected from a residence at 7513 Carroll Ave – sheet flow over street into storm drain.
- Checked ammonia for the residential discharge and it read >1 mg/l.
- Lab results for ammonia from the rehab center were over range.
- Lab results for ammonia from sump were also over range.

Conclusions:

- May be a direct connection from the rehabilitation center; conduct dye testing to confirm.
- Residential discharge could be a sump pump, although frequency was high for this kind of discharge
- Re-visit site and speak with homeowners if possible
- Investigate original location, LC29.

Outfall VA14 (JP122P0188)
Location: Flora, north of White Oak

- Initial field screening found high field and lab-tested ammonia as well as high bacteria.
- Team checked sump discharge in curb for chlorine and detergents – no hits.
- Checked ammonia from discharge from black plastic pipe – no hit.

Conclusions:

- There may be another inlet up-pipe that is connected and should be investigated for presence of flow and further screening as needed.
- Continue to check for flow and re-check sump for potential washwater.

Outfall OC7 (JP122P0188)
Location: Piney Branch, north of Sligo Creek

- Results of initial screening found high ammonia, fluoride, chlorine and total phosphorus at the outfall.
- Tracked flow through storm drain network up from outlet and isolated between two inlets.
- Called in to authorities for water main break.

Conclusions:

- Confirm(ed) water main break
- May be more than one problem at this site due to high ammonia and total phosphorus also detected.
- Re-sample outfall for ammonia, fluoride and detergents once water main break repaired

3/28/2011, 4/4/2011, 4/11/2011 Investigations
Team: Lori Lilly (CWP), Dan McCann / Gretchen Ekstrom / Sue Allen / Steve Martin (DEP)

Outfall KB14
Location: Off Maple Ave, near the Hospital

- Results of initial screening found very high ammonia, potassium, fluoride, detergents and total coliforms at the outfall. Total nitrogen and total phosphorus concentrations also very high (highest TN of any site – 9.744 mg/L and second highest TP – 0.803 mg/l). A strange precipitate formed during the ammonia test in the lab, an occurrence that apparently occurs with excessive levels of calcium, iron, magnesium and/or sulfide.
- Re-sampled outfall and found lower concentrations of ammonia (0.14 mg/l) and detergents (0.25 mg/l).
- Checked next set of inlets up-pipe from outfall on west and east sides of hospital cut-through road.

- Inlets on west side (closer to outfall) were dry. Three inlets on east side were full of standing water that did not appear to be discharging from catch basin and entering storm drain system.
- Re-sampled the outfall on 6/13 and the discharge was clean.

Conclusions:

- An intermittent discharge may be entering the system between outfall and inlets on hospital cut-through road, either through potentially contaminated groundwater or through an illicit connection with hospital.
- County should gather pipe schematics from hospital and determine some logical locations to conduct dye testing.
- Continue periodic monitoring of this outfall.

Outfall HA5

Location: 500 ft southwest of Sligo Creek Parkway off New Hampshire Ave.

- High ammonia, fluoride, detergents and total coliforms detected at outfall. Frozen suds present during the initial visit.
- Re-sampled outfall and found low concentrations of detergents and fluoride and a hit for ammonia (0.21 mg/l). Suds noted in the outfall pool.
- Found flow in manhole on the northwest side of New Hampshire Ave, flow was coming from the southwest, along New Hampshire Ave.
- Found a stomwater inlet on near New Hampshire Ave and Larch. Could not find any other manholes to check on New Hampshire Ave between the outfall and the crest of the drainage area.
- Explored tributary and upstream drainage area to the northwest of New Hampshire Ave – could not find a connection between this tributary and the problem outfall though orange bacteria flocculent seemed to a be common factor throughout the system, as at the problem outfall.
- Upon investigation of the drainage area, the team discovered a potential illicit discharge in a manhole at Glaizewood and Devonshore coming from a black, plastic PVC pipe (Figure 12). Ammonia concentrations from this pipe were elevated. The other pipes had no ammonia but did have fluoride, indicating a potable water source.

Figure 12. Four pipes enter a stomrwater manhole at Glaizewood and Devonshire. Ammonia was elevated from the flow being discharged from the black, corrugated pipe (0.25 mg/l in field, 0.14 mg/l checked with spectrophotometer later in the day).

Conclusions:

- It is unclear where the piping for this outfall originates. It may be connected to the system on New Hampshire Ave (unmapped) and did not appear to be connected to the tributary system running parallel to New Hampshire.
- A sewer line runs along northwest New Hampshire Ave as well. Since no connection could be found between the outfall and upstream drainage area, there could be a cross connection or sewer break that is allowing sewage to get into the storm drain system and then Sligo Creek along New Hampshire Ave.
- Dye should be placed in the sewer system up-pipe of the outfall to determine if there is a connection.
- The outfall should continue to be monitored for ammonia.

<u>Outfall KE01</u>

Location: Near Maple Ave and Sligo Creek Parkway

- This outfall was not surveyed during the original field work in January.
- On 3/28, the team noticed a severe sediment discharge coming from the double 72" outfalls (Figure 13). A water sample showed elevated ammonia (0.14 mg/l) and very high fluoride (1.15 mg/l).
- Team visited a nearby construction site but did not detect any water leaving the site. Team went to a location suspected by the County but did not find anything.
- During the inspection of a manhole at Lincoln and Maple, a dry weather discharge was discovered (see investigation for KE02).
- Upon return to the outfall ~2 hours later, the sediment was observed to have stopped discharging.
- A site visit to the outfall on 4/4 found the outfall discharging severe suds (Figure 13). Detergent levels measured 3.0 mg/l.

(a) **(b)**

Figure 13. (a) Sediment discharge at outfall KE01 on 3/28/2011 and (b) suds discharge at outfall KE01 on 4/4/2011.

Conclusions:

- Transitory discharges evident at this outfall.
- Enforcement measures should be increased in the drainage area to decrease the frequency of problems observed (e.g. suds).
- The County should engage in a targeted education effort in the drainage area, focused on car washes, auto dealers and others that may be suspect for large scale washwater discharges. Develop, maintain and update a list of potential generating sites in the drainage area for both washwater and sediment sources.
- The County may want to seek assistance from a local watershed group to assist in this education effort. Friends of Sligo Creek and the Anacostia Watershed Society may be able to assist.
- Continuous discharges are also a problem at this outfall (see below regarding site KE02) and require a different strategy and tracking mechanism.

<u>Manhole KE02</u>

Location: South of Maple Ave, off Lincoln St.

- This dry weather flow was discovered during investigation of outfall KE01.
- A water sample was pulled from the manhole and read 0.37 mg/l for ammonia.
- The manhole was revisited on 4/4/2011 with a different team and re-sampled. The ammonia reading during this investigation was 3.11 mg/l. Potassium was high at 17 ppm and detergents were measured at 0.25 mg/l.
- Stormwater manholes up-pipe and along Lincoln and Jefferson St. were checked. Flow was observed in a manhole on the southwest side of Lincoln in near the apartment complex.
- Dye was placed in two nearby sewer lines but the dye was not detected in the stormwater manhole.
- Dye was placed in the stormwater manhole southwest of Lincoln and observed in the original problem manhole as well as downstream at outfall KE01.
- Team checked up the hill in a neighborhood off Sheridan Ave and in a nearby park, but could only find one storm drain inlet, which was dry.
- On 6/13, the team re-visited this site – the flow was high for ammonia (0.36 mg/l) but no detergents were found.
- The team looked for additional manholes around the parking lot that may have been missed but none were located.

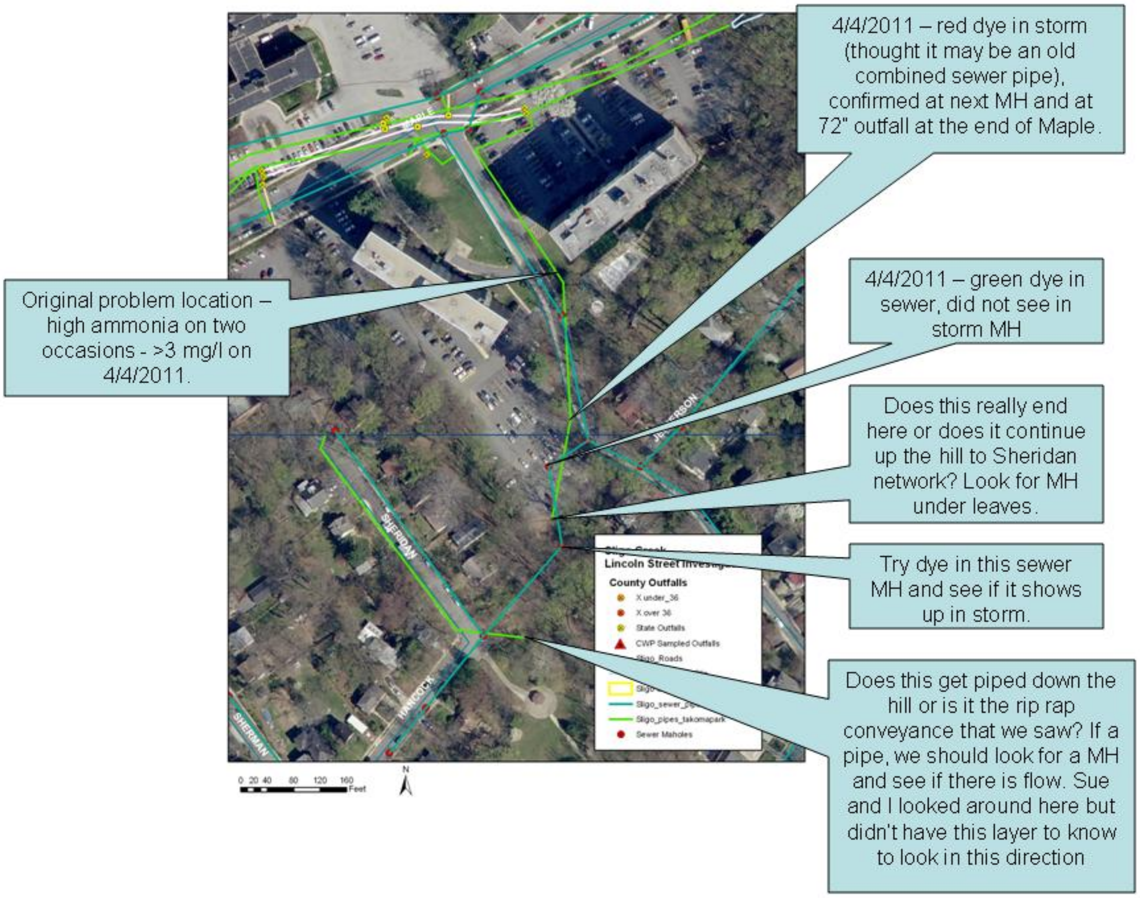

Figure 14. Stormdrain investigation of manhole KE02.

Conclusions:

- o The team was not able to determine a source for the flow.
- o The stormwater pipes should be inspected with a video camera to determine the source of the flow and verify pipe connections.

<u>Outfall SA6</u>

Location: Near intersection of Colesville and Sligo Creek Parkway

- Initial field screening found high ammonia at this outfall (0.54 mg/l).
- Re-sampled outfall and found high concentrations of ammonia in the pool (1.39 mg/l) and in the flow (2.23 mg/l).
- Opened manhole at Franklin and Hamilton. Found flow emanating from two different pipes – a pipe coming from Franklin St. and another coming from a conveyance on private property (Figure 15).
- Checked ammonia from both sources – the private residence flow had an ammonia concentration of 0.5 mg/l and the pipe coming from Franklin had an ammonia

concentration of 0.38 mg/l. Algae was noted in the concrete conveyance by the private residence and the water seemed to originate from a spring behind the house.

- Could not find anymore flow in manholes along Franklin or Colesville Rd up-pipe from Franklin and Hamilton.
- Re-checked ammonia at the outfall and concentration was 0.17 mg/l.

Figure 15. Nutrient rich flow as evidence by algae originates from behind a private residence. High ammonia detected in this discharge.

Conclusions:

- o Team appeared to observe a "spike" in the discharge (1.34 mg/L) at the beginning of the site visit and less observed at the end (0.17 mg/L). The discharge appeared constant but pollutant loading may be intermittent.
- o The private residence should be dye tested to see if there is a connection between the house and the nutrient rich waters originating in the stormwater conveyance.
- o The County may want to video the other pipe with high ammonia to determine where the flow is coming from.

<u>Outfall SA4</u>

Location: Colesville and Sligo Creek Parkway

- High ammonia, fluoride, detergents and bacteria detected at this outfall originally.
- Outfall was re-visited but no flow was observed.

Conclusions:

- o Re-visit, and sample if flowing, at various times of the day to determine if an intermittent problem exists at this outfall.

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<u>Outfall VA24</u>

Location: 350 feet north of Colesville, west side of Sligo Creek

- Initial field screening found very high ammonia (1.56 mg/l), high fluoride and detergent at this outfall. Flow was only a trickle.
- Outfall was re-sampled and ammonia was lower (0.3 mg/l).
- Flow was tracked along Watson. A stormwater manhole was opened about 350 feet up-pipe from the outfall. A water sample showed ammonia at 0.36 mg/l.

- Another stormwater manhole was opened at Greyrock and Watson – ammonia was 0.0 at this location.
- Dye was placed in the adjacent storm sewer. No dye was seen in manhole on Watson upon re-visiting several hours later.

Conclusions:

- o Problem could be a potential cross-connection or infiltration between Greyrock and Watson and the manhole 350 feet up-pipe from the outfall.
- o Dye testing in sewer should be conducted again but monitored more closely in the manhole.
- o Dye testing should be conducted in the limited number of houses in the vicinity of the problem.

<u>Outfall SB43</u>

Location: Bennington and Greenbrier

- Initial field screening found high ammonia, potassium and very high detergents (1.5 mg/l) at this outfall.
- A sample was collected at Greenbrier and Windsor; ammonia was 0.3 mg/l and detergents were 0.5 mg/l.
- Flow was tracked to where it daylights at an outfall at Greenbrier and Dale in what seems to be a newly constructed stream stabilization project (Figure 16).
- Could not find flow in any nearby stormwater manholes or inlets. One nearby inlet on Greenbrier was paved over.
- Dropped dye in an adjacent sewer line. Checked outfall several hours later but did not observe dye in flow.

Figure 16. Outfall at Dale and Greenbrier circled in red.

Conclusions:

- Determine who installed riprap project and origin of outfall.
- Video inspection of sewer should be conducted again but monitored more closely at the outfall.
- Paved over manhole may be a stormwater pipe and could be opened to look for flow.
- Adjacent houses may need to be dye tested to determine if an illicit connection is present.

6/13/2011 Investigations
Team: Greg Hoffmann (CWP), Dan McCann / Gretchen Ekstrom (DEP)

Outfall B14
Location: Dennis Aveune and Sligo Creek Parkway

- The outfall was tracked back to the intersection of Dennis Avenue and Tenbrook Avenue. There was evidence of a heavy sediment load here, but no flow was present at this location or at the outfall. Recent road patching near a water main valve may be a source of the sediment, but this is not certain.

Conclusions:

- o It appears that this is an intermittent discharge. Another site visit is advised.

Outfall VA27

Location: Brunett Avenue and Lorain Avenue

- No flow was present in the pipe originating from Brunett Avenue. However, an ammonia reading of 0.25 mg/L was detected in the stagnant water at this outfall.

Conclusions:

- o It appears that this is an intermittent discharge. Another site visit is advised.

Section 5. Recommendations

The following recommendations are made to Montgomery County in order to provide a more effective and efficient IDDE program to meet their MS4 permit requirements:

Regulatory

- Ensure repair of known illicit discharge sources.
- Follow-up with identified actions described in the drainage area investigation section above.
- Isolate sources for remaining outfalls exceeding parameters in Table 1, Appendix A.

Programmatic

- Insufficient mapping was found to hinder the isolation of pollution sources during drainage area investigations. The County should update GIS map layers after each investigation to include pipe connections, direction of flow, location of manholes and inlets, outfalls, etc.
- County staff should walk entire stream reaches during outfall surveys to find new outfalls. In this study, only 21% of outfalls were originally mapped in the County's GIS system. Of flowing outfalls, 74% of the outfalls were not originally mapped; this could account for significant more reductions in nitrogen, phosphorus and bacteria.
- For transitory discharges detected at outfalls such as sediment or suds, particularly at outfalls with a history of problems, keep a list of potential generating sites in the drainage area and visit those sites when a problem is detected.
- Future monitoring:
  - Resurvey confirmed polluted outfalls four times per year until clean for 1 year;
  - Resurvey remaining suspect and potentially polluted outfalls at least one time per year;
  - Engage/encourage citizen water monitoring efforts to expand the County's capacity to address water pollution issues
  - Continue monitoring, or have citizens continue to monitor, for bacteria and assure that standards improve after elimination of the identified problems.

Education

- Conduct education and outreach to potential generating sites such as potential washwater dischargers, esp. in drainage areas where a history of problems exist. Conduct targeted outreach to each type of business, e.g. restaurants should be targeted for grease barrels and provided materials on proper storage and containment; concrete companies should be provided with education materials regarding slurry and its proper disposal.
- Teams conducting drainage area investigations had several occasions where sump pumps appeared to be directly connected to laundry machines, either through water quality testing or anecdotal evidence from neighbors of suds flowing down the street. The extent of this problem in Montgomery County should be reviewed and enforcement / education efforts increased, if needed. The plumbing code should be reviewed to ensure that connecting laundry machines to sump pumps is a violation.

Program Support

- Provide staff with additional training and tools regarding water quality monitoring and tracking procedures, such as use of dye, smoke and video to isolate sources.
- Develop standard operating procedures for tracking illicit discharges and following up with illicit discharge repairs.
- Keep abreast of the Chesapeake Bay TMDL and the potential impacts that it may have for nutrient reduction and regulations for local Bay communities. Information on the overall TMDL can be found on EPA's TMDL website, and information on Maryland's' strategy to meet the new regulations can be found on MDE's TMDL Implementation Plan webpage.

In-Field Methods

- Add ammonia, potassium and bacteria to indicators used for detecting illicit discharges. Replace chlorine with fluoride. Monitoring for copper and phenols does not add value to the program and these can be dropped. The use of detergents as an indicator, as the County already does, is recommended, although the County should consider lowering the threshold from 0.5 to 0.25 mg/l.
- Consider the use of optical brighteners as an additional indicator or tracking parameter.
- Staff should carry all reagent waste produced in the field back to the lab for proper disposal rather than disposing of the waste at the field site.
- Staff should carry sledgehammers as well as manhole picks in their vehicles as many manholes were encountered that were difficult or impossible to open.

Section 6. References

Brown, E., D. Caraco and R. Pitt. 2004. *Illicit Discharge Detection and Elimination: a guidance manual for program development and technical assessments*. Center for Watershed Protection and University of Alabama. EPA X-82907801-0.U.S. EPA Office of Wastewater Management, Washington, D.C.

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ATTACHMENT A.
Table 1. Raw Data

Sligo Creek Illicit Discharge Survey January 2011											Exploratory Calculations*				
Flowing Outfall Data												High		Low	
Outfall ID	Pipe dia-meter (in)	NH3 (mg/L)	K (ppm)	NH3/K ratio	FI (mg/L)	Deter-gents (ppm)	Total coliforms (cfu/ 100 ml)	E. coli (cfu/100 ml)	TP (mg/L)	TN (mg/L)	Gallons/ day	TN (lb/day)	TP (lb/day)	TN (lb/day)	TP (lb/day)
B_11	56	0.3	7	0.04	0	0.25	1200	500	0.002	4.396	1,268	0.05	0.00	0.02	0.00
B_12_1	24	0.29	2	0.15	0	0	1100	0	0.024	3.766	775	0.03	0.00	0.01	0.00
B_14	32 x 50	0.485	2	0.24	0	0.25	1600	0	0.040	1.855	58,829	0.63	0.01	0.21	0.00
B1	0	0.01	3	0.00	0.23	0	0	0	0.007	1.660	n/a	n/a	n/a	n/a	n/a
B10	36	0.35	1	0.35	0.11	0	500	0	0.004	2.716	3,381	0.07	0.00	0.02	0.00
B13	42	0.11	2	0.06	0	0.25	200	0	0.007	1.666	193,818	1.62	0.00	0.54	0.00
B2	0	0.71	1	0.71	0.2	0	0	0	0.014	3.339	n/a	n/a	n/a	n/a	n/a
B3_1	0	0.55	1	0.55	0	0	800	0	0.041	2.898	n/a	n/a	n/a	n/a	n/a
B3_2	0	0	2	0.00	0	0	100	0	0.023	2.709	n/a	n/a	n/a	n/a	n/a
B4	36	0	2	0.00	0	0	400	0	0.009	4.494	4,143	0.18	0.00	0.06	0.00
CCA20	24	0	2	0.00	0.17	0.25	200	0	0.042	4.837	4,016	0.19	0.00	0.06	0.00
CCA21	30 x 80	0	3	0.00	0.61	0.25	1000	100	0.025	3.948	8,318	0.31	0.00	0.10	0.00
CCA25	15	1.33	12	0.11	0.41	0	0	0	0.062	2.534	114,114	2.19	0.06	0.73	0.02
CCA26	9	0.13	3	0.04	0	0	0	0	0.024	1.011	233	0.00	0.00	0.00	0.00
CCA8	72 x 108	3.62	31	0.12	0.16	0.75	23000	15000	0.109	6.468	32,344	2.21	0.03	0.74	0.01
CCD1	63 x 94	0	2	0.00	0.76	0.25	0	0	0.276	2.562	203,186	3.97	0.61	1.32	0.20
HA1	42	1.1	6	0.18	0.23	0	1900	0	0.005	2.198	3,228	0.05	0.00	0.02	0.00
HA5	42	2.31	8	0.29	0.46	0.75	1300	100	0.083	2.856	1,757	0.04	0.00	0.01	0.00
HC2	24	0.58	2	0.29	0.18	0	400	0	0.007	2.030	611	0.01	0.00	0.00	0.00
HC6	18	0	6	0.00	0	0.25	1600	0	0.132	2.352	n/a	n/a	n/a	n/a	n/a
KB14	36	9.17	58	0.16	1.08	0.5	4700	0	0.803	9.744	n/a	n/a	n/a	n/a	n/a

Sligo Creek Illicit Discharge Survey January 2011											Exploratory Calculations*				
Flowing Outfall Data												High		Low	
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KB2	30	0.1	4	0.03	0.45	0	1900	200	0.063	2.016	41,665	0.53	0.02	0.18	0.01
LC2	36	0	5	0.00	0.58	0	0	0	0.218	2.660	1,527	0.03	0.00	0.01	0.00
LC29	30	1.5	6	0.25	0.2	0	1200	200	0.002	1.652	1,192	0.01	0.00	0.00	0.00
LC30	?	0.42	7	0.06	0.19	0	200	0	0.077	1.862	1,275	0.01	0.00	0.00	0.00
OB30	31	0	20	0.00	0	1	1000	0	0.558	5.978	n/a	n/a	n/a	n/a	n/a
OB31	18	0.06	10	0.01	0	0.25	100	0	0.006	4.739	39,447	1.85	0.00	0.62	0.00
OC4	76	0.32	9	0.04	0.25	0	900	0	0.245	2.716	34,234	0.74	0.09	0.25	0.03
OC7	24	0.68	2	0.34	0.69	0	0	0	0.295	2.380	16,937	0.29	0.05	0.10	0.02
PC1	15	n/a	n/a	n/a	0	0.5	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PC13_ flow	36	0.39	5	0.08	0	1	22000	14000	0.074	0.823	350	0.00	0.00	0.00	0.00
PC14A	24	0.36	2	0.18	0	0.25	26000	26000	0.000	0.000	n/a	n/a	n/a	n/a	n/a
PC17	21	0	3	0.00	0	0	400	0	0.001	3.738	437	0.01	0.00	0.00	0.00
PC18	15	0	12	0.00	0	0	800	0	0.035	4.627	119	0.01	0.00	0.00	0.00
PC2	24	0	4	0.00	0.26	0	13200	6600	0.026	0.645	496	0.00	0.00	0.00	0.00
SA10	48	1.25	11	0.11	0.39	0.5	6100	400	0.070	3.752	21,430	0.74	0.01	0.25	0.00
SA11	48	0	24	0.00	0.4	0.5	3600	300	0.054	2.114	6,916	0.10	0.00	0.03	0.00
SA4	24?	0.44	6	0.07	0.25	0.5	6800	500	0.059	2.898	71	0.00	0.00	0.00	0.00
SA5	24	0	7	0.00	0.09	0	100	100	0.004	1.981	190	0.00	0.00	0.00	0.00
SA6	36?	0.54	5	0.11	0.17	0	200	0	0.017	0.941	3,412	0.00	0.00	0.00	0.00
SB37	50	1.04	4	0.26	0.3	0.25	30000	6000	0.100	4.172	261,477	10.38	0.24	3.46	0.08
SB38	20	0.01	2	0.01	0.24	0	2200	0	0.019	2.198	543	0.01	0.00	0.00	0.00
SB42	54	0.73	7	0.10	0.29	0.25	3300	1800	0.030	2.534	3,426	0.07	0.00	0.02	0.00
SB43	36 x 78	0.32	17	0.02	0.16	1.5	3800	1600	0.031	1.456	6,024	0.03	0.00	0.01	0.00
TC1	24	0	6	0.00	0	0	3100	2000	0.012	2.604	69	0.00	0.00	0.00	0.00
TC3	24	0	3	0.00	0	0	500	500	0.028	0.872	71	0.00	0.00	0.00	0.00
TC7	28	0.38	5	0.08	0	0	1100	0	0.013	1.855	68	0.00	0.00	0.00	0.00

Sligo Creek Illicit Discharge Survey January 2011											Exploratory Calculations*				
Flowing Outfall Data												High		Low	
Outfall ID	Pipe dia-meter (in)	NH3 (mg/L)	K (ppm)	NH3/K ratio	FI (mg/L)	Deter-gents (ppm)	Total coliforms (cfu/ 100 ml)	E. coli (cfu/100 ml)	TP (mg/L)	TN (mg/L)	Gallons/ day	TN (lb/day)	TP (lb/day)	TN (lb/day)	TP (lb/day)
VA10	36	0.31	4	0.08	0.18	0	300	100	0.006	4.326	62,608	2.61	0.00	0.87	0.00
VA14	50	0.56	7	0.08	0	0	900	300	0.010	4.214	56,479	2.27	0.00	0.76	0.00
VA15	48	0	11	0.00	0	0	0	0	0.022	3.598	22,823	0.74	0.00	0.25	0.00
VA21	73	0	10	0.00	0.16	0.5	600	0	0.052	3.402	140,690	4.23	0.05	1.41	0.02
VA24	12	1.56	7	0.22	0.35	0.5	0	0	0.005	1.876	191	0.00	0.00	0.00	0.00
VA26	30	0.18	5	0.04	0.75	0	0	0	0.165	2.688	216	0.00	0.00	0.00	0.00
VA27	57	1	4	0.25	0.14	0	5000	200	0.014	4.172	n/a	n/a	n/a	n/a	n/a
VA30	36	0.13	4	0.03	0	0	2000	0	0.013	3.892	1,014	0.04	0.00	0.01	0.00
WC1	38	0	4	0.00	0	0	2700	200	0.089	5.502	423	0.02	0.00	0.01	0.00
WC2	15	n/a	3	n/a	0	0	n/a	n/a	0.899	6.377	n/a	n/a	n/a	n/a	n/a
ZA4	18	0.48	2	0.24	0	0	0	0	0.021	1.512	753	0.00	0.00	0.00	0.00
ZA8	18	0	4	0.00	0	0.25	0	0	0.017	5.600	n/a	n/a	n/a	n/a	n/a

*Illicit discharge loads for total nitrogen (TN) and total phosphorus (TP) were estimated; assumptions and caveats were made to generate these estimates. They are listed below.

- Estimates were made from grab samples and assumed to remain constant over an entire year;
- To account for background nutrient concentrations in surface waters, 0.02 mg/L was subtracted from the value obtained from each outfall for total phosphorus (TP) and 1.0 mg/L was subtracted from the value of each total nitrogen (TN) sample. In-stream load calculations were made without this more conservative approach. This background level was determined from nutrient data collected by the USGS National Water-Quality Assessment (NAWQA) program for nutrients in "natural watersheds[vii]" as well as data collected from "clean" outfalls in Baltimore, MD, that is, those that did not exceed any of the identified parameters.
- A range of 50-150% of the calculated value is also displayed to account for the diurnal flow associated with some outfalls.

[vii] http://water.usgs.gov/nawqa/nutrients/pubs/awra_v36_no4/

ATTACHMENT B.
Outfall Map