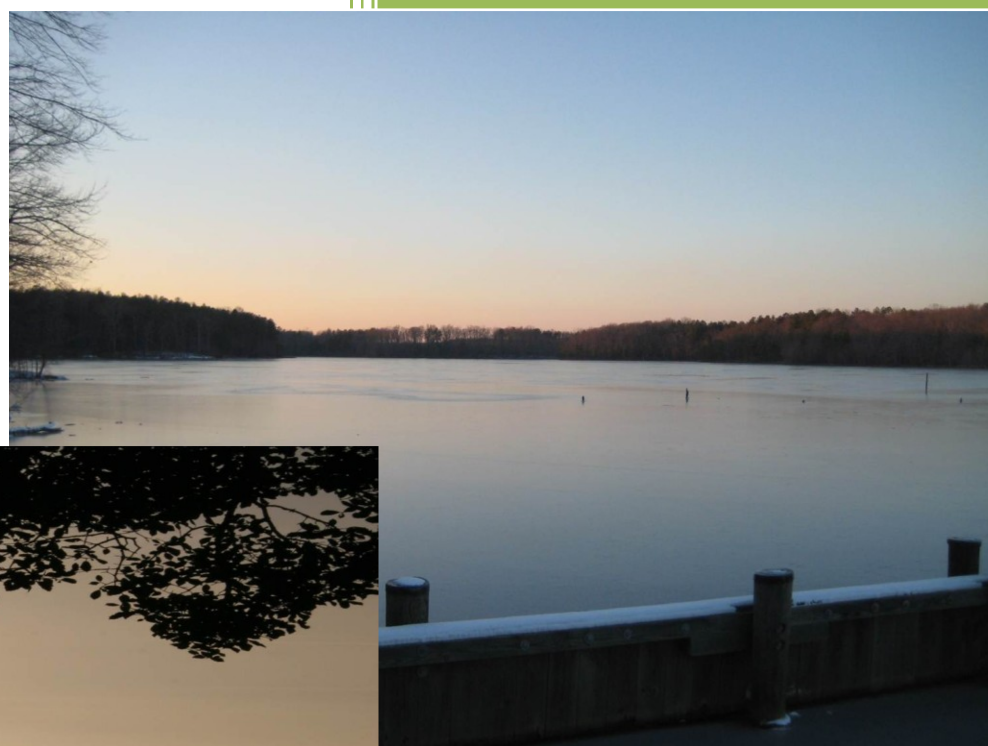
St. Mary's River Watershed Plan



Center for Watershed Protection

Ellicott City, MD

8/2/2012

Executive Summary

The St. Mary's River is located entirely in St. Mary's County, and is the last tributary in Maryland flowing into the Potomac River. Designated a "stronghold watershed" by the Maryland Department of Natural Resources, the St. Mary's River supports regionally endangered species and state threatened species, and is generally in fair health. However, the river is on the state's "Impaired Rivers" list (303d) and will face tremendous population growth and commercial development in the future due to military base realignments.

The following Watershed Plan builds upon past assessment efforts in 2002-2003 and in 2007-2008 to detail actions necessary to improve conditions in the St Mary's River watershed. The final goal of the project is the creation of a community-based and vetted watershed plan that meets EPA's A-I criteria, and is based on existing sound science and restoration principles. The plan was created with input from partners who participated in a technical advisory committee, stakeholder process meetings, and fieldwork assessments, as well as through meetings with watershed residents.

As part of efforts in community outreach and engagement in the restoration plan, a series of stakeholder meetings were held to receive feedback on the outcomes residents of the watershed wanted from the plan. The meetings resulted in the following set of goals being drafted to guide recommendations of the Action Plan:

1. **Implement effective watershed education.** Watershed education efforts should focus on a wide audience ranging from city and state employees, local residents and students. Education topics include the reduction of fertilizers, pesticide and salt application, use of native landscaping, pet waste and proper disposal of trash. A mass media education campaign, effective brochures and websites can help achieve this goal.

2. **Increase the involvement of the population** through the organization of more events that connect residents to the stream, incorporating environmental education in the schools and encouraging participation in the Adopt a Stream Program.

3. **Disconnect impervious surfaces from the stormdrain system** by incorporating stormwater retrofits in parking lots and the streetscape and disconnecting rooftop downspouts where applicable. The amount of existing impervious cover should be reduced through the removal of unused asphalt at schools.

4. **Integrate stormwater and watershed planning goals in new and redevelopment.** Future environmental impacts can be reduced through changes to existing regulations that promote green building and design, stormwater management and smart growth.

5. **Engage the business community in restoration** through a program that provides recognition for businesses that implement green practices such as stormwater treatment, pollution prevention, etc.

6. **Improve management of natural and turf areas** including parks, trails, trees, and streams through on-going trail maintenance and increased access to streams. Continue to increase the tree canopy and improve tree management and education through existing programs in the City and County.

Introduction

The 73 square mile St. Mary's River watershed is located in the mid-Atlantic Coastal Plain and is contained entirely within St. Mary's County, Maryland. St. Mary's County occupies a peninsula of land in southern Maryland along the western shore of the Chesapeake Bay between the Potomac and Patuxent Rivers. The landscape within the watershed varies from nearly flat in tidewater areas to gently rolling terrain characterized by low scarps and rises. Historically, the watershed would have been almost entirely forested. Once settlement occurred, land clearing for agriculture left the majority of the uplands cleared of forest and in agricultural use for several hundred years. Over the last hundred years, the land area in agricultural use has diminished and large areas of the watershed have reverted back to forest. In the last thirty years, this trend of increasing forest coverage has reversed, as residential and commercial growth accelerated in the County,

The stream network is 175 miles in length, and is divided among 10 subwatersheds (Table 1 and Figure 1). The tidal St. Mary's River is approximately 12 km in length. A 2008 Stream Corridor Assessment conducted by St. Mary's College found that most of the streams are healthy and are generally protected by forest buffers. However, isolated areas of erosion occur especially in areas of high impervious cover and road crossings.

Table 1. St. Mary's River Watershed Statistics
Drainage Area = 73.78 mi (24.75% of St. Mary's County) Stream length = 175 miles [1] Subwatersheds ● Lower St. Mary's ● Middle St. Mary's ● Church Creek ● Fisherman's Creek ● Craney Creek ● John's Creek ● Hilton Creek ● Pembrooke Run ● Eastern Branch ● Western Branch ● Upper St. Mary's
[1] **(St. Mary's River Watershed Characterization, 2009)**

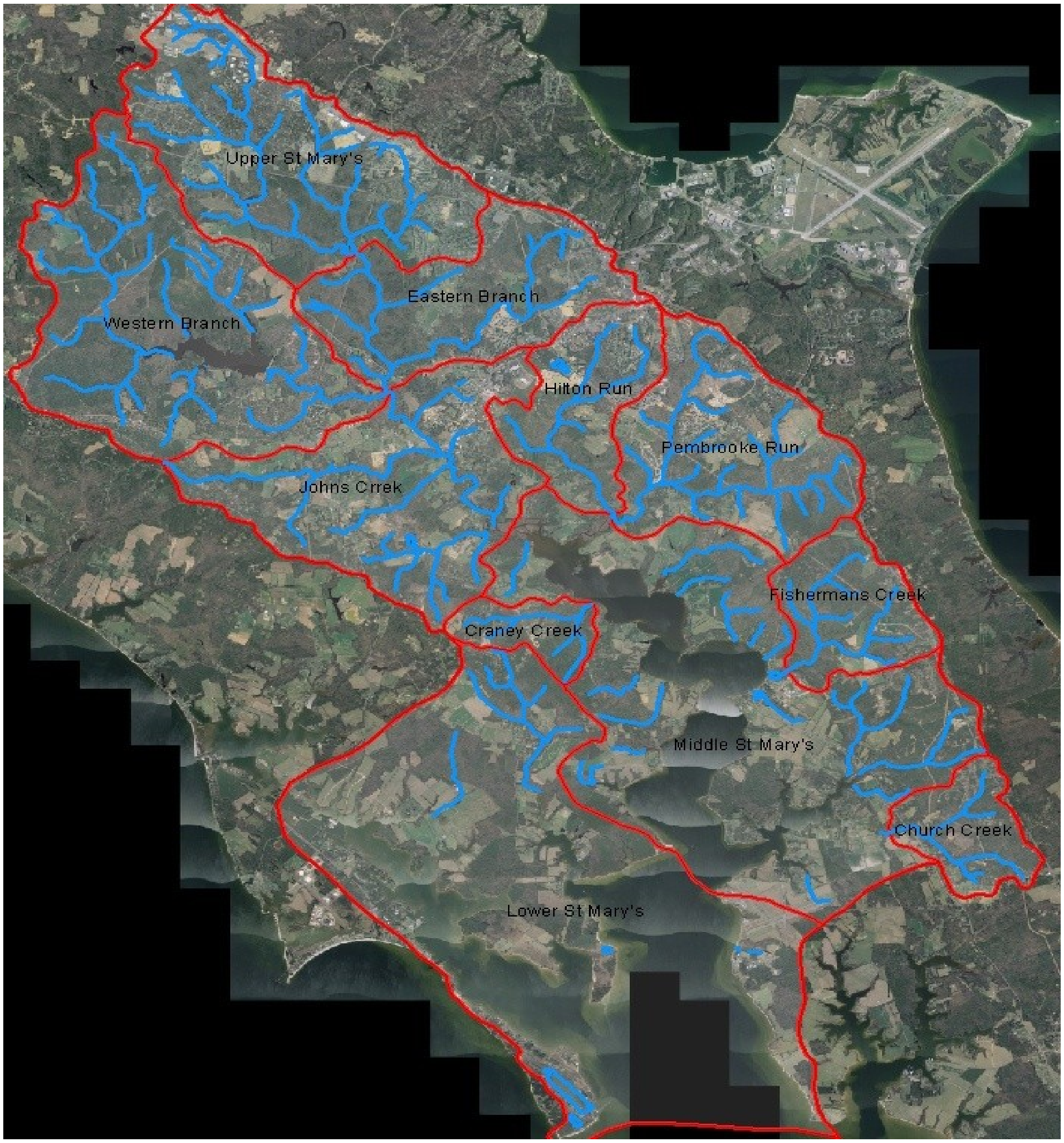


Figure 1. St. Mary's River Subwatersheds

There have been numerous studies of the St. Mary's Watershed over the years, including the St. Mary's River Stream Corridor Assessment and Tidal Shoreline Survey, the St. Mary's River Watershed Synoptic Survey, and the St. Mary's River Water Quality Assessment, all conducted by St. Mary's College of Maryland in 2008. Additionally, the Center for Watershed Protection completed the Upper St. Mary's River Baseline Watershed Assessment in 2001 and a Natural Resources Conservation Summary of St. Mary's County, Maryland in 2002. These reports provide extensive insight into the condition of the watershed's natural resources, including the River and the streams that flow into it.

In 2003, the U.S. Environmental Protection Agency (EPA) began to require that all watershed restoration projects funded under Section 319 of the federal Clean Water Act be supported by a watershed plan that includes the following nine minimum elements, known as the "a-i criteria:"

a.) Identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the watershed plan
b.) Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures
c.) A description of the NPS management measures that will need to be implemented
d.) An estimate of the amount of technical and financial assistance needed to implement the plan
e.) An information/education component that will be used to enhance public understanding and encourage participation
f.) A schedule for implementing the NPS management measures
g.) A description of interim, measurable milestones
h.) A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards
i.) A monitoring component to determine whether the watershed plan is being implemented

The St. Mary's River Watershed Action Plan draws from the previous studies and has been designed to address EPA's a-i criteria in a systematic manner. The Action Plan was developed through a partnership of six public and private entities which formed the Core Team including: the St. Mary's River Association; Center for Watershed Protection; University of Maryland Sea Grant Extension; St. Mary's County; St. Mary's College of Maryland, and the St. Mary's Soil and Water Conservation District. The Action Plan details the actions necessary to improve and maintain conditions in the watershed, based on past studies, a series of field work assessments Core Team meetings, and Stakeholder meetings.

To develop the Action Plan, the Core Team met regularly and served as a technical advisory committee, guiding the watershed planning process. In addition, two stakeholder meetings were held to provide community input into the process. A series of field assessments were conducted including a neighborhood source assessment and hotspot inventory (Wright et al, 2005), a retrofit inventory (Schueler et al, 2007), and near shore illicit discharge detection and elimination (Brown, Caraco, and Pitt, 2004). The results of the assessments are presented in this report, and the protocols can be found in Appendix B. Overall watershed recommendations are presented with associated costs, location, responsible parties, and milestones. A draft schedule for implementation and the expected benefits of implementation are also presented in the plan. The remainder of this Action Plan is organized by the a-i criteria.

Element A: Identification of Causes and Sources of Impairment

Water quality impairments in the St. Mary's River watershed are primarily associated with nonpoint sources. Non-point source pollution generally results from precipitation, land runoff, infiltration, drainage, seepage, hydrologic modification, or atmospheric deposition (US EPA, 2010). As precipitation falls on the land and creates runoff, pollutants are mobilized and transported into local water bodies. There are no major Wastewater Treatment Plants (WWTPs) or other major point sources in the watershed. There is a small package treatment plant for the Navy and Coast Guard stations at Webster Field, which discharges into the St. Mary's River. The new plant recently came online in 2011 to address compliance issues with the old treatment plant at the site.

Pollutant Sources

The major pollutant sources in the St. Mary's River watershed include runoff from developed and agricultural lands, septic systems and atmospheric deposition. In general, natural lands like forests and wetlands generate the least amount of pollutants and for the most part represent the best possible use in terms of water quality. Table 2 summarizes land use for the watershed based on the 2002 land use data from the Maryland Department of Planning. The watershed includes 4,482 acres of developed lands (8.9%), 5,603 acres of agricultural land (11.2%), 11,278 acres of forests and wetlands (22.5%), 28,669 acres of open water (57.2%) and 80 acres of bare ground (0.2%). Table 2 also shows the estimated impervious area associated with each land use type.

Table 2. St. Mary's River Watershed Land Uses			
Land Use Code	**Description**	**% Impervious***	**% Area**
11	Low-density residential	15	5.89
12	Medium-density residential	35	0.94
13	High-density residential	60	0.13
14	Commercial	90	0.59
15	Industrial	80	0.07
16	Institutional	35	1.13
17	Extractive	80	0.04
18	Open Urban Land	5	0.14
21	Cropland	3	10.08
22	Pasture	3	0.99
23	Orchards	3	0.00
25	Row Crops	3	0.08
41	Deciduous Forests	1	9.65
42	Evergreen Forest	1	0.73
43	Mixed Forest	1	11.24
44	Brush	1	0.35
50	Water	0	57.21
60	Wetlands	1	0.54
71	Beaches	1	0.01
72	Bare Rock	100	0.00
73	Bare Ground	80	0.15
241	Feeding Operations	3	0.00
242	Ag Buildings	3	0.02
Total Estimated Impervious Cover†			**5.3%**
Total Watershed Acres†			**45,198**

**Percent impervious values assigned to land use in St. Mary's River Watershed after CWP 1998, Camp Dresser, McGee 1997*
*† (*St. Mary's River Stream Corridor Assessment and Tidal Shoreline Survey, 2008)

Developed Lands

Developed areas in the St. Mary's River watershed, such as Lexington Park, California, and Great Mills, are often described as "Urban." This classification includes residential commercial, industrial and institutional land uses as well as the transportation network, roads, sidewalks, and railroads. Stormwater from developed areas can contribute pollution from fertilizers, pet waste, and fluids and emissions from vehicles. Additionally impervious surfaces associated with rooftops, roads, and parking lots generate large volumes of stormwater which can significantly damage and alter streams.

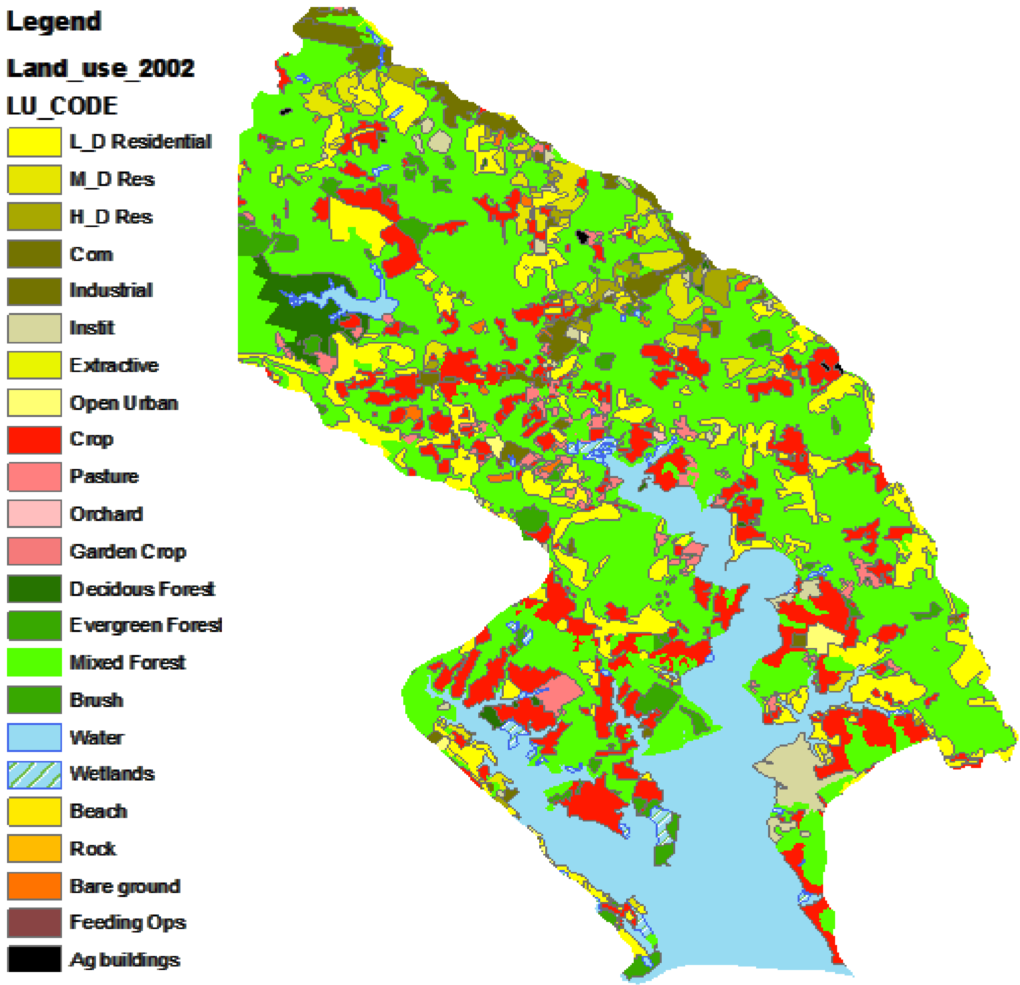


Figure 2. Land Uses in the Watershed

Agricultural Lands
Land used for growing crops, animal pasture, hay production, and nurseries are characterized as "Agricultural" lands. These lands can contribute pollution from fertilizers, animal waste, disturbed land, and air emissions.

Septic Systems
Septic systems are also called onsite sewage disposal systems (OSDS). Conventional septic systems are not designed to control nutrients. All nutrients that are not pumped out of the septic tank during the servicing pass through the system with the effluent into the drainfield. After the effluent enters the soil, phosphorus tends to bind to soil particles in the immediate vicinity of the drainfield while nitrogen tends to move with shallow groundwater, eventually reaching surface waters.

Atmospheric Sources
Atmospheric sources of pollutants include emissions into the air from vehicles, industries, power plants, dry cleaner, and other gas powered tools. Sources can also include agricultural sources including animal feeding operations and manure. There are also natural sources such as forest fires, dust storms, and volcanic eruptions. These pollutants are deposited onto impervious surfaces, where they are washed off, becoming a nonpoint source of water pollution.

Watershed Impairments and Total Maximum Daily Loads

The St. Mary's River watershed and its subwatersheds have been placed on the 303 (d) list for the following impairments: nutrients, sediment, bacteria, and biological impairments. The watershed is also threatened by increasing imperviousness. Table 3 outlines the causes of impairments in the watershed and possible sources.

Table 3: Priority Pollutants and Concerns in the St. Mary's River Watershed

Pollutant of Concern	Data Source	Potential Sources of Contamination	Watershed Effects
Nutrients (Nitrogen and Phosphorus)	MD 303d list (Bay TMDL)	•Point sources •Urban runoff •Agricultural runoff •Turf grass and lawns •Atmospheric deposition •Septic systems •Pet waste	•Eutrophication •Contributions to Bay pollution •Harmful algal blooms •Decrease in submerged aquatic vegetation (SAV)
Sediment	MD 303d list (Bay TMDL)	•Stream bank erosion •Urban runoff •Agricultural runoff •Construction sites	•In-stream habitat loss •Reduced depth in tidal creeks •Reduced light penetration for SAV growth
Bacteria	MD 303d list	•Urban runoff •Pet waste •Wildlife •Failing septic •Improper disposal of boat waste	•Swimming and Water contact related illnesses •Shellfish harvesting concerns
Biological Impairment	MD 303d list	•Stream bank erosion •Urban runoff •Agricultural runoff •Point sources	•Loss of sensitive species •In-stream habitat loss

Local TMDLs

The St. Mary's River has an approved TMDL for fecal coliform, which impacts shellfish harvesting areas. Impairment of shellfish harvesting areas by levels of bacteria exceeding Maryland's water quality standards for fecal coliform have resulted in closure of the areas to shellfish harvesting. Regulatory limits are established in the TMDL for fecal coliform, and were EPA approved on May 25, 2005.

One of the critical tasks for the TMDLs is to determine current loads from all potential sources in the watershed. The procedure needs to account for temporal variability caused by the seasonal variation and the wet-dry hydrological conditions. In order to accomplish this, data from 1999-2003 was used to calculate a median and 90^{th} percentile. A comparison of the median values and the 90th percentile values against the water quality criteria determines which represents the more critical condition or higher percent reduction. If the median values dictate the higher reduction, this suggests that, on average, water sample counts are very high with limited variation around the mean. If the 90th percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions.

These results were then used to estimate the current load condition. The allowable loads for each restricted shellfish harvesting area were then computed using both the median water quality standard for shellfish harvesting of 14 Most Probable Number (MPN)/100ml and the 90th percentile standard of 49 MPN/100ml. The TMDLs developed for the restricted shellfish harvesting areas of St. Mary's River Basin for fecal coliform median load and 90th percentile load are as follows:

Locust Grove Cove:
The median load of fecal coliform TMDL = 1.80×1010 counts per day
The 90th percentile of fecal coliform TMDL = 6.28×1010 counts per day

St. Inigoes Creek:
The median load of fecal coliform TMDL = 2.33×1011 counts per day
The 90th percentile of fecal coliform TMDL = 8.15×1011 counts per day

Carthegena Creek:
The median load of fecal coliform TMDL = 6.91×1010 counts per day
The 90th percentile of fecal coliform TMDL = 2.42×1011 counts per day

Chesapeake Bay TMDL
The United States Environmental Protection Agency (EPA), in coordination with the Bay watershed jurisdictions of Maryland, Virginia, Pennsylvania, Delaware, West Virginia, New York, and the District of Columbia (DC), developed a Chesapeake Bay TMDL for nutrient and sediment pollution, approved on December 29, 2010. Maryland Department of the Environment (MDE) allocated loads to major basins and then sub-allocated major basin loading caps of nutrient and sediment to each of 58 "segment-sheds"– the land areas that drain to each impaired Bay water quality segment – and to each pollutant source sector in those areas. MDE then aggregated the loading caps by county for ease of planning at the local level. This process will enable the State to meet key requirements for the Bay TMDL and Maryland's Watershed Implementation Plan. The target loads presented in Table 4 illustrate the total load allocation for St. Mary's County, apportioned by source sector; the St. Mary's River Watershed represents 24.75% of the County's land mass.

Table 4. St. Mary's County (Non-Federal and Federal) Bay TMDL Pollutant Load Allocations		
Sector	**Pollutant**	**2025 Edge-of-Stream Target**
Agriculture	Nitrogen	302,008
	Phosphorus	36,692
Urban	Nitrogen	200,689
	Phosphorus	21,048
Septic	Nitrogen	159,253
	Phosphorus	0
Forest	Nitrogen	250,583
	Phosphorus	8,569
Wastewater	Nitrogen	90,538
	Phosphorus	7,356

Pollutant Loads for the St. Mary's River Watershed

It is a goal of the Core Team to create a plan that is consistent with the Chesapeake Bay TMDL. The Bay TMDL calls for a 28% reduction in nitrogen and a 17% reduction in phosphorus from urban, agriculture and septic sources. To maintain consistency with TMDL requirements this report uses the Maryland Assessment and Scenario Tool (MAST) to determine the pollutant loads and reductions from the recommendations outlined in this report. MAST is a planning tool developed by the Interstate Commission for the Potomac River Basin (ICPRB) to provide rapid evaluation of various implementation scenarios for the TMDL 2 year milestone development. It allows the compilation of numerous local strategies into a single model input deck, which can then be directly integrated into the EPA Bay modeling system. MAST provides consistency with EPA modeling results and facilitates planning level decision making.

The data in MAST includes Chesapeake Bay Program land use acres and nitrogen, phosphorus, and sediment loading rates; point source information by NPDES permit number which includes flow and nitrogen, phosphorus, and sediment loads; septic system nitrogen loading rates based on three zones (critical area, within 1000 ft of a non-tidal stream, and upland areas); air deposition of nutrients on the land; load delivery fraction for edge-of-stream and delivered to the Bay; and BMP effectiveness based on location, and percent land treated or covered by a BMP. All loads are based on an annual time step.

The MAST tool provides a number of "Outputs." It will provide: acres and percentages of BMPs from the entered scenarios; estimates of nitrogen phosphorus and sediment loading before and after BMP implementation; estimated loads from the land (edge-of-stream); estimated loads to the bay (delivered); and estimated load reductions from each source sector. The tool also has a feature that allows the comparison of scenarios against the targets or against different implementation scenarios. The tool also provides summary tables that are used by MDE to create input decks for Scenario Builder.

Pollutant loads for nitrogen and phosphorus have been calculated for the St. Mary's River watershed based on the watershed land use using the MAST. The total County load estimate was divided by 24.75% (the percent of total county land the St. Mary's River Watershed occupies) to determine the total load for the St. Mary's River Watershed. Table 5 shows the annual pollutant loads by source to the St. Mary's River before implementation.

Table 5: Edge of Stream Pollutant Loading by Source for the St. Mary's River Watershed

Land Use	N load (lbs/yr)	Total P Load (lbs/yr)	Total TSS Load (lbs/yr)
URBAN	65,262.72	8,998.64	3,167,776.04
AG	64,752.18	7,096.40	904,056.90
FOREST	50,344.81	1,734.49	1,065,634.86
WATER	3,583.13	278.51	0.00
SEPTIC	41,044.31	0	0.00
Total	**224,987.14**	**18,108**	**5,137,467.79**

**from MAST 12/21/2011*

Identified Problem Areas and Sources of Pollution

Numerous field assessments were conducted in the St. Mary's River watershed in 2008 and 2011. This included a Stream Corridor Assessment, Tidal Shoreline Assessment and Synoptic Assessment conducted by St. Mary's College of Maryland in 2008, and a Shoreline IDDE Survey, Urban Subwatershed and Site Reconnaissance, and Retrofit Reconnaissance Inventory conducted by the Center for Watershed Protection in 2011. Each assessment protocol is described briefly below, with additional detail on methods provided in Appendix B. The problem areas and pollution sources identified through each assessment are presented below.

Stream Corridor Assessment

The Stream Corridor Assessment (SCA) survey (Yetman, 2001) is designed to rapidly assess the general physical condition of a stream system and identify the location of a variety of common environmental problems within the stream's corridors. Potential environmental problems identified as part of the SCA survey include: erosion sites, inadequate stream buffers, fish migration blockages, exposed or discharging pipes, channelized stream sections, trash dumping sites, in- or near-stream construction, or unusual conditions. In addition, the survey also collects information on potential wetlands creation/water quality retrofit sites, as well as data on the general condition of both in-stream and riparian corridor habitats.

The survey crew identified 119 potential problem sites and recorded basic habitat information at 98 representative sites (Figures 3 and Table 6). The most frequently observed environmental problem was erosion (29 sites), followed by channel alteration

(22 sites). In addition, there were 19 fish barriers, 14 inadequate stream buffers, 13 trash dumping sites, 8 pipe outfalls, 8 unusual conditions, 4 exposed pipes, and 2 construction sites. Of the 119 problem sites 10 were classified as being severe, and included 3 unusual conditions, 3 fish migration barriers, and one each from the erosion, exposed pipe, channel alteration, and inadequate buffer categories. The problems sites were clumped in large subwatersheds, along the main stem of the river, and in the more urbanized parts of the watershed. 76.5% of the identified problems were rated as moderate (30), low (32) and minor.

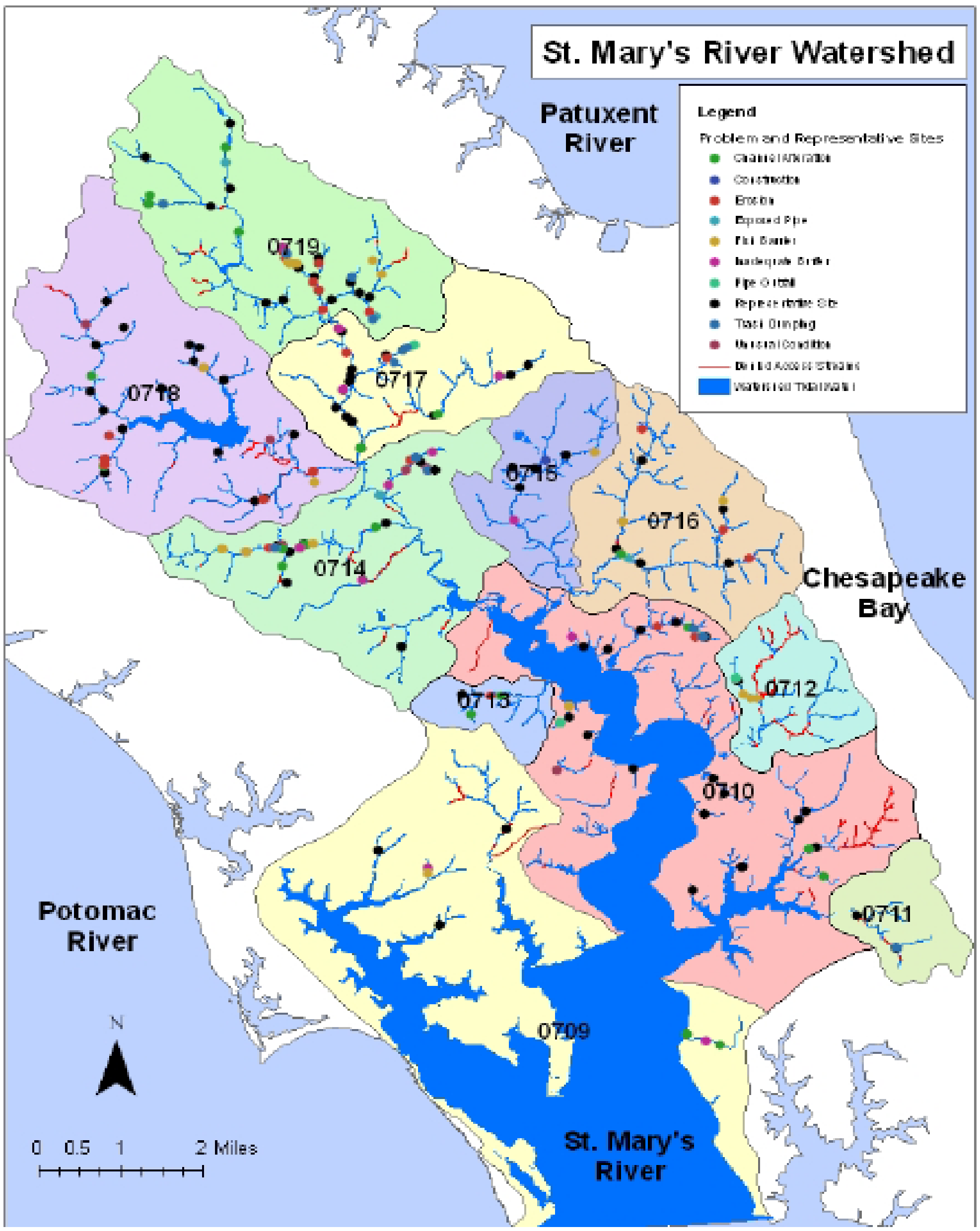


Figure 3. Map of representative and problem sites in the watershed

The Johns Creek (714) and Upper St. Mary's River (719) subwatersheds had significantly more problems than any other watershed followed by Eastern Branch (717), Western Branch (718), and Middle St. Mary's River (710) sub-watersheds with an intermediate number of problems. The Lower St. Mary's River (709), Church Creek (711), Fishermans Creek (712), Craney Creek (713), Hilton Run (715), and Pembrooke Run (716) subwatersheds were in relatively good condition. This trend indicated that impervious surfaces are one of the largest contributors to stream degradation.

	Subwatershed number										
Problem Type	709	710	711	712	713	714	715	716	717	718	719
Percent of total watershed streams	6.3	18.4	1.8	6.1	2.6	13.1	7.3	13.0	7.6	12.4	11.4
Exposed Pipe	0	0	0	0	0	1	0	1	0	0	2
Pipe Outfall	0	2	0	1	0	3	0	0	2	0	0
Construction Site	0	0	0	0	0	0	1	1	0	0	0
Channel Alteration	2	3	0	0	2	6	0	1	2	2	4
Erosion	0	3	0	0	1	7	0	3	3	6	7
Inadequate Buffer	2	1	0	0	0	5	1	0	3	0	2
Fish Barrier	1	1	0	3	0	2	1	2	0	3	6
Trash Dumping	0	2	1	0	0	5	0	0	2	0	5
Unusual Condition	0	1	0	0	0	4	0	0	1	2	1
Total Problems	5	13	1	4	3	33	3	8	13	13	27
Representative Sites	4	20	2	1	1	12	4	5	15	18	16
Representative Sites	4	20	2	1	1	12	4	5	15	18	16

Table 6. Potential problems found during the stream corridor assessment

Tidal Shoreline Assessment

The tidal shoreline assessment involved surveying the shoreline by boat to identify erosion and other problems. The shoreline of the tidal portion of the St. Mary's River is mainly comprised of private, residential lands, but also includes some areas of farmland, small commercial ventures such as marinas, Webster Field, and St. Mary's College of Maryland. The most densely populated section of the river is St. Inigoes Creek, closely followed by the south side of St. George's Creek. The principal problems observed on the tidal shoreline of the River appear to be inadequate buffers and erosion (Figure 4).

Inadequate buffering is principally a problem on a very small scale at residential sites where natural vegetation has been removed for development and to improve water views from buildings. On a larger scale the same problem is present at farm sites on St. George's Creek and on the eastern shore of the river just south of Tippity Witchity Island, as well as along the College's waterfront property and along the shoreline of Webster Field, for example.

Overall, the majority of erosion problems on the River have been neutralized by corrective action such as bulk heading or revetment with rip rap. However, in some places, erosion is still an issue. Along the St. Mary's College waterfront, sand bags and black plastic sheeting are being used to retain an eroding bank close to one meter high. A similar bank was documented on the north shore of St. George's Creek, where no control structures are in place.

Another erosion site exists on the up-river side of Tippity Witchity. While fairly sheltered, and, by the appearance of flora on the bank, not eroding rapidly, this bank is approximately two meters high. A similar erosion site appears on the southern shoreline in the bend above Pagan Point. The most severe erosion site on the river is located on the western shore across from Chancellor's Point. At this site, an inadequate buffer has resulted in the erosion of a bank approximately 4 meters high and several hundred meters long. A similar problem may be seen around the point to the south, where a bank approximately 2 meters high and several hundred feet long is eroding between the green number 3 channel marker and Carthagena Creek.

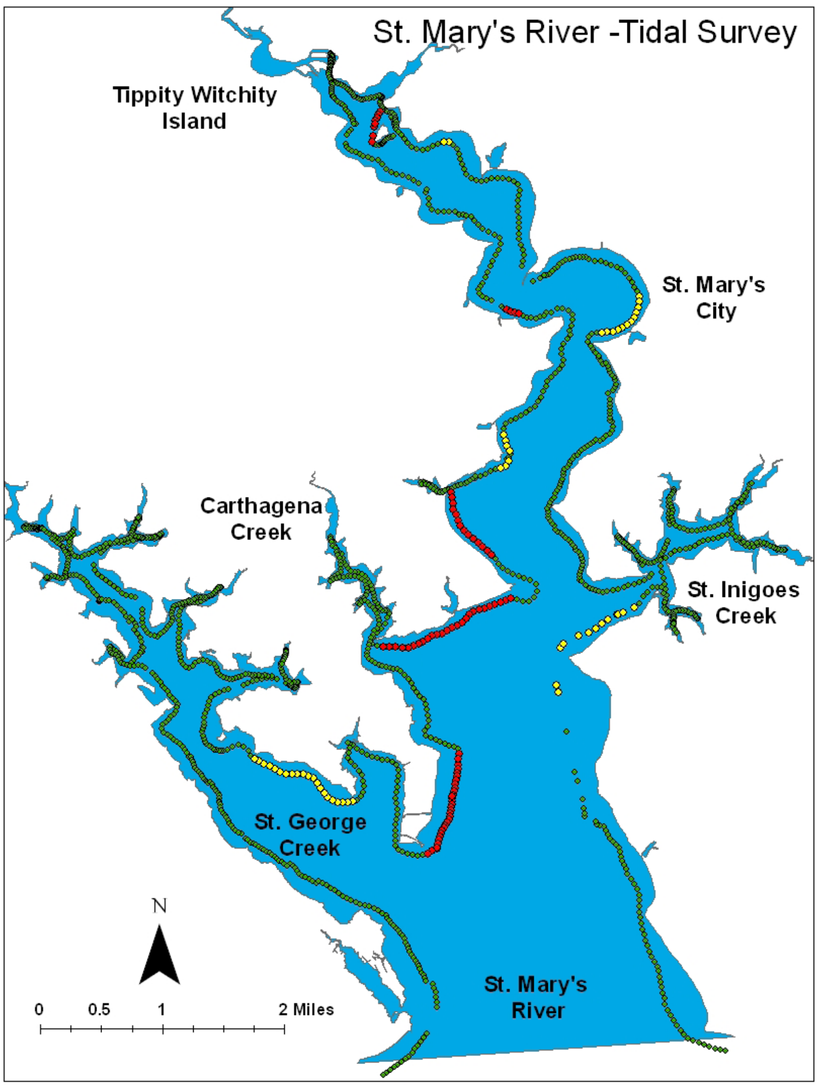


Figure 4. Tidal shoreline of the St. Mary's River with an assessment of shoreline stability. (Green markers indicate stable shoreline, red markers show shoreline erosion sites, and yellow markers show shoreline segments with inadequate buffering)

Synoptic Assessment

The 2008 synoptic survey included water quality monitoring and nutrient analyses at 15 non-tidal stations and a single station at the mid-point of the tidal reach (Figure 5). Biological sampling also occurred in April for macroinvertebrates and in July for fish. All procedures followed Maryland Biological Stream Survey (MBSS) protocols (Kayzak, 1997).

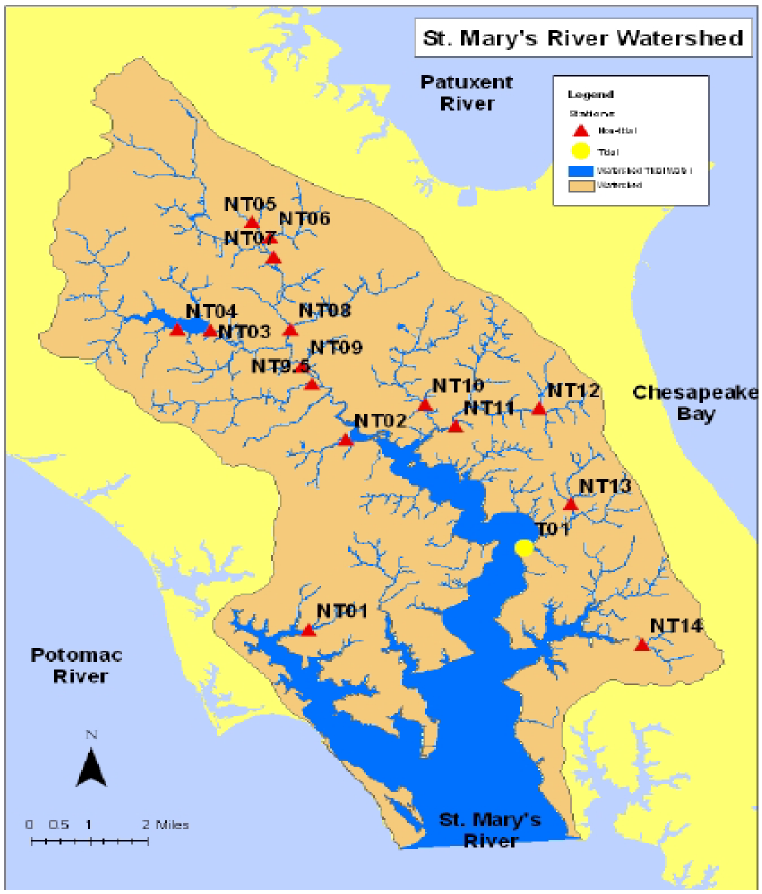


Figure 5. St. Mary's River Watershed Synoptic Stations

MDE #	SMRP #	Temp (C)	DO (mg/L)	pH	Conduct. (mhos/cm^2)	PO_4 (mg/L)	NO_{23} (mg/L)	TP (mg/L)	TN (mg/L)
		MDE Results							
SM52	NT01	4.8	12.00	5.80	0.187	0.0063	0.003	0.081	0.83
SM45	NT02	5.4	11.90	5.60	0.120	0.0024	0.804	0.012	1.04
SM59	NT03	9.0	8.90	7.80	0.080	0.0025	0.155	0.021	0.64
SM23	NT08	6.5	11.21	5.56	0.097	0.0023	0.481	0.015	0.80
SM43	NT09	2.6	12.60	5.40	0.092	0.0035	0.894	0.014	0.79
SM41	NT9.5					0.0035	1.460	0.016	1.58
SM19	NT10	4.3	10.73	6.05	0.101	0.0023	0.263	0.012	0.40
SM16	NT11					0.0007	0.507	0.013	0.58
SM11	NT13								
SM1	NT14	6.6	10.90	6.20	0.139	0.0028	0.645	0.006	0.73
		Synoptic Survey Results							
SITE	MDE #	Temp (C)	DO (mg/L)	pH	Conduct. (uhos/cm^2)	PO_4 (mg/L)	NO_{23} (mg/L)	TDP (mg/L)	TDN (mg/L)
NT01	SM52	27.26	3.95	7.07	47	0.0570	0.0066	0.170	1.41
NT02	SM45	21.32	8.08	7.38	81	0.0044	0.5460	.	.
NT03	SM59	22.34	7.71	6.76	14	0.0006	0.0067	0.011	0.58
NT08	SM23	21.87	8.12	6.85	60	-	0.4484	0.022	1.00
NT09	SM43	21.84	7.74	6.89	47	0.0013	0.3680	-	-
NT9.5	SM41	20.88	8.96	7.39	79	0.0057	1.7100	0.022	1.75
NT10	SM19	22.14	8.34	7.18	60	0.0030	0.1869	0.022	0.66
NT11	SM16	22.55	7.65	6.50	50	0.0032	0.4204	0.019	0.89
NT13	SM11	21.11	7.76	6.06	76	0.0037	0.2173	0.020	0.66
NT14	SM1	21.94	6.87	6.33	47	0.0054	0.2860	-	-

Table 7. Synoptic survey nutrient concentrations.

Macroinvertebrates

The 2008 sampling effort resulted in a total of 536 individuals in 36 families and 8 orders were obtained in kick net samples. By comparison, in all the SMRP studies from 1999 through 2006, 57 families of aquatic insects have been found at St. Mary's River watershed non-tidal stations. Therefore, the collections made in 2008 seem to be good representations of macroinvertebrates based on historic sampling and because a comprehensive study of aquatic insects (Boward et al., 1998) found 56 families of insects in the entire lower Potomac watershed.

The 2008 sampling effort found that Diptera (31.6%) and Ephemeroptera (29.7%) were the most common orders followed by Odonata (14.0%), Plecoptera (9.6%), Trichoptera (7.9%), and Coleoptera (6.3%). Two pollution tolerant species, Megaloptera (0.8%) and Hemiptera (0.2%) were relatively rare in the 2008 samples. The number of insect families at each station in 2008 was variable with between 4 and 20 families, and generally the insects found reflected specific stream conditions.

A comparison of insects at each site in 2008 by their proportion of EPT indicated that all stations except NT02 had at least 30% of their total count in EPT orders. The mean percentage of EPT in all samples was 37.4% for all stations. Yet, some of these results are misleading when EPT proportions were compared to total numbers of individuals and families. For example, the lowest aquatic insect abundance (8 individuals) and the fewest taxa (4) occurred at Craney Creek. However, at this site 3 of the 8 individuals were trichopterans giving a false impression of high insect diversity based on the EPT ratio (37.5%). This is the first year that Craney Creek was sampled for insects, and the site is not monitored for water quality. Therefore, it is difficult to determine whether this site is perturbed or has historical problems. Stations NT06 and NT11 also had few insects with 23 and 24 individuals, respectively; however, both had high EPT percentages. NT06 had 56.5% EPT and NT11 had 41.1%. The only other time that NT06 was sampled for insects was in the year 2000, and that sample also yielded 23 individuals (Paul and Tanner, 2004). Site NT11, by contrast, had 78 individuals in 2005, so the high EPT percentage at this site is an anomaly especially with both Plecoptera and Trichoptera entirely absent in 2008.

The highest numbers of individuals (94) were found at the Below IBR station. The next highest numbers were at NT02 (93 individuals), and at NT05 (85 individuals). Despite the high number of insects at NT02, the site had an EPT percentage of only 10.8, the lowest of any of the sampled stations and no mayflies (Emphemeroptera) were found there.

There were also other confusing results. The Below IBR site had a fairly low EPT ratio of 31.9%, despite having the highest number of insects (94 individuals). NT05 (Landfill Tributary) had the most surprising results of all because it had a large number (85) of insects and a 42.3% EPT ratio. These results are curious because the station is characterized by very heavy bank erosion and siltation, and these conditions were coupled with very high ammonia concentrations relative to all other stations. In addition, this station has had historic water quality problems, yet this station has had relatively high aquatic insect densities in past years (90 individuals in 2000) but low densities (the number dropped to 32 in 2005) as well (Paul, 2006; Paul and Tanner, 2001, 2005).

In general, many of these results echo the results found in previous sampling years. Aquatic insect abundance, diversity and community structure found in the 2008 collections support SMRP results and those of MBSS studies (Boward et al. 1998; Stranko and Rodney, 2001). The 2008 aquatic insect results also reflect the current physical and chemical conditions at non-tidal St. Mary's River stations. The anomalies encountered in 2008 at some stations might be explained by repeated sampling at these stations in the future.

Fish

A total of 817 individual fish belonging to 26 species and representing 10 families were collected in 2008. Tessellated darters (24%) and American eels (20%) were the most common species, while the percentage of Red-breasted sunfish (5%) and Least brook lampreys (6%) were considerably lower in number from the previous collections. Petromyzonidae (eels), Anguillidae (lampreys), Centrachidae (sunfish) and Percidae (darters) when combined made up 70% of all fish collected. Over a third (13 out 41) of all species collected in 2008 were relatively rare and were collected at 3 or fewer stations out of 13 total stations.

Figure 6 shows IBI scores by station across the span of SMRP sampling years. It is clear that Church Creek (NT14) had the lowest scores, and while this is based on only two sample years, 2000 and 2001, the station has poor habitat and a strong fish community is not supported. The site with the highest mean IBI scores and with at least 4 scores was NT02, Warehouse Run. In contrast to Church Creek, Warehouse Run has good in-stream habitat, a high aquatic insect diversity and cold water temperatures year-round. Some other stations with high IBI scores, such as NT11 (Pembrook Run), have fairly high IBI score despite clear signs of habitat degradation. For the most part, year-to-year IBI scores were consistent and did not range greater than one 1.0 IBI score. The authors of the study concluded that the conditions at stations, as measured by fish community diversity, were relatively stable and had not changed much from 1999 - 2008.

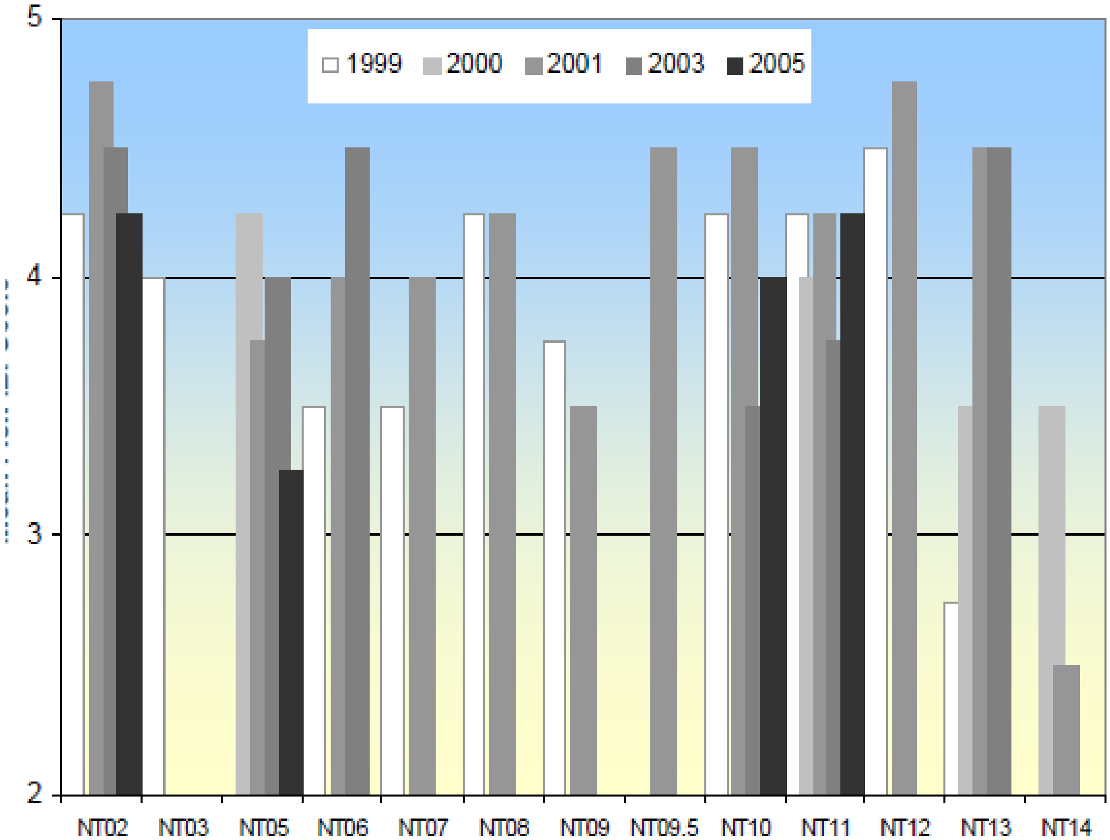


Figure 6. Mean IBI Scores for non-tidal fish communities at St. Mary's River stations

Shoreline IDDE

In 2011, field teams conducted a near shore water quality monitoring utilizing modified Illicit Detection and Elimination (IDDE) procedures (see Brown et al., 2004 for protocol) to gain a picture of where septic system failures may be occurring. Data thresholds for water quality were established at 0.1 mg/l of ammonia and 10,000 CFU of total coliforms, above which the sample was considered an indicator of human waste. Using this protocol, the east side of the St. Mary's River had indicators for ammonia at 4 sites, East-01, East-02, East-03 and East- 05 (Table 8). There were 4 sites that had indicator hits for Total coliform, East-05, East-06, East-18, and East-19 (Table 8). These sites are all in the Middle Saint Mary's River with sites 01, 18, and, 19 near its confluence with the Upper St. Mary's River, which drains much of the densely developed areas.

Table 8: IDDE results for East Side of Saint Mary's River						
Site ID	**HPL NH4 Nitrogen (mg/l)**	**pH**	***HPL corrected ammonia***	**Percent Salinity (ppt)**	**E. coli**	**Total coliforms**
SMR- East- 01	0.3738	7.23	*0.29073656*		6,000	9,200
SMR- East- 02	0.4298	7.36	*0.33643572*	3	2,700	6,000
SMR- East- 03	0.175	8.3	*0.15378464*	5	2,600	4,300
SMR- East- 04	0.056	7.54	*0.04462543*	4	4,100	6,000
SMR- East- 05	0.1932	7.33	*0.15074848*	0	6,900	11,300
SMR- East- 06	0.05628	8.04	*0.04632175*	0	4,800	10,900
SMR- East- 07	0.03374	8.4	*0.03051599*	3	0	200
SMR- East- 08	0.00644	8.32	*0.00565927*	0	700	3,100
SMR- East- 09	0.02996	8.37	*0.02709718*	0	600	2,800
SMR- East- 10	0.03164	8.53	*0.02981376*	5	3,300	4,600
SMR- East- 11	0.05712	7.83	*0.04587915*	5	1,500	3,400
SMR- East- 12	0.00994	8.45	*0.00899019*	6	600	1,800
SMR- East- 12A	0.00798	8.41	*0.00721747*	6	900	4,000
SMR- East- 13	0.02576	8.15	*0.0220122*	7	100	200
SMR- East- 14	0.01316	8.45	*0.0119025*	7	0	1,400
SMR- East- 18	0.0924	8.06	*0.07605063*		2,300	17,300
SMR- East- 19	0.06748	7.84	*0.05420037*		5,000	20,000

Using the same protocol, the west side of St. Mary's River had indicators for ammonia at 1 site, West-08, and there was 1 site that had indicators for Total coliform, West-06 (Table 9 and Figure 7). It should be noted, however, that E. Coli was found at all but 4 sites in the river.

Table 9: IDDE results for West Side of Saint Mary's River						
Site ID	**HPL NH4 Nitrogen (mg/l)**	**pH**	***HPL corrected ammonia***	**Percent Salinity (ppt)**	**E. coli**	**Total coliforms**
SMR- West- 04	0.05	8.37	*0.0430516*	6	0	1,600
SMR- West- 05	0.03	8.34	*0.0295267*	7	1,400	5,400
SMR- West- 06	0.06	8.17	*0.0484508*	4	10,400	12,800
SMR- West- 07	0.07	7.54	*0.0516544*	0	4,900	7,400
SMR- West- 08	0.20	7.90	*0.1650413*	1	2,100	4,000
SMR- West- 09	0.06	8.43	*0.0534346*	2	500	4,100
SMR- West- 12	0.03	8.17	*0.023687*	5	300	800
SMR- West- 13	0.02	8.04	*0.0140578*	1.5-2	3,900	5,700
SMR- West- 14	0.01	8.50	*0.0079152*	8	400	1,500
SMR- West- 15	0.01	8.09	*0.0093911*	5	2,000	3,400
SMR- West- 16	0.01	8.55	*0.0094998*	7	0	0

SMR- West- 17	0.01	7.87	*0.0099025*	2	3,300	8,200

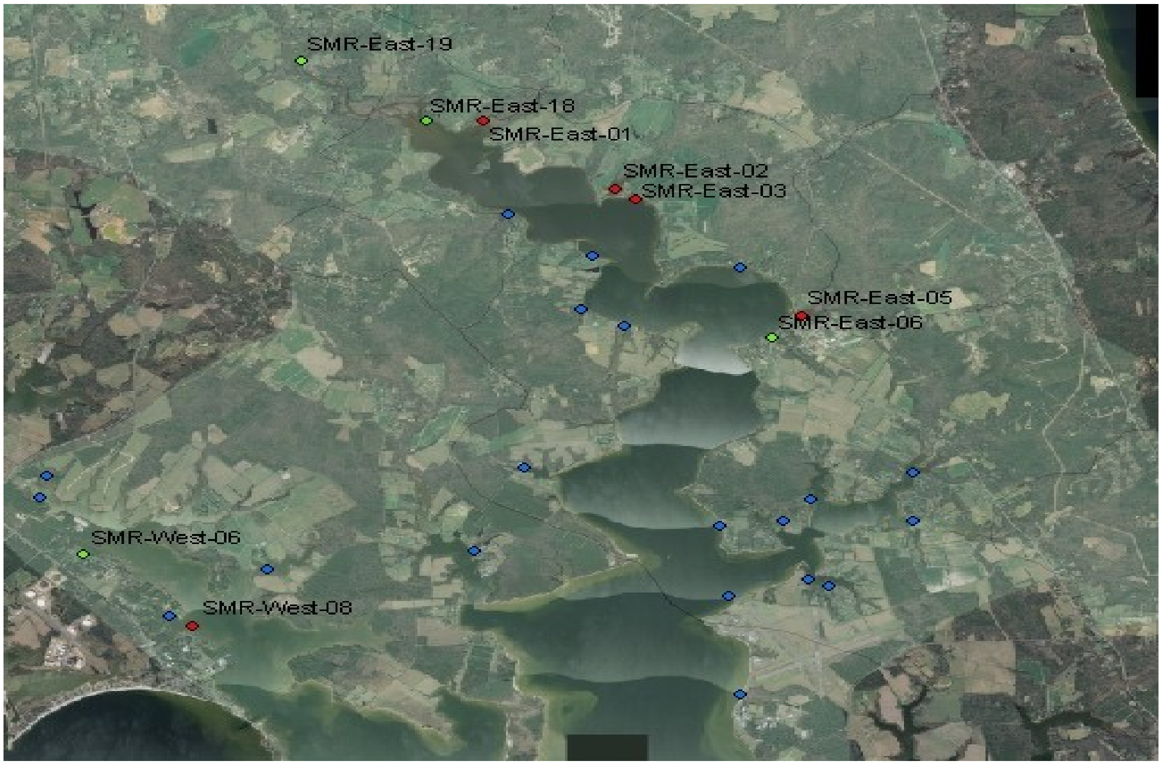


Figure 7. IDDE Sites with Positive Results (red=ammonia, green=total coliforms)

Additional targeted monitoring should be conducted to further establish trends. This data does indicate that some targeted monitoring should continue in and at mouth of the Upper St. Mary's watershed. Additionally, sites West-06 and 08 should be monitored more closely for potential waste indicators.

Urban Subwatershed and Site Reconnaissance

The Urban Subwatershed and Site Reconnaissance (USSR) field survey was used to evaluate potential pollution sources and restoration opportunities. The USSR included two major assessment components. First is the Hotspot Site Investigation (HSI), which is used to evaluate commercial, industrial, municipal, and transport-related sites that may contribute highly polluted stormwater runoff to the storm drain system or adjacent receiving waters. At sites subjected to the HSI (Wright et al, 2005), field crews investigate vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure to evaluate potential sources of stormwater pollution. The second component, the Neighborhood Source Assessment (NSA) was conducted to evaluate pollution source areas, stewardship behaviors, and restoration opportunities within individual residential areas.

Retrofit Reconnaissance Inventory

The Retrofit Reconnaissance Inventory (RRI) inventory (Schueler et al, 2007), was used to identify and evaluate potential stormwater retrofit opportunities. Stormwater retrofits are stormwater management practices that can be used to address existing stormwater management problems. The stormwater retrofit potential of each candidate project site was assessed by evaluating drainage patterns, drainage areas, land use, land cover, available space and other site constraints (e.g., conflicts with utilities, conflicts with existing land uses, site access, property ownership, potential impacts to adjacent natural resources).

Element B: Expected Load Reductions

To maintain consistency with TMDL requirements this report uses the MAST to determine the pollutant loads and reductions from the recommendations outlined in this report. The load reductions MAST uses are based on Chesapeake Bay Program land-use loading rates and approved BMP efficiencies. While these reductions are a simple estimate and may not reflect real world pollutant reductions they do provide an accounting mechanism that is consistent with the Bay TMDL and State reporting requirements.

There are four main ways that BMPs are credited in MAST. The primary method is through application of pollutant removal efficiencies where a percentage of the pollutant load from a specific land use is reduced when a specific BMP is applied. As an example, a Dry Extended Detention Pond removes 20% of the nitrogen that would have otherwise been delivered without the BMP. The second way a BMP is credited is through a land use change where the credit equals the difference in pollutant loading rates for the land use being converted (e.g., pasture) and the land use after conversion (e.g., forest). Riparian forest buffers are credited as a land use change and also receive an efficiency-based credit because it is assumed they reduce pollutants from the adjacent acreage. Finally some BMPs do not convert land uses or "treat" adjacent acres, but instead are given credit for a mass load reduction. An example of this is stream restoration or street sweeping, where the BMP is functioning to prevent loading by removing material before it can enter the stream (street sweeping) or preventing sediment and nutrients from entering the stream by protecting the channel (stream restoration).

Future Pollutant Target Loads

Table 10 shows the pollutant load targets for the County and for the St. Mary's Watershed needed to meet Bay TMDL requirements and the State of Maryland Watershed Implementation Plan (WIP) requirements. Table 11 shows the expected load reductions from implementation of the strategies in the St. Mary's County Phase II WIP. The load reductions are based on realistic implementation scenarios over the next ten years. Overall the restoration implementation would result in a total phosphorus load reduction of 22.1% from urban sources, and 46% from agriculture. Total nitrogen load reduction percentages are expected to be 28.9% from urban sources, 27.5% from agricultural sources, and 6.4% from septic sources.

Table 10: TMDL Loading Allocation- Edge-of-Stream					
2017 County Wide			**2017 St. Mary's Watershed**		
Sector	N lbs/yr	P lbs/yr	Sector	N lbs/yr	P lbs/yr
Agriculture	343,282	38,962	Agriculture	84,962	9,643
Urban	208,220	22,358	Urban	51,534	5,534
Septic	185,719	0	Septic	45,965	0
2025 County Wide			**2025 St. Mary's Watershed**		
Sector	N lbs/yr	P lbs/yr	Sector	N lbs/yr	P lbs/yr
Agriculture	302,008	36,692	Agriculture	74,747	9,081
Urban	200,689	21,048	Urban	49,671	5,209
Septic	159,253	0	Septic	39,415	0

** County Wide numbers are based on county wide TMDL Phase 2 target water quality goals for load from federal and non-federal sources, Edge-of-Stream*
***St. Mary's watershed goals are based on 24.75% of the county wide delivered target loads*

Table 11. Estimated Load Reductions for Strategies in St. Mary's County Phase II WIP			
Load Reductions	**Nitrogen**	**Phosphorus**	**Notes**
Urban Nutrient Management	4797.7	472.1	3000 acres of public land; 20,000 acre of private lawn
Urban Buffers	14042	1513	522 acres
Ag Buffers	9710	631	522 acres
Urban Wetlands	3.1	0.5	24% of 10 acres
Tree Planting	15.95	1.5	5 acres planted
Septic upgrade	1067	0	60 units in CA
Septic Pump	1554	0	pumping 50% of all units
Cover Crop	8109.9	2636.6	standard rye cover crop on 100% of tilled land
Total Reduction	39299.7	5254.7	

This restoration strategy will allow the County to meet the load allocation of 282,373 lbs/yr of N and 10,266 lbs/yr of P from non-federal urban sources by 2020 (MDE, 2011). The St. Mary's River Watershed Action Plan strategy focuses on reducing nutrients and sediment from urban sources, as well as agricultural sources, septic sources and wastewater treatment plants. The goals or milestones set forth in this plan were developed to be consistent with Chesapeake Bay TMDL two-year milestones.

Element C: Proposed Management Measures

Restoration Practices

This section of the plan presents an overview of the key recommendations for restoring the watershed. Watershed restoration must occur as a collaborative effort among local, county and state governments, watershed groups, businesses, and residents. The actions of each partner are critical to the success of the total effort. Local and state governments are able to implement capital projects such as stream restoration, large-scale highway stormwater retrofits, and changes in municipal operations. Complementing governmental efforts, watershed groups and citizens are able to implement smaller scale local programs such as lawn care education, rain gardens, changes in agricultural practices, outreach to residents, and restoration of streams and wetlands. It is important that restoration occurs at all levels to ensure a wide range of projects are implemented and community objectives are achieved for the St. Mary's River.

The variety of restoration practices recommended include stormwater retrofits, stream corridor and shoreline restoration, on-site sewage disposal system repairs and upgrades, agricultural best management practices, pollution prevention/source control education, and changes in state, county and municipal practices and programs. The specifics of each practice are described in Table 12 and the applicable partners are identified as private (watershed group and citizens), public (local/state government) or both.

Table 12: Recommended Watershed Management Practices

	Type	Practices	Partner
Restoration Practice	**Stormwater Retrofits***	• Regenerative Stormwater Conveyance	Public
		• On-site residential (rain gardens, rain barrels, etc.)	Private
		• On-site commercial (sand filters, underground storage, etc.)	Public
	Pollution Prevention/Source Control Education* **	• Residential pollution prevention • Forest cover and tree plantings • Commercial pollution prevention (businesses, marinas) • Partner with local school systems and youth groups (Boy and Girl Scouts) to promote environmental stewardship	Both
	On-site Sewage Disposal System Repair and Upgrade	• Septic system failure detection and repair • Prioritization of septic systems for upgrade to denitrifying technology and homeowner outreach • Identification and testing of community and combined septic systems	Both

* See Appendix A for more detail on the proposed stormwater retrofits
** See Appendix B for more detail on the proposed stream repair practices
*** See Appendix C for more detail on the proposed residential and hotspot source control practices

Stormwater Retrofits

There are three categories of stormwater retrofits recommended for the watershed, 1) onsite residential treatments, such as bioretention and filtering practices, 2) onsite non-residential treatments such as sand filters or underground storage and filtering systems, and 3) regenerative stormwater conveyances which include re-creation of in-stream wetlands and floodplain connection.

Storage retrofits including wetlands provide the widest range of watershed restoration benefits, but present a challenge due to the large space requirements. Residential retrofits comprised of bioretention, filtering, and impervious area reduction are small changes that can provide a substantial benefit when implemented broadly in neighborhoods across the watershed. Sand filters or underground storage and filtering systems work well on the intensively used, largely impervious surfaces typically found on commercial, industrial, or municipal properties. Through the evaluation of impervious cover, land use, and restoration goals, the optimal stormwater retrofit practice can be selected for a particular site, thereby helping to mitigate watershed water quality issues through the improvement of water treatment and recharge.

Residential

Key restoration practices identified as applicable in the residential areas of the St. Mary’s River watershed include bioretention and infiltration, pervious surface installation, removal of sediment from roadside swales and storm drain stenciling. Bioretention and infiltration retrofits are shallow, landscaped depressions that contain a layer of prepared soil, a mulch layer, and vegetation. These areas provide filtering of stormwater runoff by temporarily ponding water during storms, aiding in sediment and nutrient storage. Bioretention facilities have artificially constructed underground drainage systems, while infiltration facilities allow runoff to absorb into the existing soil at sites when infiltration rates are adequate (typically greater than 0.5 inches per hour).


Figure 8. Possible site for residential retrofit

Neighborhoods in the St. Mary's watershed require a range of different residential retrofit implementations, from swales at cul-de-sacs, to rain gardens and rain barrels on higher density housing locations (Figure 8). For instance, the replacement of impervious asphalt parking lots with pervious pavement at larger multi-family complexes can provide significant benefits such as slowing the rate at which stormwater travels by holding and absorbing it, then passing it through a sand and gravel filter to reduce pollutants.

While not technically a retrofit, the removal of sediment from roadside swales can mitigate the effects of stormwater pollution. This practice does not require design and construction, but will help to maintain the proper function and performance of roadside swales in improving water quality. In areas where stormwater infrastructure routes runoff directly to the river, stencils or permanent stickers can be affixed to catch basin drains reminding residents that those drains are not a waste disposal facility.

Non-residential
Municipal, industrial, or commercial facilities with large impervious areas in the form of roofs and driving/parking surfaces can generally benefit from rerouting stormwater from a direct storm sewer infrastructure connection to slower infiltrating areas. Downspouts on these types of properties could be rerouted to retention areas such as rain gardens, or reconnected to bypass areas where they may come into contact with harmful pollutants. Marinas would benefit from retrofits such as sand and gravel beds to filter and slow the rate of stormwater, as well as rain barrels, cisterns and rain gardens to detain runoff. Dry pond retrofits or conversion to more effective stormwater practices such as bioretention could be used at several facilities in the watershed. The amended facility would allow a longer detention time, greater settling, interaction with native plants and soil and more denitrification in the system. Trees and other native vegetation may increase the pollutant removal and trapping ability of a dry pond and improve its overall nutrient uptake. In addition, impervious cover removal and replacement with permeable paving are good options to help treat and reduce stormwater in parking lots at restaurants and businesses in the watershed.

Regenerative stormwater conveyance systems
Regenerative stormwater conveyance (RSC) systems are wetland-based systems that use open channels and sand seepage filtering to minimize potential for erosion and create aquatic and/or wetland habitat. These goals are accomplished by having stormwater pass through a series of cascading pools, riffle weir grade controls, native vegetation, and an

underlying sand channel to convey storm flow, and infiltrate stormwater to allow for the treatment and removal of pollutants and recharge of groundwater. RSC systems combine the features and treatment benefits of a number of retrofit practices including swales, infiltration, filtering, and wetland practices. Regenerative stormwater conveyances have been successfully constructed in many other coastal plain locations (Figure 9), and have been used with success in the State of Maryland.

Figure 9. Regenerative Stormwater Conveyance (Underwood & Associates)

Figure 10 presents some examples of locations in the St. Mary's watershed where stormwater retrofits can be implemented to provide volume reduction and pollutant treatment. Table 13 provides a summary of 37 potential retrofit sites visited and the proposed retrofit projects developed for each site. All of the sites were visited during the field work done in 2011, although some of the proposed retrofit projects were from the original field work completed in 2002. A brief description is provided, along with the estimated drainage area treated. Appendix A has a map of the St. Mary's watershed with the location of each retrofit, and Appendix D has the concept sheets for 7 projects.

Figure 10. Stormwater Retrofit Inventory
A) Low-to-Moderate Workforce housing bioretention site. B) Potential bioswale location at St. Mary's Industrial Park. C) Stormwater pond retrofit site at Great Mills High School. D) Stormwater pond retrofit site at McKay's shopping center. E) Parking lot sheet flow to dry pond at Church of Christ. F) Large parking lot at Wildwood shopping center generating significant runoff.

Table 13: Summary of Stormwater Retrofit Recommendations			
Site	**Concept Description**	**Estimated Drainage area (acres)***	**Ranking**
JR-2	Existing wet pond that would benefit from forebay. Also, verify WQv	20.0	Medium
JR-2A	Improve existing facility by converting to shallow marsh wetland with forebays and micropool	5.0	High
JR-2B	Convert drainage ditch to vegetated dry swale with underdrain to provide WQv	5.0	Medium
JR-3	Ex.Trapezoidal wet pond – Concept to evaluate potential for ED, forebay and safety improvements	13.7	Medium
JR-3A	Evaluate for WQv and forebay and maintenance improvements	11.5	Medium
JR-12	Maintain current facility, provide forebay and convert to wet ED pond or micropool ED	31.4	High
JR-12B	Create linear pond/wetland cells (2 or more cells) in existing conveyance channel to provide water quality storage volume	61.0	High
JR-14	Existing wet pond is in fairly good condition. Concept merely to provide forebays at inlets and verify WQv	19.4	Low
JR-15	Existing dry pond that has converted to wetland. Look to provide WQv and forebays Modify outlet to provide WQv	47.0	Medium
JR-16	A bioretention facility is proposed to provide water quality treatment	2.0	Medium
HR-1	Shallow marsh wetland w/ forebay	18.4	High
HR-2	Provide wet ED for WQv by expanding existing pond to provide treatment for uncontrolled commercial & residential areas	38.0	High
HR-2A	Provide bioretention in existing grass/ greenspace adjacent to parking lot	3.0	Medium
HR-4	Construct a stormwater practice to provide water quality and channel protection downstream from existing CMP outfall	32.0	High
HR-5	Modify weir wall with hooded orifice to achieve better WQv; construct forebay	24.0	Medium
HR-5A	Add forebays, bioretention cells, and micropool	24.0	Medium
HR-6/PR1	Possible retrofit includes riser modification for WQv and Cpv as well as forebay design	22.0	Medium
HR-7	Verify water quality volume in permanent pool and also provide forebay at inflow points	35.0	Medium
HR-8	Drainage channel alteration and dry pond retrofit	2	Medium
HR-11	Expand and convert to bioretention.	3.0	Medium
HR-11A	Existing dry pond with emergent wetland community. Concept is to add a riser, forebay, and inlet protection to create a shallow marsh wetland facility.	14.3	High
USM-1	Dry pond retrofit, removal conveyance channels, bioretention	5	High
USM-3	Bioretention or wetland at intersection	1	High
USM-4	Concepts involve converting dry ponds and grass channel to bioretention facilities	14.0	High
USM-5	Nutrient Management for grounds	3	Low
USM-6	Removal of approximately 7000 ft of Impervious cover at site of Old Health Building	.25	Low
USM-7	Maintenance of the facility is needed and there is severe erosion at the inlet. Facility currently lacks pretreatment	26.6	High

Table 13: Summary of Stormwater Retrofit Recommendations			
Site	**Concept Description**	**Estimated Drainage area (acres)***	**Ranking**
USM-9	Micropool ED pond	35.0	Medium
USM-2011-01	Convert dry pond to ED pond with micropool	21.8	High
USM-2011-02	Enhancements are recommended, including wetlands plantings, berms, and possible modifications to the outlet. Also, a pollution prevention plan should be developed for the fertilizer storage area	23.0	Medium
USM-2011-03	Bioretention facility for untreated parking lot	2.5	Medium
USM-2011-04	Bioswale modification to drainage channel	1.5	High
USM-2011-05	Conversion of existing pond to include forebays and wetlands plantings	2.5	High
USM-2011-06	Bioretention in corner of parking lot and Impervious Cover Removal	2	Medium
USM-2011-07	Install Sandfilter	0.5	Low
USM-2011-08	Install Bioretention practice along road	1	Low
USM-2011-09	Enhancements are recommended, including wetlands plantings, berms, and possible modifications to the outlet.	7.5	Medium
USM-2011-10	Install bioretntion practices in parking lot	2.5	Medium
USM-2011-11	Install bioretntion practices in parking lot	0.25	Low
USM-2011-12	Install Sandfilter	1.8	Medium
USM-2011-13	Provide bioretention in existing grass/ greenspace adjacent to parking lot	0.5	High
USM-2011-14	Provide bioretention near boat ramp	2	High

Pollution Prevention/Source Control

Residents and businesses may engage in behaviors and activities that can influence water quality both negatively and positively. Positive behaviors such as tree planting (Figure 11), disconnecting rooftops, and picking up pet waste can help improve water quality.

Figure 11. Neighborhood Source Assessments
A) Example of residential lot with no tree cover. B) Example of residential lot with significant tree cover.

Table 14 provides the results of the NSA that was conducted and recommended practices for each of the neighborhoods visited in the watershed. The observations of the field crews for both source control opportunities and small residential retrofits are included in the table. Appendix A has a map of the neighborhood locations in the watershed.

Table 14: Summary of Neighborhood Assessment Recommendations

Neighborhood	Site ID	Median lot size (acres)	Septic Outreach	Rain Barrels	Rain Gardens	Bioswales	Bayscape	Nutrient Management	Pet Waste	Forest Canopy	Street Trees	Notes
St Inigoes & Lawrence St	SMR-ES-101	1/4	X	X	X							septic system outreach/ investigation, potential bioswale opportunity, Rain barrels a potential
Ancient Oaks, Waterview Drive	SMR-ES - 102	1/2										living shoreline, coastal plain outfall at end of post oak rd
Saint Peters Key, Bauer Rd	SMR-ES-103	1/2					X			X		bioswales, a few houses are doubling as commercial sites - follow up hotspot investigation
Dutchmans Cove, Rosecroft Rd	SMR-ES-104	1/4, 1/2	X									potential septic issues, lots of trees, forestry outreach
King James Parkway	SMR-ES-105	1/2			X			X				woods in backyard
Park Pines, Park Pines Dr	SMR-ES-106	1/4			X						X	
Leachburg, Leachburg & Toms Rd	SMR-ES-107	1/4			X					X		
Wichshire Dr	SMR-ES-108	1/2		X			X			X	X	bioswales, low priority rain barrels, woods in backyard
Amanda Estates	SMR-ES-109	1/2				X		X			X	tree planting, bioswales
Green Leaf Blvd	SMR-ES-110	<1/4						X		X	X	new construction sites source of sediment, potential pond retrofit
Southhampton, Lincoln Ave	SMR-ES-111	<1/4									X	impervious cover removal
Glenn Forest , Green Tree	SMR-ES-112	single family attached, 1/8			X	X					X	bioswales in community area, bioretention in park/traffic islands
Abberly Crest	SMR-ES-113	multifamily					X					storm drain stenciled
The Greens at Hilton Run, Hilton Dr	SMR-ES-114	multifamily						X		X		upper lot appears to discharge directly into creek
Willow Woods	SMR-ES-115	1/4			X							rain gardens in individual lots, dry pond/extend detention
Pembrook	SMR-ES-116	1/4			X			X				some rain gardens opportunities on some yards, possible dry pond, extend detention retrofit

Table 14: Summary of Neighborhood Assessment Recommendations

Neighborhood	Recommended Actions											Notes
	Site ID	Median lot size (acres)	Septic Outreach	Rain Barrels	Rain Gardens	Bioswales	Bayscape	Nutrient Management	Pet Waste	Forest Canopy	Street Trees	
Lynn Rd/ S Essex Rd	SMR-ES-117	1/4			X	X						bioswale
Bryan Rd & Scarborough & Planters	SMR-ES-118	1/4			X			X				pond retrofit to extended detentions, rain gardens
Midway & Saratoga	SMR-ES-119	< 1/4		X						X	X	rain barrel distribution, small tree street tolerant , island bioretention
St. Marys Landing	SMR-ES-120	multifamily			X		X					rain garden in common areas
Westbury (North & South of Pegg)	SMR-ES-121	Attach <1/8, detached 1/4			X							possible rain garden opportunities, possible curb bump-out bioretention possibilities
Spring Valley Dr & Fox Ridge Rd	SMR-ES-122	1/4				X				X		bioswale, coastal plain outfall
Rutherferd & Harison	SMR-LX-123	1/2				X	X					great bioswale/ RSC opportunity
Meadow Lane	SMR-LX-124	1/4						X				possible curb extension bioretention, existing wet pond
Heard's Estates, Clipper Dr	SMR-LX-125	1/4			X		X					
Hickory Hill North	SMR-LX-126	1/4					X	X				
West Mead Condos	SMR-LX-127	multifamily									X	Add forebay or sand seepage wetland to add treatment near double-barrel culverts; street tree planting on Amber Road; Pond collects road drainage from Amber road
Hickory Hill South & Kelly's Cluster Duplex	SMR-LX-128	Attach <1/4, detached <1/4						X				
Hickory Hills East Luxury Town Homes	SMR-LX-129	multifamily					X					pond maintenance
Villas at Greenwoods	SMR-LX-130	multifamily					X					
Military Rd & Church Rd	SMR-LX-131	1/4			X		X	X				
MacArthur Blvd	SMR-LX-132	1/4										

Table 14: Summary of Neighborhood Assessment Recommendations

Neighborhood	Site ID	Median lot size (acres)	Septic Outreach	Rain Barrels	Rain Gardens	Bioswales	Bayscape	Nutrient Management	Pet Waste	Forest Canopy	Street Trees	Notes
	Recommended Actions											
Piney Point	PS-101	1/4		X	X							rain gardens, rain barrels, check on sewage connection
Loblolly Ct	PS-102	1/4			X							Strategically placed rain gardens where channelized flow is directed
Green's Rest	PS-103						X	X				rain gardens, lawn care education, forestry plan for neighborhood
Brook Mill Rd	PS-104	1/4			X					X		trees, rain gardens in drainage, less intensive lawn care
Hunting Quarter/ Duck	PS- 105	1/4, 1/2			X							
Mobile Homes	PS-106											Coastal plain, outfall downstream adjacent
Bates Rd, Guenthor Dr, Stoney Run Rd	PS-107	1/4, 1/2, 1			X			X				Rain gardens, lawn care/education workshop, native plants
Aberdeen Ln	PS-108	1/2, 1			X			X				education, rain gardens, rain barrels
Hunter Quarter, Townhouses	PS-109	multifamily			X	X						potential for rain garden/ bioretention

On-site Sewage Disposal System Repair and Upgrade

As of January 2008, Maryland Department of the Environment estimated 420,000 On-site Sewage Disposal Systems (OSDSs) in the State of Maryland. According to the Chesapeake Bay Program, the average septic system annually delivers about 9.5 pounds of nitrogen per person to the "edge of stream". Table 14 shows the estimated annual total nitrogen loading rates for septic systems in three different zones (critical area, upland, w/in 1000' of a stream) using Chesapeake Bay Program septic loading data.

Table 15: Septic Loads in the Chesapeake Bay	
Septic Zone	**Average TN load (lbs /system)**
Not within 1,000 ft of a perennial stream	6.67
Within 1,000 ft of a perennial stream	11.12
Critical Area	17.79

While data to calculate the exact number of septic systems in the St Mary's River watershed was not available at the time of this report, the St. Mary's County Department of Land Use and Growth Management has estimated that seventy percent of the county's 37,064 households are served by septic systems (Washington Post, 2012). Using 2007 Building data for the watershed and assuming that buildings outside the Lexington Park Development District are probably using OSDSs for wastewater treatment, it is estimated that at least 4,000 systems are present in the watershed. Roughly 1,100 of these buildings are located in the critical area (within 1,000ft of tidal shoreline) and most if not all are likely treating their wastewater on-site. If the CBP formula is applied to the St. Mary's River watershed an estimated 38,000 pounds of total nitrogen per year are being deposited into the River from septic systems alone. Note, however, that these figures are based on working/properly maintained systems and systems experiencing some degree of failure or improper maintenance can contribute significantly greater amounts of polluting nutrients. In addition to individual on-site homeowner septic systems there are larger community shared OSDSs in the watershed. Through 2030 the total proposed number of new residential dwellings is 19,300 dwellings. Of these, an estimated 5,790 rural dwellings will be located on individual OSDSs with up to 25% of the new systems required to be denitrifying systems.

Recognizing the impact of all OSDSs on both local and downstream water quality in the St. Mary's Watershed, recommended practices in the St. Mary's consist of OSDS failure identification through testing, repair and upgrade in nutrient prone areas, and upgrades for existing systems that are not utilizing the best available technology (BAT) to reduce nutrients. An enhanced denitrification system is an example of BAT that utilizes bacteria to biologically remove nitrogen from wastewater. These types of systems can typically reduce wastewater levels of total nitrogen by up to 6 pounds annually (MDE, 2011b). This represents at least a 50% improvement in nutrient reduction over a typical OSDS found in the watershed.

Oyster Restoration

Oysters are an important resource to the ecosystem, the economy, and the culture of the St. Mary's River Watershed and Chesapeake Bay region as a whole and comprehensive oyster restoration is paramount to a restored Chesapeake Bay. Historically the St. Mary's River contained 2,461 acres of suitable oyster habitat; however, combinations of overharvesting, loss of habitat, disease, and poor water quality have resulted in significant declines in both oyster populations and suitable reef habitat (USACE 2012). The U.S. Army Corps of Engineers' (USACE) in close partnership with the Maryland Department of Natural Resources and the Virginia Marine Resources Commission developed a native oyster restoration master plan that presents a strategy for large-scale, concentrated oyster restoration throughout the Chesapeake Bay and its tributaries. *The Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan* identifies that 19 (Tier 1) tributaries in the Chesapeake Bay are currently suitable for large-scale oyster restoration. Tier 1 tributaries are the highest priority tributaries that demonstrate the historical, physical, and biological attributes necessary to provide the highest potential to develop self-sustaining populations of oysters. The St. Mary's River is listed as a Tier 1 tributary and a goal of restoring 200 to 400 acres of oyster reef has been established (USACE 2012). A specific tributary plans should be developed for the St. Mary's River and include a refinement of the restoration target.

Figure 12. St. Mary's River Oyster Restoration Target Areas for Maryland DNR and St. Mary's River Watershed Association

Element D: Technical and Financial Assistance Needs

There are currently no dedicated funding sources in St. Mary's County for implementation of the projects identified in this plan. While costs for some stormwater retrofit projects might be covered under Capital Improvement Project (CIP) budgets, there is not a revenue source within the County government that can cover the cost of most of the projects. The enactment of the Chesapeake Bay TMDL and State Watershed Implementation Plan requirements may result future funding, but currently the most likely source for funding will be through grants secured by the project partners, primarily the St. Mary's River Watershed Association.

One resource that can be utilized to repair and upgrade OSDSs in the St. Mary's Watershed is the Bay Restoration Fund. Effective July 1, 2012, a $60 annual fee is collected from each home served by an OSDS. The total estimated program income is $27 million per year with 60% of these funds used for system upgrades and the remaining 40% used for cover crops. The St. Mary's County 2010 Comprehensive Plan noted that even with funding to assist in the installation of alternative systems few residents have availed themselves of the program. Since 2007 the County has retrofitted 125 septic systems inside the Critical area and six outside the critical area. The County estimates a current pace of 60 upgrades per year in the Comprehensive Plan.

Costs for many of the projects proposed in this Plan can be found in Table 15. The source for these numbers was a recent report focused on costs for implementation in the State of Maryland. Therefore, the numbers presented are reasonably accurate in terms of present day costs, although the land cost measures may be inflated compared to actual land costs in the watershed since the numbers in the table do not reflect County specific numbers.

Table 16. Summary Unit Planning Level Stormwater Cost Estimates Per Impervious Acre Treated (Source King and Hagan, 2011)							
Stormwater Management Practice	Pre-Construction Costs[1]	Construction Costs[2]	Land Costs[3]	Total Initial Costs	Total Post-Construction Costs[4]	Total Costs over 20 Years	Average Annual Costs over 20 Years
Impervious Urban Surface Reduction	$8,750	$87,500	$50,000	$146,250	$885	$163,957	$8,198
Urban Forest Buffers	$3,000	$30,000		$33,000	$1,210	$57,207	$2,860
Urban Tree Planting	$3,000	$30,000	$150,000	$183,000	$1,210	$207,207	$10,360
Wet Ponds and Wetlands (New)	$5,565	$18,550	$2,000	$26,115	$763	$41,368	$2,068
Wet Ponds and Wetlands (Retrofit)	$21,333	$42,665	$2,000	$65,998	$763	$81,251	$4,063
Dry Extended Detention Ponds (New)	$9,000	$30,000	$5,000	$44,000	$1,231	$68,620	$3,431
Dry Extended Detention Ponds (Retrofit)	$22,500	$45,000	$5,000	$72,500	$1,231	$97,120	$4,856
Infiltration Practices w/o Sand, Veg. (New)	$16,700	$41,750	$5,000	$63,450	$866	$80,770	$4,039
Infiltration Practices w/ Sand, Veg. (New)	$17,500	$43,750	$5,000	$66,250	$906	$84,370	$4,219
Filtering Practices (Sand, above ground)	$14,000	$35,000	$5,000	$54,000	$1,431	$82,620	$4,131
Filtering Practices (Sand, below ground)	$16,000	$40,000		$56,000	$1,631	$88,620	$4,431
Urban Nutrient Management[5]		$61,000		$61,000	$31	$61,620	$3,081
Urban Stream Restoration	$21,500	$43,000		$64,500	$891	$82,320	$4,116
Bioretention (New Suburban)	$9,375	$37,500	$3,000	$49,875	$1,531	$80,495	$4,025
Bioretention (Retrofit Highly Urban)	$52,500	$131,250	$3,000	$186,750	$1,531	$217,370	$10,869
Vegetated Open Channels	$4,000	$20,000	$2,000	$26,000	$610	$38,207	$1,910
Bioswale (New)	$12,000	$30,000	$2,000	$44,000	$931	$62,620	$3,131

1 Includes cost of site discovery, surveying, design, planning, permitting, etc. which, for various BMPs tend to range from 10% to 40% of BMP construction costs.

2 Includes capital, labor, material and overhead costs, but not land costs, associated implementation; for street sweeping includes only capital cost of mechanical sweeper. Nutrient management construction costs refer to the cost of an outreach campaign, not to any construction costs.

3 For all stormwater BMPs that require land it is assumed that: 1) the opportunity cost of developable land is 100,000 per acre and 2) 50% of projects that require land take place on developable land with the rest taking place on land that is not developable. This brings the opportunity cost of land for stormwater BMPs that require land to 50,000 per acre. Actual county-specific land cost and percent developable land values can be filled in. NOTE: The area of some BMPs may be significantly less than the impervious area treated.

4 Combined annual operating, implementation, and maintenance costs.

5Best available data indicate that "retail" (i.e., direct mail) public outreach campaigns cost about $15 per household contacted. For an illustrative county, we assumed that each household has 5,941 sq ft of turf and 2,406 sq ft of impervious cover (medium density development). This means that 7.33 households need to adopt this BMP to potentially result in an acre of turf being treated, at a cost of 109.98 per turf acre. Based on a review of direct mail response rates, we assumed that 2% of households contacted will respond positively to this outreach effort, bringing the cost per turf acre treated to 5,497.50/acre. The equivalent on a per-impervious-acre was based on the MDE June 2011 stormwater guidance document, which provides an equivalent for this practice of .09 acres impervious area per one acre of this practice. This estimate does not include any additional costs for soil tests by the homeowner to determine the appropriate amount of fertilizer required.

Oysters

The Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan provides cost estimates for restoring oyster populations in the St. Mary's River. This cost estimate takes into account numerous factors including distance traveled to the site, the source of the substrate, the source of any seeding that may be done and the construction itself. Construction costs are broken down by construction substrate including fossil shell, limestone, concrete rubble and rock, such as granite. The plan summaries the high and low cost estimates to construct a reef with a height of 12 inches, seeding with broodstock oysters, and monitoring. Once the construction costs were developed, they were applied to the restoration targets acreage for each of the Tier 1 tributaries. Table 17 shows the cost of the low range acreage and high range acreage of the restoration targets.

Table 17: St. Mary's River Oyster Restoration Cost Estimates	
Low	**High**
Total Initial Cost	
$ 9,630,000	$ 57,590,000
Seeding	
$ 7,430,000	$ 14,850,000
Monitoring	
$ 40,600	$56,700
Total Restoration Cost	
$ 17,100,600	$ 72,496,700
**From USACE Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan, Maryland and Virginia. March 2012. (pg. 170-173)*	

Element E: Information, Education, and Public Participation

Stakeholder Meetings

Since the public and other stakeholders will have to live with the decisions developed during the watershed planning process, they play a vital role in the creation and implementation of a watershed management plan. Their participation gives them a stake in the outcome and helps to ensure the implementation of the plan. Stakeholders also bring to the table issues that are important to the community, and participate in activities to achieve nutrient and water quality goals.

The stakeholder process included a series of public meetings where local residents were invited to provide input into development of the plan. Both meetings were held on March 29, 2011. One meeting was held during the day and focused on local environmental professionals, county and municipal staff and local business and had 21 participants. The other stakeholder meeting was held in the evening and focused on residents and students and had 15 participants. The meetings provided opportunities to provide information on preliminary findings; additionally the meetings provided stakeholders the opportunity to weigh in on goals for the watershed, provide input on project implementation, and provide feedback on proposed strategies. The final stakeholder meeting will be held at the completion of the watershed plan and coincide with the implementation of one of the larger bioretention projects.

The stakeholder meetings resulted in the following set of goals being drafted to guide recommendations of the Action Plan:

1. **Implement effective watershed education.** Watershed education efforts should focus on a wide audience ranging from city and state employees, local residents and students. Education topics include the reduction of fertilizers, pesticide and salt application, use of native landscaping, pet waste and proper disposal of trash. A mass media education campaign, effective brochures and websites can help achieve this goal.

2. **Increase the involvement of the population** through the organization of more events that connect residents to the stream, incorporating environmental education in the schools and encouraging participation in the Adopt a Stream Program.

3. **Disconnect impervious surfaces from the stormdrain system** by incorporating stormwater retrofits in parking lots and the streetscape and disconnecting rooftop downspouts where applicable. The amount of existing impervious cover should be reduced through the removal of unused asphalt at schools.

4. **Integrate stormwater and watershed planning goals in new and redevelopment.** Future environmental impacts can be reduced through changes to existing regulations that promote green building and design, stormwater management and smart growth.

5. **Engage the business community in restoration** through a program that provides recognition for businesses that implement green practices such as stormwater treatment, pollution prevention, etc.

6. **Improve management of natural and turf areas** including parks, trails, trees, and streams through on-going trail maintenance and increased access to streams. Continue to increase the tree canopy and improve tree management and education through existing programs in the City and County.

Pollution Prevention/Source Control Education

Residents and businesses engage in behaviors and activities that can influence water quality. Some behaviors that negatively influence water quality include over-fertilizing lawns, using excessive amounts of pesticides, poor housekeeping practices such as inappropriate disposal of paints, household cleaners or automotive fluids, and dumping into storm drains. Alternatively, positive behaviors such as tree planting, disconnecting rooftops, and picking up pet waste can help improve water quality. Whether a pollution prevention program is designed to discourage negative behaviors or encourage positive ones, targeted education is needed to deliver a specific message that promotes behavior changes. Local watershed organizations and other civic groups such as the Master Gardeners are in a position to influence these changes using pollution prevention education and outreach to teach citizens how to properly care for the watershed.

Pollution source control also includes the management of "hotspots" which are certain commercial, industrial, institutional, municipal, and transport-related operations in the watershed. These hotspots tend to produce higher concentrations of polluted stormwater runoff than other land uses and also have a higher risk for spills. They include auto repair shops, department of public works yards, restaurants, etc. Specific on-site operations and maintenance combined with pollution prevention practices can significantly reduce the occurrence of "hotspot" pollution problems. Local government agencies must adopt pollution prevention practices for their facilities and operations and lead by example, followed with inspection and incentive based educational efforts for privately operated sites with enforcement measures as a backstop. The ability to conduct such inspections and enforcement actions should be clearly articulated in local codes and ordinances, and through education programs.

Educating both the current and next generation of environmental stewards is an essential aspect of source control education and pollution prevention. Without present and future concern for the state of the St. Mary's Watershed, restoration efforts could prove futile. Recommended strategies include partnering with existing public school conservation programs as well as direct outreach to youth groups such as Boy and Girl Scouts. Water quality sampling is an effective hands-on tool to educate school-aged children on identifying potential problems in the River. Collection and identification of aquatic insects is a simple and fun way of determining stream health. Tablet tests for various water quality parameters such as dissolved oxygen, phosphorus and nitrogen are available to form a basic understanding of aquatic health. Engaging not only young people, but adults, in naturalist activities such as kayaking and bird/wildlife watching can develop and enhance an appreciation for the natural beauty of the St. Mary's River. Interaction with the natural setting of the St. Mary's Watershed through promotion of responsible recreation will motivate changes in lifestyles that ultimately improve water quality and the overall health of the watershed.

Elements F/G: Schedule and Milestones

Table 18 sets forth the goals to be achieved, locations, responsible parties and long term milestones for implementation for of the recommendation. The table also incorporates goals set forth as part of the County's strategies to meet the Bay TMDL requirements. The overarching goal is aimed at achieving water quality goals. Real watershed restoration required a multi-faceted approach, which combines land use decisions with on-the-ground implementation, education and protection and restoration of watershed function. The table also indicates which watershed plan goals developed by the stakeholders each of the recommendations will help meet.

Table 18: Recommendations, Responsible Parties, and Desired Outcomes for Restoration

	Recommendations	**Location**	**Responsible Parties**	**Time frame**	**Goal #**
Urban Nutrient Management	Regulate fertilizer applications on 3,000 acres of commercial/institutional property through Maryland's Nutrient Management Law	County wide	Maryland Department of Agriculture (MDA), St. Mary's County, St. Mary's College of Maryland	Short term	1
Urban Nutrient Management	Work with environmental organizations/agencies to implement homeowner education programs to promote "BayWise"-type lawn management practices on 20,000 acres of private turf	County Wide	Maryland Department of Agriculture (MDA), St. Mary's County, St. Mary's River Watershed Association (SMRWA)	Short term	1,2,6
Septic System Upgrades	Retrofit 60 septic systems in the Critical Area per year to BAT	County Wide	St. Mary's County Health Department, MDE	Long term	5
Septic System Maintenance	Conduct outreach to homeowners about maintaining septic systems	County wide	St. Mary's County Health Department, MDE, SMRWA	Short term	1,5
Buffers	Increase shoreline buffers by 2,361 acres and outreach to residents on buffer management	Critical Area	SMRWA, MD DNR, St. Mary's County, NRCS, SCD	Long term	3,6

Table 18: Recommendations, Responsible Parties, and Desired Outcomes for Restoration					
Buffers	Increase stream buffers by 1,859 acres and outreach to residents on buffer management	County wide	SMRWA, MD DNR, St. Mary's County, NRCS, SCD	Long term	3
Wetland Restoration	Utilize wetland mitigation funding generated by development to restore 10 acres of wetlands	Watershed Wide	St. Mary's County, NRCS, SCD, MD DNR	Long term	6
Tree Planting	Plant trees on 20 acres public lands utilizing existing programs	Watershed Wide	St. Mary's County, NRCS, SCD, MD DNR	Long term	1,2,3
Agriculture	Increase outreach and cost-share to farmers in locations with high nutrient concentrations	High Nutrient Areas (Synoptic Survey)	NRCS, SCD, SMRWA, UMD Cooperative Extension	Long term	5
Agriculture	Increase acreages of cover crops via incentive payments	Watershed Wide	NRCS, SCD, SMRWA	Long term	4
Education	Education and outreach to local school system and community youth groups	Watershed Wide	SMRWA	Short term	1,2
Growth	Participate in local codes and ordinance review	County wide	SMRWA, St. Mary's County, CWP	Long term	2,4
Growth	Advocate for preservation of forest and highly productive farmland	County wide	SMRWA	Long term	4,5
Stormwater	Explore tax credit for homes and businesses that voluntarily implement stormwater improvements	County wide	SMRWA, St. Mary's County,	Long term	4,5
Stormwater	Establish 9 pilot stormwater retrofit projects	Watershed Wide	St. Mary's County, CWP, UM Sea Grant Extension	Long term	3

Element H: Load Reduction Evaluation Criteria

Since the St. Mary's River has a TMDL for the river itself as well as being part of the larger Chesapeake Bay TMDL the State has already established criteria for determining whether load reductions are being achieved over time. Specifically the State of Maryland established formal standards, which are the ultimate criteria by which to judge the success of the nutrient reduction plan, for the tidal nutrient TMDLs which are as follows:

- The 30-day average concentration of chlorophyll a to should less than 50 ug/l in the tidal river, and
- Dissolved oxygen must be 5 mg/l or greater throughout the tidal river at all times.

An intermediate measure is the set of BMPs estimated to achieve the reduction goals needed to achieve the WIP goals. An estimate of the number of BMPs can be inferred from the WIP Strategy based on the proportions of land uses in the St. Mary's River Watershed. This is being done for urban retrofits within the context of developing the basin implementation plan for the St. Mary's River. Data is presently available to do this for most of the agricultural BMPs.

The following process is recommended for determining if the plan needs to be revised. First, BMP implementation tracking information can be compared with BMP implementation goals to determine when the goal has been achieved. This comparison can made after the 5 years. If during this comparison it is shown that interim goals are not being met, a revision of the plan may be necessary. Because of groundwater lag times, and the lag time for some BMPs to reach maximum effectiveness (e.g. riparian forest buffers), ultimate water quality improvements will not be observed until several years after the control measures are fully implemented. USGS information regarding groundwater lag times should be consulted to estimate the groundwater lag time in this region.

Second, State monitoring occurs in both the non-tidal and tidal waters. Tidal monitoring will account for ground water lag-times and climatic variability. This information will be compared to the tidal water quality standards noted above.

Thirdly, the recently developed Chesapeake Bay TMDL and the Watershed Implementation Plans developed by the State of Maryland and the local jurisdictions also provide criteria and standard to determine if TMDL Load Limits are being met. These criteria include Maryland Department of Environment's State restoration tracking activities in support of the Chesapeake Bay Program nutrient management goals which serves as the foundation for tracking progress on implementing nutrient TMDLs. The State of Maryland is working towards consistent accounting procedures between localized nutrient TMDLs and the regional Chesapeake Bay Program nutrient goals. The adoption of a new Chesapeake Bay Program watershed model (Phase V) offers an opportunity to develop additional consistency.

Criteria for updating the load reduction analysis: If the water quality does not meet standards, field validation of BMP implementation should be undertaken. If this BMP validation process verifies that the BMPs have been fully implemented, then the NPS reduction plan should be revised. This should include additional source assessments to ensure no significant sources of nutrients have been overlooked.

Assessing the attainment of water quality standards is generally the responsibility of the State;

- Tidal and non-tidal long-term monitoring at fixed stations that can characterize time trends in water quality. Limited in geographic coverage. Generally a function of DNR.
- Intensive sampling studies of major waterbodies to characterize more detailed geographic aspects of water quality. Limited in temporal coverage. Generally a function of MDE.
- Random non-tidal biological monitoring that can measure statistical trends in the health of Maryland streams in general (Maryland Biological Stream Survey). This monitoring also has the explicit purpose of assessing the impacts of atmospheric acid deposition (e.g., acid rain). Generally a function of DNR.
- Continuous monitoring of shallow tidal waters to evaluate the shallow water criteria of the Chesapeake Bay. Generally a function of DNR.
- Assessment of fish tissue for toxic substances. Fish function as sentinels; fish tissue violations prompt the State to consider further source assessments, which may be performed

If the Chesapeake Bay Program research results in a change of BMP reduction effectiveness, then the NPS reduction analysis should be updated to reflect those changes.

Criteria for updating the water quality standards: If new information becomes available that demonstrates the water quality standards need to be revised, then that information should be documented and provided to MDE's Science Services Administration. Several specific criteria are listed below:

- If water quality standards change, then the TMDL should be considered for revision.
- If a significant error is found in the TMDL analysis, then it should be considered for revision.
- If NPS reduction analyses indicate it is infeasible to achieve the water quality standards, and it is infeasible to reduce point sources, then the validity of the TMDL analysis should be assessed. If the analysis is validated, the water quality standards should be revisited.

Element I: Monitoring Component

There is currently no monitoring being done by the County to evaluate stormwater projects or watershed efforts. There are monitoring programs maintained by the State of Maryland.

Statewide Monitoring Efforts

According to *Maryland's TMDL Implementation Guidance for Local Governments* (May 2006):*"The State is responsible for water quality monitoring to identify impaired waters and to evaluate water quality to determine if TMDLs are being achieved. Local governments or other groups may conduct additional monitoring to supplement the State monitoring. This may be done to document the effectiveness of innovative projects and programs, or to provide additional information about impaired waterbodies and pollutant sources."* This is done using an array of monitoring programs that are described in *Maryland's Water Quality Monitoring Strategy*:
http://www.mde.state.md.us/programs/ResearchCenter/EnvironmentalData/Documents/www.mde.state.md.us/assets/document/Maryland_Monitoring_Strategy2009.pdf

The State's routine monitoring includes the following elements:

- Maryland Biological Stream Survey
- Maryland Core and Trend Monitoring Stations
- Bacteria Monitoring
- Fish and Shellfish Tissue Monitoring for Toxic Substances

Maryland Biological Stream Survey

The Maryland Department of Natural Resources (DNR) implements probabilistic monitoring of fish and macroinvertebrate communities in wadeable streams and rivers in Maryland. Known as the Maryland Biological Stream Survey (MBSS), the monitoring provides indices of biological integrity and underlying data of which the indices are composed. The Maryland Department of Environment uses the indices for assessing whether aquatic life designated uses are being achieved in non-tidal streams under Maryland's water quality standards. The underlying MBSS data are also analyzed to help identify the stressors that are impacting the biological integrity, and can serve as interim measures of progress (See Section H). Finally, the MBSS data is used to identify high quality (Tier II) waters for protection under Maryland's anti-degradation policy, a part of the State water quality standards framework.

The MBSS monitoring design ensures that a sufficient number of random samples are included in each Maryland 8-digit basin to support 303(d) listing decisions. This data provides an estimate of stream miles impacted, which can serve as a measure of incremental progress (See Section H).

Additional information on the MBSS program is available on DNR's website at: http://www.dnr.state.md.us/streams/mbss/.

Maryland Core and Trend Monitoring Stations

The Maryland Department of Natural Resources maintains a network of 54 monitoring stations on fourth-order streams and larger non-tidal rivers to assess the status and trends in water quality at a broad scale. Water quality samples from these major streams and rivers have been collected monthly since 1986. Status and trends are determined annually for total chlorophyll, specific conductance, dissolved oxygen, a variety of nitrogen and phosphorus species, sulfate, total alkalinity, total organic carbon, total suspended solids, turbidity, and water temperature.

Bacteria Monitoring

Certain types of bacteria are indicators of potential pathogens. Maryland conducts monitoring for bacteria in three general areas:

- Non-tidal General Contact Recreation Waters: Bacteria monitoring is conducted as part of Maryland's five-year cycling strategy described below. The monitoring design ensures that a sufficient number samples are collected in representative areas to determine whether standards are being achieved within a Maryland 8-digit basin (i.e. the Lower Monocacy River watershed).
- Public Beaches:
- Shellfish Harvesting Waters:
- Fish and Shellfish Tissue Monitoring for Toxic Substances

Maryland monitors about ten (10) selected commercial and recreational harvesting areas in non-tidal and tidal tributaries and lakes each year on a rotating basis. This program ensures that aquatic resources harvested from State waters are safe for human consumption, and provides information on potential sources and trends in water pollution levels. Bioaccumulation in fish tissue is a natural means of concentrating toxic substances that might be present in very low concentrations. These substances can be difficult and costly to measure directly. Thus, the fish tissue monitoring serves as a cost-effective screening system for identifying additional monitoring needs. Additional information on this program is available at
http://www.mde.state.md.us/CitizensInfoCenter/Health/fish_advisories/index.asp

Watershed Cycling Monitoring

Monitoring is conducted for on a 5-year rotational basis to evaluate progress on water resource restoration and to help target TMDL implementation.

- 12-digit watershed outlet monitoring: Flow and concentrations of key pollutants will be monitored on a monthly basis to provide an intensive set of data once every five years.
- Tidal rivers and impoundments will be assessed for chlorophyll and other key constituents needed to evaluate progress on TMDL implementation.
- Subbasin synoptic surveys, consisting of a large number of stations up in the headwaters of each Maryland 8-digit watershed will be conducted.
- Biological impairment investigations

References

Boward, D, D. Randle, P. Kazyak, H. Dail, and J. Christmas. 1998. Lower Potomac River Basin, Environmental Assessment of Stream Conditions. (CBWP-MANTA-EA-96-5). Chesapeake Bay and Watershed Programs, Maryland Department of Natural Resources, Annapolis, Maryland.

Brown, E., D. Caraco and R. Pitt. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*. Prepared for the U.S. Environmental Protection Agency Office of Wastewater Management. Center for Watershed Protection. Ellicott City, MD.

Kazyak, P.F. 1997. Maryland Biological Stream Survey. Sampling Manual Monitoring and Non-Tidal Assessment. Chesapeake Bay and Watershed Programs, Maryland Department of Natural Resources, Annapolis, Maryland.

King, D and Hagan, P. 2011. Costs of Stormwater Management Practices in Maryland Counties. Prepared for Maryland Department of the Environment Science Services Administration by University of Maryland Center for Environmental Science. http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/King_Hagan_Stormwater%20Cost%20Report%20to%20MDE_Final%20Draft_12Oct2011.pdf

Maryland Department of the Environment. 2011.

Maryland Department of the Environment. 2011b. Accounting For Stormwater Wasteload Allocations And Impervious Acres Treated. MDE, Baltimore, MD. Online at: http://www.mde.maryland.gov/programs/water/bayrestorationfund/documents/www.mde.state.md.us/assets/document/brf-wwtpbnr-enrevalprocess_tyu_ppres_070907.pdf

Paul, R.W. 2008. St. Mary's River Stream Corridor Assessment and Tidal Shoreline Survey. Final report submitted to Maryland Coastal Zone Management Program, Department of Natural Resources. NOAA Award No. NA06NOS4190237.

Paul, R.W. 2006. Riverlands-Translating St. Mary's River Water Quality Data into Public Policy, Final Report submitted to Environmental Protection Agency, Chesapeake Bay Program, November, 2006.

Paul, R.W. and C.E. Tanner. 2005. Final Performance Report, St. Mary's River Project. U.S. Department of Housing and Economic Development, EDI-Special Project number B-01-SP-MD-0780, submitted July 7, 2005.

Paul, R.W. and C.E. Tanner. 2001. Final Report YR1. Grant #: X-983090-01 to Mary's College of Maryland. Delivered to the Environmental Protection Agency, Region III, Philadelphia, PA, submitted February 2001.

Schueler, T., D. Hirschman, M. Novotney, and J. Zielinski. 2007. *Urban Stormwater Retrofit Practices.* Manual 3 in the Urban Subwatershed Restoration Manual series. Center for Watershed Protection. Ellicott City, MD.

Stranko, S. and W. Rodney. 2001. Final Data Report: Habitat Quality and Biological Integrity Assessment of Freshwater Streams in the Saint Mary's River Watershed. CBWP-MANTA-EA-01-2. Chesapeake Bay and Watershed Programs, Maryland Department of Natural Resources, Annapolis, Maryland.

United States Army Corps of Engineers (USACE): Baltimore and Norfolk Districts. 2012. Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan, Maryland and Virginia. March 2012.

US EPA. 2010. What is nonpoint source pollution? US EPA Office of Water website. Last updated February 2010. http://www.epa.gov/owow_keep/NPS/whatis.html

Washington Post. St. Mary's commissioners reject county's bay health plan. Published June 13, 2012. Online at: http://www.washingtonpost.com/local/st-marys-commissioners-reject-countys-bay-health-plan/2012/06/12/gJQAFxLoZV_story.html.

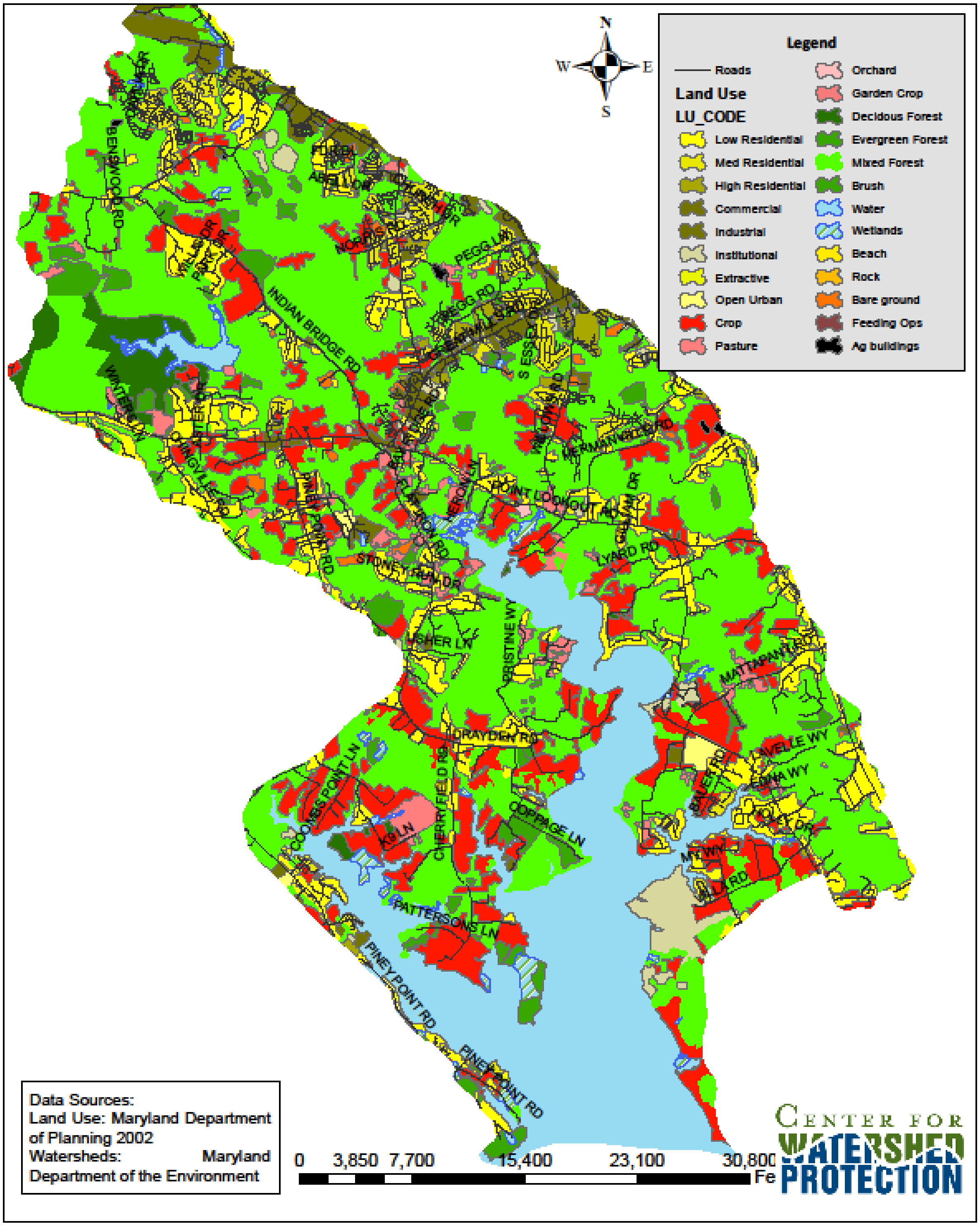
Wright, T. C. Swann, K. Cappiella, T. Schueler. 2004. *Unified Subwatershed and Site Reconnaisance*. Manual 11 in the Urban Subwatershed Restoration Manual series. Center for Watershed Protection. Ellicott City, MD.

Yetman, K.T, 2001. Stream corridor assessment survey – survey protocols. Maryland Department of Natural Resources, Annapolis. MD

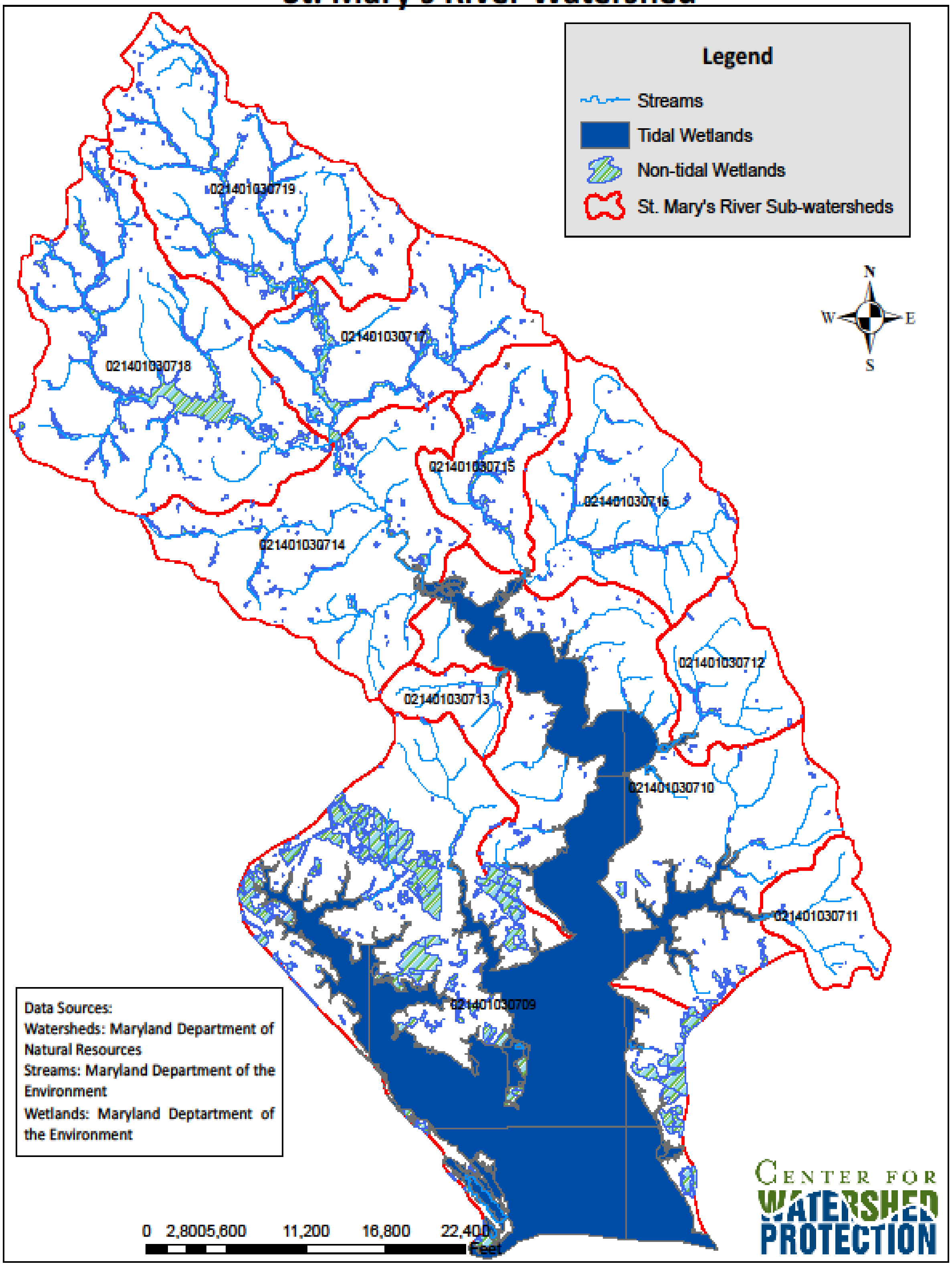
Appendix A.

MAPS

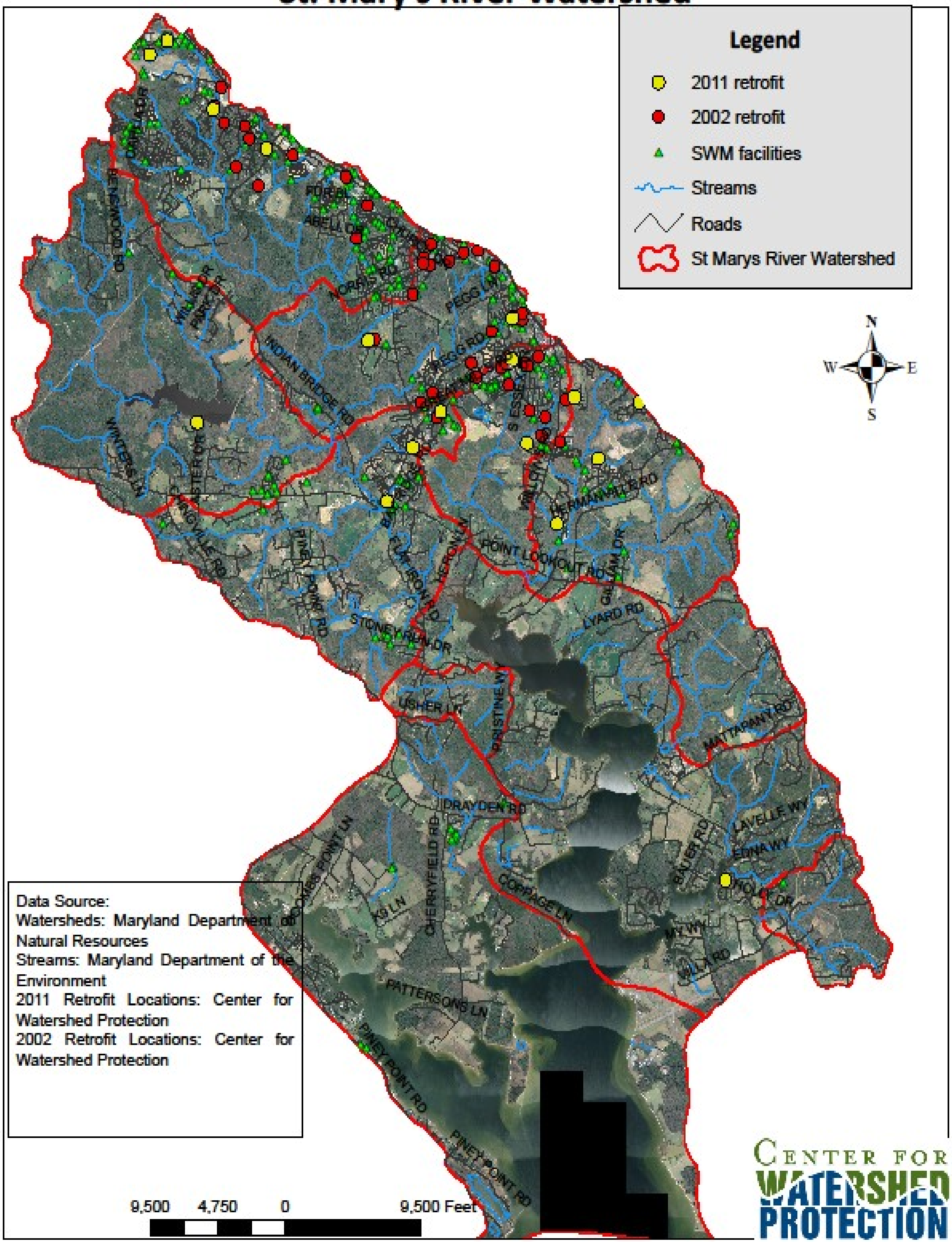
Land Use- St. Mary's River Watershed



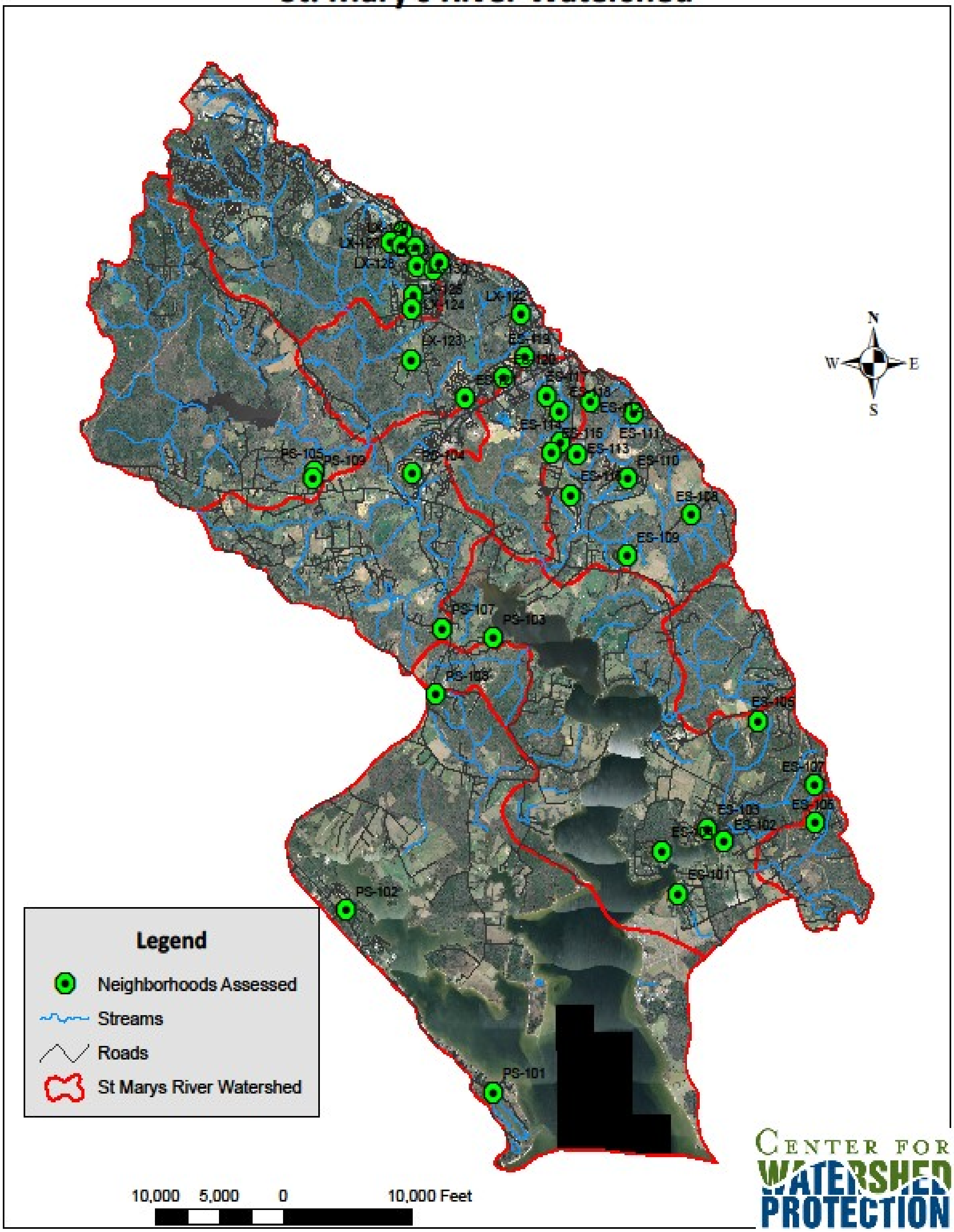
Watersheds, Streams, and Wetlands- St. Mary's River Watershed



Urban Stormwater Retofit Locations- St. Mary's River Watershed



Neighborhood Source Assesment Locations-
St. Mary's River Watershed



Appendix B

Field Assessment Protocols and Methods

Stream Corridor Assessment
Between April 1st and September 30th, 2008 a survey team of five St. Mary's College of Maryland students under the direction on Dr. Robert Paul and Ms. Amy Drohan with support from Maryland DNR walked and assessed just over 118 miles of stream. The team utilized the Stream Corridor Assessment (SCA) protocols and survey techniques to document the condition of the stream and environmental problems impacting stream heath and function. The results of the assessment are presented in a document written by Dr. Robert Paul and titled "*St. Mary's River Stream Corridor Assessment and Tidal Shoreline Survey*". This section integrates key information from that report into the watershed plan.

Methods

Prior to the start of field work, letters were sent out to all property owners with lands adjacent to watershed water bodies and asked them to contact the project director if they objected to the survey crew entering their property. A total of 54.6 stream miles were denied access by property owners and this was 31.6% of the watershed miles. The survey crew was allowed access and walked a total of 118.4 stream miles during the survey period which represents nearly 70% of the total stream miles. Additionally the St. Mary's College of Maryland student crew members were trained on SCA protocols and survey techniques by a Maryland DNR staff expert.

Developed by the Maryland Department of Natural Resources (DNR)'s Watershed Restoration Division, the SCA survey utilizes a small survey team to record observable problems and prioritize restoration opportunities. The Stream Corridor Assessment (SCA) survey is designed to provide a method which can be used to both rapidly assess the general physical condition of a stream system and identify the location of a variety of common environmental problems within the stream's corridors. It is intended to be a tool that can help resource managers identify not only the location of environmental problems but also restoration opportunities that exist within a drainage network. Potential environmental problems identified as part of the SCA survey include: erosion sites, inadequate stream buffers, fish migration blockages, exposed or discharging pipes, channelized stream sections, trash dumping sites, in- or near-stream construction, or unusual conditions. In addition, the survey also collects information on potential wetlands creation/water quality retrofit sites, as well as data on the general condition of both in-stream and riparian corridor habitats. The survey can also be used to assist in the identification of healthy stream sections that may be in need of environmental protection (Yetman, 2001).

The St. Mary's River DNR delineated 12-digit subwatersheds were identified on maps and the streams within the subwatersheds classified on the basis of their stream orders. Each stream segment was assigned a unique identifying numerical code that allowed the field crew to assemble and compile information based on specific locations.

Site documentation included a photograph and a GPS location. Stream impacts and problems were identified and ranked on a scale from one to five for severity compared to reference conditions, correctability of the problem, and site accessibility. Representative sites were recorded at about one mile intervals along the stream and serve as a comparator for the health of the streams across the St. Mary's River watershed and to highlight areas that might be suitable for protection. At representative sites, the field crew ranked the condition of attachment sites for macroinvertebrates, embeddedness, habitat for fish, channel alteration, sediment deposition, velocity and depth, channel flow status, bank vegetation protection, condition of banks, and riparian vegetation zone width as optimal, suboptimal, marginal, or poor. While the rankings are subjective, they do offer a solid starting point in determining what problem sites need to become a priority for restoration (Yetman, 2001). At each of these representative and problem sites the survey team took a picture of the stream that includes a six digit number.

Severity rankings indicate how good or bad a specific problem site was relative to others. Severity rankings were used to compare problems of the same type. It was not possible, for example, to compare rankings between an in stream construction site and a fish barrier. In most cases the negative influence of construction on the stream ecosystem was inherently much larger than the impact of a single fish barrier. We used the following severity rankings in accordance with the SCA protocols (Yetman, 2001).

Tidal Shoreline Survey

The tidal shoreline survey took place in June 2008, by the same St. Mary's College of Maryland student team under the direction of Dr. Robert Paul and Ms. Amy Drohan.

Methods

A. power boat was used to move along a specific route approximately 75 meters from shore. The survey team utilized 17 cruises to photograph and collect survey data on the entire length of the St. Mary's River tidal shoreline. A Ricoh Caplio 500SE GPS camera (Ricoh Company Ltd., Tokyo, Japan) was mounted on a tripod and programmed to take shoreline pictures automatically every thirty seconds. The boat then proceeded along the shoreline at approximately 5 nautical miles per hour. This combination of speed and distance was ideal for capturing a complete image of the shoreline.

The photographs were stored on a computer and images obtained with the camera were converted to ArcMap shapefiles with Geospatial Experts' GPS-Photo Link- Ricoh Edition software. Photographic images, once converted to ArcMap shapefiles, were plotted on GIS maps of the tidal St. Mary's River. To photograph the shoreline of NESEA (Naval Air Station-Patuxent River, Webster Field Annex) it was necessary to secure special permission from their security office, and they also screen photographs removing those which showed sensitive buildings.

All photographs were linked to their GPS locations and mapped. The photos were then analyzed for level and need for restoration. The shoreline segments recommended for possible restoration are highlighted in the map.

Synoptic Survey

Between April 1st and September 30th, 2008 a synoptic survey was conducted by St. Mary's College of Maryland students under the direction on Dr. Robert Paul and Ms. Amy Drohan and with the assistance of the Watershed Assessment Division of the Maryland Department of Natural Resources (DNR). The assessment included water quality monitoring and nutrient analyses at 15 non-tidal stations and a single station at the mid-point of the tidal reach

(Figure 6). Biological sampling also occurred in April for macroinvertebrates and in July for fish. All procedures followed Maryland Biological Stream Survey (MBSS) protocols.

The results of the assessment are presented in a document written by Dr. Robert Paul and titled "*St. Mary's River Synoptic Survey*". This section integrates key information from that report into the watershed plan.

Water Quality Sampling Methods-

Non-tidal stations were selected to characterize four general watershed regions. As the upper St. Mary's River and middle branches drain a vast majority of the watershed, providing the largest volume of freshwater entering the tidal St. Mary's River, the majority sampling sites (11 of 15) were concentrated here. For the most part, either USEPA (Plafkin et al., 1989) or MBSS (Kazyak, 1997) protocols were used to originally select nontidal sites. Selection criteria were applied to all potential non-tidal stream sites: 1) stream order (Horton, 1945), 2) relative position in the watershed, 3) whether the sampling site was representative of the stream, 4) site position relative to upstream sampling locations, 5) site position relative to tidal sampling locations, 6) accessibility, and 7) special considerations (such as distinctive features or attributes).

Water temperature, salinity, dissolved oxygen (DO), pH, turbidity, and *in situ* chlorophyll fluorescence measurements were taken at a tidal station at 0.5, 1.0, 2.0 and 3.0 m. Nutrient samples were taken from May through August at the surface. All sampling equipment used in the filtering process was rinsed three times with sample water. After filtering was complete all filter pads were stored in aluminum foil envelopes on ice in sealed polyethylene bags. All tidal samples were delivered on ice to the laboratory the same day they were collected. Nutrient samples were immediately frozen in a secured freezer before being transported to the Analytical Chemistry Laboratory at Chesapeake Biological Laboratory– CBL (University of Maryland) in Solomons.

Biological Sampling Methods

The St. Mary's College of Maryland team coordinated sampling efforts with Stream Waders volunteers who were sampling in the St. Mary's River watershed at the same time, April 15, 2008. MBSS protocols (Kazyak, 1997) were followed for kick net sampling. All samples were preserved with 70% ethanol, transported to the laboratory, the macroinvertebrates separated from debris, and the specimens then stored in polyethylene bottles with 70% ethanol until identified. Dr. Robert Paul identified the macroinvertebrates to family level using Peckarsky et al. (1990) and Jessup et al. (2002) as authorities. Individuals were counted, tallied, and entered into a spreadsheet.

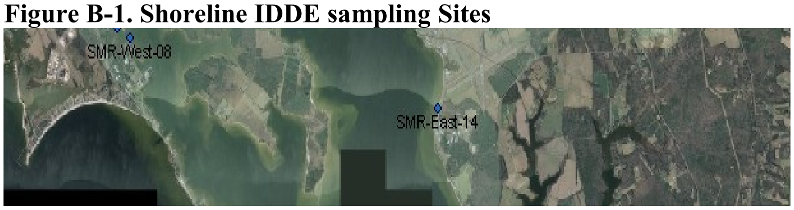
Fish were collected at all non-tidal sites from July 14 through July 25, 2008. Thirteen of the fifteen non-tidal SMRP sites were sampled for fish using MBSS protocols (Kayzak, 1997). The two non-tidal sites not sampled were NT01- Locust Grove Cove, a site that is actually brackish, and NT04- St. Mary's Lake. Electroshocking was used to sample in 75 m segments designated at each of the SMRP non-tidal stations. A Smith-Root Model LR-24 Electrofisher 24-volt shocking system was used for sampling. All individuals were identified to species using Kayzak, et al. (2003) and Page and Burr (1991) as authorities. Once fish were indentified, they were weighed, and released

Water Quality Results
Generally, nutrient levels and total / volatile suspended solids were quite low throughout the study period (Figure 7). Water quality data was not noticeably different between the surface (0.5 m) and depth (3.0 m). However, chlorophyll *a* and percent dissolved oxygen were clearly higher and lower, respectively, on the June 11, 2008 sampling date. This is significant because storm events in mid-May (5/9-5/12 and again on 5/14-15) clearly influenced lowered water temperature and salinity at the dock site. This, in turn, created an algal bloom that sank or developed near the bottom, which depressed the Secchi disk depth and dissolved oxygen concentration in the water on May 14th. As a result the St. Mary's College of Maryland team strongly suspects that storm events cause rather dramatic changes in St. Mary's River tidal water quality.

Shoreline IDDE
On June 20, 2011 two Center lead field teams conducted a near shore water quality monitoring utilizing modified Illicit Detection and Elimination (IDDE) procedures to gain a snapshot picture of where septic system failures may be occurring. The teams traveled to 29 predetermined sites (Figure B-1).

Field Collection
Sites were selected to gain a snapshot understanding of where septic systems may be failing and where additional monitoring and outreach efforts should focus. Sites were selected where the shore line contained residential sites in the critical area, marinas, stream outfalls, and agriculture and forest land (Figure B-2). The teams utilized power boats driven by local

Figure B-1. Shoreline IDDE sampling Sites



volunteers to travel to the general site locations collect water quality samples and GPS information; field crews used the Shoreline Survey Field Sheet (Appendix C) to record data collected at the site. Water quality samples were collected approximately 15 feet from shore at 2 feet deep. Samples were kept on ice until the end of the field day.

Figure B-2. Example Shoreline IDDE Sites
A.) Monitoring location near St. Mary's College East-06. B) Monitoring location near houses East-08

A salinity measurement was collected first with a refractometer, which was zeroed with distilled water before reading the sample. Ammonia was collected and analyzed in the field as well. A glass cuvet was rinsed 3 times with sample water. A specified amount of reagent was added to the sample depending on whether the sample was freshwater (4 drops of each reagent) or brackish/marine (10 drops of each reagent). The cuvet was rinsed with distilled water after each measurement. Seven other samples were collected for later analysis as specified in Table 6.

Table 6. Shoreline IDDE sample collection
At freshwater sites only – 0.5-1 L sample collected in a clean Nalgene bottle, rinsed 3 times with sample water, for sub-samples of fluoride, potassium, anionic surfactants and conductivity;
100 ml of sample for E. coli and total coliforms collected in a sterile sample bottle;
1 sterile whirlpack bag for Enetrococcus;
1 sample for turbidity;
1 Nalgene bottle for chlorophyll a, stored in a black plastic bag until back at the lab;
1 Nalgene bottle for B. adolescentis and optical brightener;
50 ml of sample for total nitrogen and total phosphorus collected in plastic, autoclaved bottle. The sample was frozen at the end of the field day and express shipped in a cooler to Chesapeake Biological Laboratory in Solomons, MD.

Lab Analysis

A 10 ml subsample of sample 1 was collected in a glass cuvet, rinsed three times with sample water, and analyzed for fluoride with a Hannah photometer. A 10 ml blank was created with distilled water; the photometer was zeroed before each sample reading. When the upper range of the photometer was surpassed, a reading of ">2.2 mg/L" was recorded.

A 1 ml subsample of sample 1 was collected with pipette, rinsed 3 times with sample water and analyzed for potassium with a Hardy compact ion meter. The meter was calibrated at the beginning of each day with 2000 ppm and 150 ppm standards provided by the manufacturer.

A 1 ml subsample of sample 2 was plated on a 3M petrifilm plate and incubated at 35° C for 24 hours ± 1 hour. Red colonies with gas and blue colonies with gas were visually counted for each plate or per grid cell and multiplied by 20 to get a count per plate for E. coli (blue colonies) and total coliforms (red + blue colonies). Results of counts/plate were multiplied by 100 to report colony forming units (CFU) per 100 ml.

Urban Subwatershed and Site Reconnaissance (USSR)

Field teams, each consisting of at least one CWP staff and one volunteer, conducted assessments of upland conditions and retrofit opportunities in the St. Mary's River watershed. The primary assessment protocols used were the Urban Subwatershed and Site Reconnaissance (USSR) field survey to evaluate potential pollution sources and restoration opportunities and the Retrofit Reconnaissance Inventory (RRI) to evaluate potential sites for location of stormwater retrofits.

Assessment Protocol

The USSR is a "windshield survey" and physical observation where crews drive every road to determine specific pollution sources and identify areas outside the stream corridor where pollution prevention possibilities exist. The USSR can be a powerful tool in shaping an initial subwatershed restoration strategy, and in locating upland restoration projects that deserve further investigation. The concept behind the USSR is to provide watershed groups, municipal staff, and consultants a quick but thorough characterization of upland areas to identify major sources of pollutants and restoration opportunities for source controls, pervious area management, and improved municipal maintenance (i.e., education, retrofits, and referral for immediate enforcement).

The USSR conducted had two major assessment components: hotspots and neighborhoods. Descriptions of methods, sites visited, and recommendations are discussed separately for each assessment in the following sections.

Hotspot Site Investigation (HSI)

The Hotspot Site Investigation (HSI) is used to evaluate commercial, industrial, municipal, and transport-related sites that may contribute highly polluted stormwater runoff to the storm drain system or adjacent receiving waters. At sites subjected to the HSI, field crews investigate vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure to evaluate potential sources of stormwater pollution. Based on field observations, field crews assign a hotspot designation to each site. According to the hotspot designation criteria set forth in Wright et al. (2005), sites can receive one of four different hotspot designations:

- *Not a Hotspot*: no confirmed pollution sources; few to no potential sources
- *Potential Hotspot*: no confirmed pollution sources; some potential sources
- *Confirmed Hotspot*: one confirmed pollution source; many potential sources

• *Severe Hotspot*: two or more confirmed pollution sources; many potential sources

The hotspot designation, along with observations made by field crews, is used to recommend follow-up actions, which may include: follow-up inspections; illicit discharge investigations; future employee training and education efforts; stormwater retrofits; stormwater pollution prevention planning; and enforcement actions.

Neighborhood Source Assessment

The Neighborhood Source Assessment (NSA) was conducted to evaluate pollution source areas, stewardship behaviors, and restoration opportunities within individual residential areas. The assessment looks specifically at yards and lawns, rooftops, driveways and sidewalks, curbs, and common areas.

Neighborhoods were assessed in terms of age, lot size, tree cover, drainage, lawn size, general upkeep, and evidence of resident stewardship (i.e., storm drain stenciling, pet waste management signage, etc.). Each site was assigned a pollution severity of "severe," "high," "moderate," or "low," using a set of benchmarks set forth in Wright et al. (2005). Pollution severity is an index of how much non-point source pollution a neighborhood is likely generating based on easily observable features (i.e., lawn care practices, drainage patterns, oil stains, etc.). A restoration potential was also assigned to each neighborhood type as "high," "moderate," or "low." Restoration potential is a measure of how feasible onsite retrofits or behavior changes would be based on space, number of opportunities, presence of a strong HOA, etc. Opportunities for the following types of restoration activities were evaluated for each site:

• On-site retrofits – such as rain gardens/barrels or other rooftop disconnection practices;
• Better lawn and landscaping practices – improved buffer protection, native plants, turf reduction, tree planting opportunities (Figure 15), proper fertilization and pesticide application, and mowing practices
• Dumping and trash—proper disposal of car maintenance fluids, trash and debris; and
• Better open-space management – management of neighborhood common areas or courtyards (landscaping, pet waste, etc.).

Stormwater Retrofit Inventory

Two field crews, each consisting of two CWP staff and one or more volunteers conducted a stormwater retrofit inventory in the watershed on January 25 and 26, 2011. The inventory was used to identify and evaluate potential stormwater retrofit opportunities.

Stormwater retrofits are stormwater management practices that can be used to address existing stormwater management problems. They are an essential element of a comprehensive watershed restoration plan because they can help improve water quality, increase groundwater recharge, provide channel protection and control overbank flooding. The success of many other watershed restoration practices—such as bank stabilization, riparian corridor restoration and aquatic habitat enhancement—cannot be guaranteed without using stormwater retrofits to address existing stormwater management problems and to establish a stable, predictable hydrologic regime.In addition to the stormwater management benefits they offer, stormwater retrofits can be used as demonstration projects, forming visual centerpieces that can be used to help educate residents and build additional interest in watershed restoration.

Assessment Protocol

A number of potential stormwater retrofit opportunities were assessed during the stormwater retrofit inventory. Candidate project sites were identified prior to the field work using aerial photography, GIS data, input from project partners, information gathered during previous watershed reconnaissance work and information gathered during the stream and upland assessments. In general, candidate project sites were located at stormwater hotspot facilities, at relatively large tracts of publicly owned open space (e.g., parks, schools) and at existing stormwater management facilities. Field crews visited each of the pre-identified candidate project sites (as well as a few additional sites) during the field investigation. The locations of the sites that were visited during the stormwater retrofit inventory are shown on a map in Appendix A.

Using the Retrofit Reconnaissance Inventory (RRI) (Schueler et al., 2007), the stormwater retrofit potential of each candidate project site was assessed by evaluating drainage patterns, drainage areas, land use, land cover, available space and other site constraints (e.g., conflicts with utilities, conflicts with existing land uses, site access, property ownership, potential impacts to adjacent natural resources). Unless there were obvious site constraints and/or evidence that a particular stormwater retrofit would offer few or no watershed restoration benefits, a preliminary stormwater retrofit concept was developed for each candidate project site. Each preliminary retrofit concept was developed based on the space available at the candidate project site, the particular constraints and characteristics of the site, the size of the drainage area to be served by the stormwater retrofit, the land use and amount of impervious cover found within the drainage area and the overall watershed restoration objectives being pursued. For this project, the primary objectives of the stormwater retrofit inventory were to identify opportunities to provide water quality treatment and to identify potential demonstration projects (Figure 16).

Appendix C

FIELD FORMS

SHORELINE SURVEY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Location: St Mary's River		Site ID: SMR-East-	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Air Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use on Shoreline (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☐ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional

Vegetative buffer on shoreline? ☐ Yes, width: ____ ft ☐ No

Other: ________________________________

Known Industries: ________________________________

Notes:

Section 2: Site Description

LOCATION & SITE CONDITIONS		POTENTIAL POLLUTION SOURCES		PHYSICAL INDICATORS
Distance from shoreline	Direction of current	☐ Waterfowl	☐ Wastewater treatment plant	☐ Groundwater seepage
____ ft	☐ East to west	☐ Pets	☐ Outfall (complete ORI form)	☐ Algae
Sample Location	☐ West to east	☐ Beach bathers		☐ Discolored sand (black or gray)
☐ Shoreline	☐ North to south	☐ Septic system	☐ Trash	☐ Odor
☐ Surf zone	☐ South to north	☐ Marina	☐ Public restroom ☐ Sewered ☐ Septic	☐ Color
☐ Off-shore	Wind Direction	☐ Agricultural Activities		☐ Floatables
Tide	☐ East to west	☐ Ditch	☐ Other: ____	
☐ Flooding	☐ West to east			
☐ Ebbing	☐ North to south			
	☐ South to north			

Section 3: Quantitative Characterization

FIELD DATA FOR SHORELINE SAMPLE COLLECTION			
PARAMETER	RESULT	UNIT	EQUIPMENT
Salinity	Dilution? %	ppm	Refractometer
Ammonia		mg/L	Specific ion probe (see instructions)
E. coli (complete in lab)		CFU/100ml	Petrifilm plate
Total coliforms (complete in lab)		CFU/100ml	Petrifilm plate

Section 4: Data Collection

1. Sample depth: ft	2. Sample for optical brightener? ☐ Yes ☐ No
3. Sterile sample for bacteria analysis? ☐ Yes ☐ No	

Shoreline Survey

Retrofit Reconnaissance Investigation **RRI**

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE:	ASSESSED BY:	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name:____
Address:____

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:________________

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:____________

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:________________________

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☐ Other:__________

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ ______________
Imperviousness ≈______________%
Impervious Area ≈ ______________

Notes:

Drainage Area Land Use:
☐ Residential
  ☐ SFH (< 1 ac lots)
  ☐ SFH (> 1 ac lots)
  ☐ Townhouses
  ☐ Multi-Family
☐ Commercial
☐ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:__________

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width:________

Existing Head Available:	**Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)**

Hotspot Site Investigation **HSI**

WATERSHED:	SUBWATERSHED:		UNIQUE SITE ID:
DATE: __/__/____	ASSESSED BY:	CAMERA ID:	PIC#:
MAP GRID:	LAT __° __' __" LONG __° __' __"		LMK #

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: __________________________

____

____

Category: ☐ Commercial ☐ Industrial Miscellaneous ☐ Institutional ☐ Municipal ☐ Golf Course ☐ Transport-Related ☐ Marina ☐ Animal Facility

SIC code (if available): ___________

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Basic Description of Operation:

____

	INDEX*
B. VEHICLE OPERATIONS ☐ **N/A** *(Skip to part C)* — **Observed Pollution Source?**	☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ____________	
B2. Approximate number of vehicles: _______	
B3. Vehicle activities *(circle all that apply)*: **Maintained Repaired Recycled Fueled Washed Stored**	O
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	O
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	O
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	O
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	O
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	O
C. OUTDOOR MATERIALS ☐ **N/A** *(Skip to part D)* — **Observed Pollution Source?**	☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	O
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	O
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	O
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	O
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	O
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	O
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	O
D. WASTE MANAGEMENT ☐ **N/A** *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials **any of these**	O
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing **any of these**	O
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell **if both are yes**	O
E. PHYSICAL PLANT ☐ **N/A** *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	O O

*Index: O denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

A-1

WATERSHED:	**SUBWATERSHED:**	**UNIQUE SITE ID:**	
DATE: __/__/____	**ASSESSED BY:**	**CAMERA ID:**	**PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: ________________________________ Neighborhood Area (acres) ______

If unknown, address (or streets) surveyed:

____

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: ____________________

Residential *(circle average single family lot size):* ____________________

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

				INDEX*
Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: ____% With Basements ____%			
Sewer Service? ☐ Y ☐ N				O
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%				O
Record percent observed for each of the following indicators, depending on applicability and/or site complexity		**Percentage**	**Comments/Notes**	
B. YARD AND LAWN CONDITIONS				
B1. % of lot with impervious cover				
B2. % of lot with grass cover				O
B3. % of lot with landscaping (e.g., mulched bed areas)				◇
B4. % of lot with bare soil				O
**Note: B1 through B4 must total 100%*				
B5. % of lot with forest canopy				◇
B6. Evidence of permanent irrigation or "non-target" irrigation				O
B7. Proportion of *total neighborhood* turf lawns with following management status:		High: ___		O
		Med: ___		
		Low: ___		
B8. Outdoor swimming pools? ☐ Y ☐ N ☐ Can't Tell Estimated # ___				O
B9. Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell				O
C. DRIVEWAYS, SIDEWALKS, AND CURBS				
C1. % of driveways that are impervious ☐ N/A				
C2. Driveway Condition ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up				O
C3. Are sidewalks present? ☐ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☐				
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation				O
What is the distance between the sidewalk and street? _____ ft.				◇
Is pet waste present in this area? ☐ Y ☐ N ☐ N/A				O
C4. Is curb and gutter present? ☐ Y ☐ N If yes, check all that apply:				
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment				O
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy				◇

* INDEX: O denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

Appendix D:
CONCEPT SHEETS

Site visits to possible retrofit opportunities were conducted on January 26th & 27th within the St Mary's River watershed.
Some sites were visited and no retrofit concept was developed due to:

- insufficient information regarding drainage conditions, site utilities, etc.;
- lack of adequate drainage area or impervious cover to justify retrofit expenditure;
- lack of opportunity for appropriate cost-benefit retrofit opportunity;
- existing stormwater BMP(s) are in place and functioning;

Other sites required drainage infrastructure repair or upgrade, which is outside the scope of this project.

Seafarers Harry Lundeberg School of Seamanship

Site Description:
Large campus style facility with several buildings, parking area, and pier system. Extensive sea wall system was damaged during Hurricane Isabel and subsequent storms. Current effort of facility managers is to obtain permits to repair seawall and adjacent structures. This includes:

- Removal of 3 existing (damaged) piers to be replaced by a single pier;
- Removal of several outbuildings immediately adjacent to the water, and replacing them with a small park area and a constructed wetland; representing a significant reduction in impervious surfaces.

Facility is served by a large central parking lot that drains to a large wet pond (created as a borrow site and sediment basin when site was developed). Conveyance is through a concrete channel; options to retrofit as a grass or dry swale create possible maintenance and/or nuisance concerns due to standing water (back water from pond) and vegetation.
Overall management of facility is aware of environmental stewardship opportunities:

- Use of parking lot is minimized by an aggressive transportation program for students: shuttle busses are available to transport students to classes on satellite campus;
- Fire fighting training facility utilizes a multiple pond system to recycle water for firefighting exercises.

Potential Retrofit:
No concept was developed. Possible retrofit opportunities that can be explored: nutrient management plans for the managed turf areas. A significant amount of goose feces was evident throughout the turf areas of the property, although property managers indicate that they are migratory and not resident geese.

Great Mills High School

Site Description:

High School campus with a large stormwater management detention pond (western edge of large parking lot) and a smaller linear detention facility (along the southern edge). The large detention pond includes concrete low flow pilot channels from the two primary storm drain inflow points to a concrete weir with a low flow orifice (assumed – since it was submerged at the time of the inspection), 2-stage large storm confined weir. Weir wall is backed by riprap within the geometry of the receiving channel.

Stormwater basin is likely designed for channel protection: extended detention; and larger storm detention. Possibly includes a water quality ED component (need to review plans – see information needs below). The downstream channel appears to be stable. The backing of the weir with rip rap is likely contributing to the clogging of the orifice.

Several areas of the curbing in the vicinity of the detention basin (and elsewhere) are broken – likely due to the snow removal (Figure 6).

Proposed Retrofits:

1. Re-engineer the large detention basin with water quality components:
    a. Remove low flow concrete pilot channels
    b. Establish forebays at storm drain inflow points
    c. Determine soil permeability and assess infiltration potential
    d. Create multiple wetland/shallow marsh cells

2. Bioretetnion
    a. Construct curb cuts along eastern edge of the parking lot (Figure 6).
    b. Install conveyance down to the (new) design high water of basin (based on retrofit #1 above).
    c. Construct bench bioretention areas along western edge of detention basin (Figure 7).

3. Assess the design computations of the smaller basin for similar retrofits.

Information Needs:

1. Design computations for current design.
2. Minor as-built survey of adjacent slopes to assess bioretention efficacy.
3. Minor survey of parking lot to determine potential drainage area to proposed curb cuts


Figure 1: Overhead View Great Mills High School


Figure 2: Low flow pilot channel – partially submerged


Figure 3: Multi stage weir – low flow orifice submerged


Figure 4: Stone backfill behind weir (weir wall upstream to right)


Figure 5: Low flow pilot channel - submerged


Figure 6: Curb along edge of parking immediately adjacent to detention basin

McKay's Shopping Center

Site Description

Large shopping center parking lot that drains towards Great Mills Road. The upper half of the parking lot is collected by grate inlets and drains into a perimeter stormwater basin/channel on each side of the parking area through drainage systems. A single small curb cut also drains a portion of Lex Woods Drive into the basin. The lower half of the parking sheet flows into the long front portion of the basin/channel through large "curb cuts" located at the end of each drive aisle at the bottom of the parking lot

The geometry of the perimeter basin/channel is a large trapezoidal section with approximately 20 ft wide flat bottom with the top width approximately 40 ft in the front (it should be noted that there is a slight taper with the dimensions getting narrower moving towards the north east due to the alignment of Great Mills Road.) This front section is crowned with a high point in the middle of the property and drains to each side with relatively shallow and flat grades. The basin areas on each side are similarly trapezoidal in shape with flat bottoms (approximately 30 to 35 ft wide), however the side slopes are steeper and the invert is deeper (as related to the adjacent driveway grades).

The perimeter stormwater management basin/channel does not appear to have any detention capabilities (culverts flowing in are the same diameter as going out). The flat bottom and flat grade appears to encourage sheet flow and infiltration, however there are no baffles or other means to ensure sheet flow (significant pockets of standing water were evident during the site visit).

Proposed Retrofits

1. Create parking lot curb-extension bioretention areas at each of the grate inlets in the upper half of the parking lot. This will provide treatment of a major portion of the upper half of the parking lot. A minimum of 4 parking spaces (and possibly 6 depending on the contributing drainage area) would be needed at each location.
2. Create shallow bioretention areas at each of the large curb cuts at the lower end of the parking lot. Sufficient surface area is available without losing parking, however, there is very little head loss from the edge of the parking to the invert of the trapezoidal section in these areas.
3. Create perimeter bioretention along the sides of the basin on the northeast side:
    a. Create a new curb cut adjacent to the existing grate inlet immediately adjacent to the basin;
    b. Establish a non-erosive conveyance from the curb cuts into a perimeter bioretention basin.
4. Create multiple cells and baffles to encourage greater flow sinuosity within the trapezoidal channel.

Information Needs

1. Depth of grate inlets in the upper portion of the parking.
2. Delineation of drainage areas to each parking lot curb-extension bioretention.
3. Soils information (infiltration capacity) within the basin/channel.
4. Design for the current design.

St. Mary's River Watershed Retrofit Assessment
McKay's Shopping Center
1/26-27/11

Figure 1: Overhead View McKay's Shopping Center

Figure 2: Inlet culvert in north-east basin

Figure 3: Outlet culvert in north-east basin

Figure 4: Inlet culvert in north-west basin

Figure 5: Outlet Culvert in north-west basin

Figure 6: Curb cut on Lex Woods Drive into north-west basin Great Mills Road

Figure 7: Typical curb cut into swale along Great Mills Road

Figure 8: View of swale along Great Mills Road – looking west

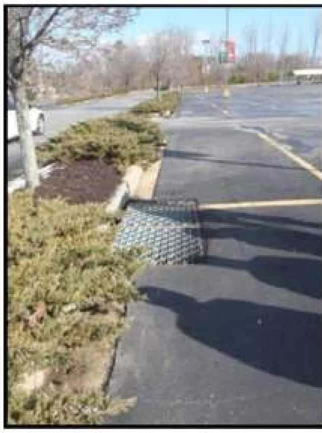


Figure 9: Typical grate inlet in south half of parking lot (every other island)

Figure 10: View of south half of parking with grate inlets at islands

St Mary's Lake

Site Description

Large parking area (approx 1.7 acres) with continuous grade towards the lake. Lower edge on the northeast side of the ramp has a large concrete drainage channel (presumably built to convey concentrated runoff through the area of the bathhouse and sewer lines).

Proposed Retrofit:

1. Impervious cover reduction:
    a. Establish a minimum parking need;
    b. Eliminate pavement in the upper area of the parking lot;
    c. Replace pavement with permeable pavers for use during infrequent large events.
2. Bioretention at lower edge of parking:
    a. Install bioretention cell in the north-east corner of the parking lot above the concrete channel by removing a wedge of parking. Removal of some of the concrete channel may be required to daylight the underdrain.

Information Needs:

1. Topography of parking area to determine the best configuration for removing pavement and/or sizing bioretention.
2. Basic elevations of the concrete channel relative to the edge of the parking lot.

Figure 1: Overhead view St Mary's Lake parking and boat ramp

Figure 2: Parking lot looking Principal spillway CMP pipe

Figure 3: Drainage channel at bottom of parking area – looking east

Figure 4: Looking west along bottom edge of parking area; boat ramp to the right

Figure 5: Looking down boat ramp to water

Compliance Corp Stormwater Basin

Site Description:

Large parking area and rooftop drainage area is conveyed in a flat grass channel (approximately 160 ft – with the last 30 ft down a steeper stone armored section) around the backside of the Compliance Corp Building and down a into a large stormwater detention facility. Existing concrete riser structure includes a triangular weir in front of a corrugated metal pipe – which discharges into a small stream. Pipe invert is rusted out the entire length of the outlet. Basin appears to have compacted areas in the center (from grass mowing or other maintenance vehicles) with standing water. Invert of the riser is at the bottom of the basin so there appears to be no water quality or volume reduction capacity.

Proposed Retrofits:

1. Establish a dry swale for the 130 ft +/- length of the conveyance swale into the basin;
2. Create a forebay at the top of the grass swale, and at the entrance into the basin;
3. Modify the riser to create a water quality feature – shallow marsh, extended detention, micro-pool, etc.
4. Create an elevated sand filter or other filtering device within the basin as part of the riser system.

Information needs:

1. Original design of the basin
2. Basic (relative) elevations of the inflow channel;
3. Contributing drainage area

St. Mary's River Watershed Retrofit Assessment
Compliance Corp Stormwater Basin (behind A&E Motel)
1/26-27/11

Figure 1: Entrance channel from parking lot around north side of building

Figure 2: Partial drainage area to entrance channel

Figure 3: Entrance channel entering detention basin

Figure 4: Standing water in area compacted by mowing or maintenance

Figure 5: View of south half of parking with grate inlets at islands

Figure 6: Principal spillway CMP pipe

Sign Corner: Intersection of Pt Lookout Road & Great Mills Road

Site Description:

Large signaled 3-way intersection with curb inlets. Curb inlets drain to open areas:

- South bound Pt lookout Rd curb inlet to a flat area adjacent to stream;
- North bound Pt Lookout Rd curb inlet to a flat area encumbered by advertising signs adjacent to stream;
- North bound Great Mills Road curb inlet to low wooded area with subtle channels leading to stream

Proposed Retrofits:

1. Southbound Pt lookout Rd curb inlet - bioretention cell:
    a. Construct "flow-through" curb inlet on either side of existing curb inlet.
    b. Shallow excavation of area behind curb inlet to create bioretention cell.
    c. Daylight underdrain (if needed) into adjacent stream.
2. North bound Pt Lookout Rd curb inlet- bioretention cell:
    a. Establish drainage area to determine if "flow-through" curb inlet on either side of existing curb inlet is justified (if retrofit #3 is implemented, upstream flow on west side may be greatly reduced).
    b. Shallow excavation of area behind curb inlet to create bioretention cell; will require careful coordination with existing signage, possible utilities, and selective thinning of existing volunteer woody vegetation.
    c. Daylight underdrain (if needed) into adjacent stream.
3. North bound Great Mills Road curb inlet - bioretention cell:
    a. Construct "flow-through" curb inlet upstream side of existing curb inlet.
    b. Shallow excavation of area behind curb inlet to create bioretention cell; will require careful grading to avoid existing large trees.
    c. Daylight underdrain (if needed) into adjacent stream.
4. Alternate north bound Great Mills Road curb inlet – water quality berm:
    a. Construct permeable berm along contour lines (similar to level spreader swale configuration) and through existing large trees.

Information Needs:

1. Hydraulic designs of existing drainage system to verify coordination with MD SHA
2. As-built inverts and/or design plans for existing drainage system to verify
3. Verification of utilities
4. Drainage area to each location for sizing
5. Soils information to establish underdrain requirements
6. Relative elevations to establish quantities of materials
7. Design/sizing criteria and specifications for water quality berm

Figure 1: Overhead View – intersection of Pt Lookout Road & Great Mills Road

Figure 2: Sump curb inlet – south side of Pt Lookout Road; looking south-east with retrofit area in view

Figure 3: Sump curb inlet – looking south; bioretention retrofit area in background

Figure 4: Sump curb inlet – north side Pt Lookout Road; looking north-east; possible retrofit area to the left

Figure 5: On-grade curb inlet east side Great Mills Road; looking north up south-east with retrofit area in view

A&E Motel

Site Description:

The A&E Motel on Great Mills Road drains to a ditch that runs along the eastern and southern property line immediately adjacent to the building. The total drainage area (including the developed areas further to the north across S Essex Drive, and roadway drainage from Great Mills Road) exceeds the capacity of the ditch and floods the adjacent motel rooms.

Proposed Retrofits:

The only viable options for reducing the channel flooding are to:

1. Implement stormwater attenuation in the upstream drainage areas (mostly built out and few opportunities for significant volume reduction or peak flow attenuation; or
2. Improve the channel conveyance capacity by either enclosed pipe or concrete channel from Great Mills Road to the receiving channel at the far south-west corner of the A&E property.

Figure 1: Overhead View – A&E Motel


Figure 2: Interior courtyard (sump with drain under building at left background


Figure 3: Roadway drainage contributing to ditch


Figure 4: Start of ditch at north-east corner of property (looking south)


Figure 5: Courtyard drainage entering ditch from under building


Figure 6: Full length of ditch along east side of building (draining towards camera). Large storm drain contributing to flow at left.


Figure 7: Continuation of Ditch around back of motel.


Figure 8: Receiving channel – Compliance Corp stormwater discharge enters from the left in the background)

Appendix F:
COMPLETED FIELD FORMS

Appendix G:
2002 CWP Retrofit Inventory