# State of Our Watersheds

## The 2005 Conference for the Baltimore Region

October 15, 2005

Loch Raven High School

Baltimore, Maryland

Sponsored by the Baltimore DPW and
Baltimore County DEPRM

# STATE OF OUR WATERSHEDS
# THE BALTIMORE REGION
OCTOBER 15, 2005

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# INTRODUCTION

This October marks the third anniversary of the signing of the Baltimore Watershed Agreement. The signing of the Baltimore Watershed Agreement was the impetus for creating the State of Our Watersheds conference. It also requires the preparation of the annual State of Our Watersheds report. A change in this year's report is the omission of the section on monitoring results. During a review by staff it was decided to wait for more data collection and then recreate the maps at that time. An analysis of trends is also planned for the future as more data becomes available.

An outline of the monitoring programs maintained by Baltimore City and Baltimore County is again included in the report. A new addition this year is in section IV. This year's report has been adapted to reflect the theme of this year's conference, impervious surfaces. Section IV includes subtopics on measuring impervious surfaces, the affect of scale on impervious surface amounts and the assumptions derived from the Impervious Cover Model. An analysis of water quality data collected by Baltimore City and County supports the compelling research that increases in impervious surfaces result in negative impacts on the water quality of the region's streams.

This year's report contains a more in depth update on the Total Maximum Daily Loads (TMDLs) for the watersheds in the Baltimore region. The State of Maryland has been aggressively preparing models for the TMDLs throughout the state. Each stream system in Maryland will be monitored and modeled for impacts from several different pollutants. The results will determine the stream systems that will be listed as impaired waters. Local jurisdictions along with the State will then determine strategies that will be used to reduce the impact of the specific pollutants from the stream system. The approaches must aim at a removal of the stream system from the impaired waters list.

Section VII updates the progress of Baltimore County and Baltimore City's capital restoration programs. Both jurisdictions are constantly searching for innovative ways to make restoration advancements in a highly urban environment. The types of projects are progressing beyond standard best management practices. Localized projects in Baltimore City include the removal of unused asphalt from school sites, community greening projects, and the intensive community awareness and activities in watershed 263. Expansive projects in Baltimore County include mile long stream restoration projects and a substantial reforestation program growing in the rural areas of Baltimore County.

An update on the watershed planning efforts by both Baltimore County and Baltimore City is included in section VIII. This also highlights the cooperative efforts that the two jurisdictions have initiated. A summary of this year's activities of volunteer organizations in the Baltimore Region has been provided. The accomplishments of the region's local citizens are admirable, impressive and creditable in the overall restoration efforts for the Chesapeake Bay. The resource list continues to be modified and updated and at the end of the report a copy of the Baltimore Watershed Agreement is included.

Thank you to the participants in this year's conference. Once again we can celebrate the accomplishments of the past year and prepare for more in the coming years.

# BALTIMORE COUNTY MONITORING PROGRAMS

## Introduction

Baltimore County has developed an integrated monitoring program to meet regulatory and non-regulatory program requirements, support watershed planning efforts, and to assess the effectiveness of restoration. Chemical, physical and biological components of stream systems are monitored. These components are monitored for regulatory programs that include: the National Pollutant Discharge Elimination System (NPDES) – Municipal Stormwater Discharge Permit Program, the Total Maximum Daily Load (TMDL) Program, and stream restoration permit requirements. The non-regulatory programs include the Chesapeake Bay Tributary Strategy Program, Coastal Zone Management, and the Reservoir Management Program.

The monitoring programs provide information on the existing condition of stream water quality and channel stability, biological resources, and help determine trends over time. A brief description of each monitoring program element is provided below.

## NPDES Permit Monitoring

The current NPDES – Municipal Stormwater Discharge Permit is Baltimore County's third five-year permit. It runs from June 15, 2005 through June 15, 2010. The permit specifies monitoring requirements that are detailed below. Additional non-specified monitoring requirements are included in the permit in general terms, such as, monitoring Best Management Practice (BMP) for effectiveness. Our entire monitoring program addresses the non-specified monitoring requirements.

### *Long Term Monitoring Site - Scotts Level Branch*

These waters are 303(d) listed as impaired by nutrients, suspended sediments, fecal coliform bacteria, and biology. A TMDL is being completed that identifies a reduction of 15% of the current nitrogen and phosphorus loads. The requirements of Baltimore County's 2005 NPDES permit call for a long-term project that will monitor the effects of numerous BMP projects separately and cumulatively planned for the Scotts Level subwatershed upstream of Rolling Road. A paired watershed monitoring approach is being set up to factor out climatic effects using Powder Mill Run (similar size and land use) – nearby, and also in the Gwynns Falls watershed. This monitoring effort will replace Spring Branch that studied the effects of a single stream restoration project. Chemistry, biology, geomorphology, and discharge will be monitored.

Chemistry: To be monitored at two USGS gages (storms and baseflows), and additional baseflows will be monitored at selected other sites on a monthly basis. For storms, grab samples will be collected at ~30 minute intervals for 12 storms during the first year. Later years' samples will be collected over a range of discharges to develop estimated mean concentrations (EMCs). These, when combined with discharge, can calculate event and annual pollutant loads. Storm loads combined with baseflow loads will give total loads for the watershed covered.

Geomorphology: A total of 30 randomly selected permanent cross-sections will be monitored on the two streams. The yearly data will be plotted and overlaid with prior

years to detect channel changes. Also, three longitudinal profiles will be established and monitored yearly in Scotts Level Branch. Soil core samples will be taken from the banks and bed in the vicinity of the cross-sections. Samples will be analyzed for bulk density, particle size distribution, total nitrogen and total phosphorus. These results will be used to estimate annual sediment, nitrogen, and phosphorus load contributions that can be compared with the chemical sampling results.

Biology: Benthic invertebrates will be sampled at every other cross-section annually in the spring using the Maryland Biological Stream Survey (MBSS) methodologies. Also, fish assemblages will be done at selected sites in the summer. The biological results will be compared with the other types of data for both streams.

***Stormwater Management Design Manual Effectiveness – Windlass Run***

The NPDES permit requires monitoring of a subwatershed for geomorphologic impacts resulting from development utilizing the revised Stormwater Management Design Manual (effective 2000). The results of a countywide screening for a suitable location, followed by field verification, led to the selection of Windlass Run as the monitoring subwatershed.

The Windlass Run subwatershed has the potential for a large area of future development. The level of imperviousness in the subwatershed is currently about 3%, and is expected to increase to over 20%. The extension of MD route 43, currently under construction, will open this area to development. The level of future development in the Windlass Run subwatershed would be expected to have a severe impact on the water quality and the channel stability without stormwater controls. Stormwater management for the development that will occur in this subwatershed will be designed in accordance with the new Stormwater Management Design Manual. The new stormwater management requirements should be more protective of the stream system. This study will determine the level of protection that is provided by the new requirements.

The geomorphic monitoring consists of a channel cross-section measurement, a channel slope/profile measurement and a Wolman pebble count. Fish assemblage and macroinvertebrate monitoring sites have been established. A water level gage has been installed to measure changes in the discharge rate.

***Illicit Connection Monitoring***

The County is required to screen a minimum of 150 storm drain outfalls annually for the purposes of detecting and removing unpermitted discharges to the storm drain system. The Watershed Management and Monitoring Section of DEPRM is responsible for performing the outfall screenings, reporting screening data, and coordinating remedial actions. However, specific correction measures may be the responsibility of the Department of Public Works (DPW), DEPRM, or both, depending upon the nature and sources of detected discharges. If there are indications that existing permit limits are being exceeded, or that there are unpermitted discharges, the cases are referred to the Maryland Department of the Environment (MDE) for permitting or enforcement. Water main leaks are referred to Baltimore City Department of Public Works for correction. Because chlorine is extremely toxic to the fauna in a stream, it is of particular concern

when leaks or discharges occur from the public distribution system. Sanitary sewer leaks are referred to Baltimore County Department of Public Works for correction.

## Chemical and Discharge Monitoring

Chemical monitoring provides a snapshot of the chemical condition of the streams within Baltimore County at the time of the sample. In association with the measurement of stream flow it is possible to calculate the pollutant loads for each of the measured chemicals. The chemical condition of the stream water is usually different between dry weather flow (baseflow) and storm flow. The programs described below are designed to measure water quality for both weather conditions. The data will allow a determination of current (ambient) water quality and, over time, any trends in water quality.

### *Baseflow Monitoring Program*

Baltimore County initiated a baseflow monitoring program in 1999. The initial effort was targeted at watersheds that were undergoing, or about to undergo, water quality management plan preparation. In 1999, the targeted watersheds included the Lower Gunpowder, the Little Gunpowder, the Middle River and the Baltimore Harbor watersheds. The data was used in the calibration of the Storm Water Management Model (SWMM) pollutant load models that were included in the Water Quality Management plans. In the fall of 2000, the baseflow monitoring was shifted to the Back River, Jones Falls and Gwynns Falls watersheds. The shift was intended to address the lack of chemical monitoring information available for these watersheds. These watersheds were monitored until the spring of 2001. Insufficient staff curtailed the continuance of the baseflow monitoring program until the spring of 2003.

The baseflow monitoring program, which resumed in 2003, was also redesigned. Baseflows are monitored in the Patapsco/Back River Basin in odd-numbered years, while the Gunpowder Basin/Deer Creek are monitored in the even-numbered years. Approximately ten sites in each of the six watersheds in the Patapsco/Back River Basin were selected and monitored in 2003. During 2004, 62 sites distributed over 7 watersheds in the Gunpowder Basin/Deer Creek were monitored, and in 2005 the Patapsco/Back River Basin sites are again being monitored. The sites are normally monitored from six to eight times during the sampling year.

This design will allow the County to determine ambient water quality for major portions of each watershed. The two-year sampling cycle will also allow an analysis of baseflow water quality trends for the pollutant parameters analyzed.

### *Chemical Trend Monitoring Program*

The Chemical Trend Monitoring Program was initiated in 2003 as a pilot program. The monitoring plan was to conduct storm flow sampling at US Geological Survey (USGS) gage sites throughout Baltimore County. Due to staffing constraints this effort was scaled down to focus on the Prettyboy Watershed. Currently three USGS gage station sites are monitored on tributaries to the Prettyboy reservoir: Graves Run, George's Run, and Gunpowder Falls at Hoffmanville. Grab water quality samples are collected during both baseflow and storm events to represent the range of flow experienced at the gages. Twenty to thirty grab samples are collected at each gage during the course of each calendar year. The discharge (flow) data for each gage is obtained from USGS and the

chemical monitoring results are matched to the discharge based on the time and date of sampling. The data is then analyzed to determine the relationship between pollutant concentration and discharge rate at each gage for each pollutant. The equation derived from the analysis is applied to the annual discharge data for each gage to derive the pollutant concentrations for each fifteen-minute interval. The data can be converted to pollutant loads to determine the annual pollutant load delivery at each gage. The yearly data is analyzed for trends in both the pollutant concentrations and the pollutant loads.

### *Joint Agency Monitoring*

During the past year the City of Baltimore and Baltimore County worked together to achieve benefits from cooperative opportunities. These agencies, along with UMBC and the Center for Watershed Protection, have secured federal grant funding for a cooperative project to characterize the pollution delivery from streets to the waterways via storm drain systems. Part of this effort will study pollution removal by street sweeping and inlet cleaning management measures. This will be a two-year study.

Also, this year, City and County staff conducted a joint sampling event. Following a written protocol, staff from both agencies met at several stream locations and jointly took baseflow samples. These samples were subsequently taken to their respective laboratories for analysis. The results will allow comparison of the data collected and analyzed by the labs. The objective is to demonstrate and achieve sampling data in the future that will be comparable between the two agencies.

Finally, Baltimore County and the City of Baltimore have collaborated over the past three years to produce the State of Our Watersheds conference and report.

### *Tidal Waters Monitoring Program*

Baltimore County has had a tidal recreational water monitoring program since 1990. The program is administered by the Department of Environmental Protection and Resource Management – Environmental Health Section. The program has historically focused on fecal coliform concentrations, but has recently switched to enterococci as the bacteriological indicator. The beach swimming standard of 35 MPN is used for comparison purposes to assess the general bacteriological water quality. Fecal coliform and E. coli may be measured in the event of a sewage spill/release to provide as much information as possible to characterize the potential public health threat. Starting in 2002, surface water quality samples were obtained at seven tidal water sites representing the various major tidal basins in Baltimore County.

## Stream Geomorphologic Monitoring

Geomorphologic monitoring refers to the measurement of the physical characteristics of the stream (stream width, depth, various bank stability measures, etc.) The data are used to determine the physical stability of the stream channel.

### *Stream Stability Assessments*

A component of the water quality management plans prepared for ten of the fourteen watersheds in Baltimore County is an assessment of stream stability using stream geomorphologic measurements. This monitoring allows the County to determine

the miles of degraded stream channel in need of restoration. The eventual goal is to assess all the streams within the County.

Additionally, DEPRM has secured consulting assistance through a multi-year on-call contract to perform planning level stream stability assessments on various streams in Baltimore County. These assessments will entail field teams who will "cruise" (by walking) assigned stream reaches collecting morphological, riparian, habitat quality, and other data useful in making evaluative assessments of stream condition and evidence of change. Other information will be collected related to infrastructure conflicts, pollution sources, fish blockages, etc. The stream assessments will be used in support of the Small Watershed Action Plan (SWAP) process and TMDLs; for comparison of baseline conditions and stream management/restoration needs; and for consideration of potential stream restoration projects. To date the field work for the Goodwin Run - Hunt Valley – Loveton Small Watershed Action Plan streams has been completed and the report is being written.

***Stream Restoration Geomorphologic Monitoring***

The stream restoration permit requirements by the U.S. Army Corps of Engineers and the Maryland Department of the Environment include post construction monitoring of each project. Monitoring is also utilized to determine if the project met its goals. Post construction monitoring also provides feedback that enables improvement of subsequent project designs and construction approaches.

Post construction monitoring requires periodically collecting field data – usually annually for 2 to 5 years and occasionally additional monitoring after large storms. In most cases, channel cross-sections are monumented and surveyed at points along the project. For multi-year surveys plots are overlaid (current year over prior years) to detect any changes in morphology that may have occurred between these periods. Other components that may be included in the monitoring plan and report include: bed material characterization via the Wolman pebble count procedure, inspection of the condition of any riparian plantings, visual inspection of the degree of channel erosion or deposition etc., and photographing the channel and banks at key locations.

## Biological Monitoring

In addition to the biological monitoring required at Scotts Level Branch under Baltimore County's NPDES permit, the County has three additional stream related biological monitoring programs. These programs use the biological community to assess the ecological health of the streams within the County (Probabilistic Monitoring Program), assess the effectiveness of stream restoration projects (CIP Monitoring Program), and provide data on the best streams in Baltimore County to serve as bench marks (Reference Site Monitoring Program). A fourth volunteer based monitoring program (Stream Watch Program) will be implemented in the near future. The assessments are based on the benthic macroinvertebrate community and fish assemblage. It is widely accepted that the biological community composition of streams is sensitive to human disturbances. By monitoring the biological community, the County can assess the amount of change due to human impacts and the benefit of stream restoration to the organisms in the streams. In addition to the above, the County monitors the extent of

submerged aquatic vegetation (SAV) occurrence in its coastal waters. The biological monitoring programs are described in more detail below.

***Probabilistic Macroinvertebrate Monitoring – 100 Random Points***

The County has determined that adopting the MBSS methodologies and identification to the taxonomic genus level will result in data that is directly comparable with State generated data. This will expand upon the available data for assessing county waters. Randomly selected sites for monitoring (probabilistic monitoring) will allow statistically valid statements regarding the state of the waters.

The County has contracted with a consultant to perform the probabilistic monitoring. Each year a different basin will be sampled: the Patapsco/Back River basin will be sampled in odd numbered years, and the Gunpowder River Basin and Deer Creek watershed will be monitored in even years. One hundred sites will be selected at random for each year's sampling efforts. One hundred sites were randomly selected from the stream miles in the Patapsco/Back River Basin for sampling in 2003 & 2005, and 100 sites were selected for the Gunpowder/Deer Creek Basins for 2004. The contractor samples these 100 sites for macroinvertebrates during the spring index period, March 1 to April 30, using the protocols for the Maryland Biological Stream Survey (MBSS). A Benthic Index of Biotic Integrity (BIBI) has been calculated for the samples collected in 2003 and 2004 that describes the condition of the biological community in the streams of the county.

***Capital Improvement Projects Monitoring***

Baltimore County has been monitoring benthic macroinvertebrates in conjunction with several capital improvement stream restoration projects. Monitoring is performed in the stream segments where the restoration takes place. The segments are monitored pre- and post-construction to document any change in the biological community. Eight sites are currently being monitored under this program.

Starting in spring of 2003 the sampling protocols were changed from kick-net sampling, as per U. S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocols II (RBP II), to d-net sampling, as per MBSS. Samples are taken during the spring index period, March 1 to April 30, and are identified to genus or the lowest possible taxonomic level.

The permits for a number of stream restoration projects require biological monitoring for both benthic macroinvertebrates and fish assemblage. The current projects with these requirements are Minebank Run Phase II stream restoration, Un-named Tributary to Jones Falls near Wood Valley and East Branch Honeygo Run. The pre-construction samples have been collected.

***Reference Site Monitoring***

Baltimore County has been monitoring eight reference sites in the county since spring of 2001. The County's geographic Information System (GIS) was used to identify watersheds within the County that contained greater than 50% forested land use and less than 20% urban land use. Based on the GIS data, 21 sites met the land use criteria and were selected for chemical and physical habitat analysis. These sites were then evaluated for physical habitat, and chemical grab samples were taken. After the initial assessment

using criteria based on the physical habitat and chemical results, thirteen of the sites were eliminated.

The remaining eight sites were then sampled for benthic macroinvertebrates in the spring, summer and fall of 2001 and 2002. Sampling was performed according to USEPA RBP II. This sampling methodology uses a kick seine collection method with picking a minimum of 150 organisms in the field. The samples were identified in the laboratory to genus or the lowest practical taxonomic level. In the spring of 2003 sampling protocols were changed to MBSS protocols.

***Volunteer Biological Monitoring***

Baltimore County has, in the past, contracted with Maryland Save Our Streams (SOS) to collect benthic macroinvertebrate samples at 144 sites throughout the County. Maryland Save Our Streams used citizen volunteers to collect samples all across the County at fixed stations using the EPA Rapid Bioassessment II Protocols. This included sampling with a kick seine, sorting a minimum of 150 organisms from a sample in the field, and identification to the taxonomic family level. The contract was completed on June 30, 2002. The results from this program were presented at the 2003 conference.

Future volunteer biological monitoring opportunities will be available through the "Stream Watch Program" that is currently being developed, and biological monitoring associated with the development of the Small Watershed Action Plans.

***Habitat – Submerged Aquatic Vegetation***

Submerged Aquatic Vegetation (SAV) is found in the shallow waters of the Chesapeake Bay. In Baltimore County, these plants commonly include Vallisneria americana (wild celery), Myriophyllum spicatum (Eurasian watermilfoil) and Elodea canadensis (common waterweed), and others. SAV grasses are good indicators of the water quality conditions of our waterways. They provide critical food, shelter, and nursery grounds for many species of shellfish, finfish, waterfowl, and other organisms. These grasses also stabilize the sediments and incorporate oxygen into the water. SAV is sensitive to pollution, especially suspended sediments that reduce sunlight needed for photosynthesis. High nutrient levels can also reduce light penetration when they stimulate dense phytoplankton blooms that block sunlight.

SAV density and distribution are monitored by Baltimore County in its tidewater areas in the spring and summer of each year. County waterways are surveyed by boat by paddling the shallow areas and motoring in deeper waters. The presence or absence and density of SAV are determined by several methods. Visually, the presence or absence of SAV can be observed on the bottom in shallow water or in areas where the tops of plants are near the surface. In waters from 5 to 7 feet deep, a long handled rake is used to rake 2 to 4 square foot areas in random grid patterns. In waters deeper than 3 feet deep, a tethered rake was also frequently towed along the bottom. The shoreline and creek surface is also monitored for floating pieces of SAV, an indication of SAV presence, although not necessarily from the specific area. SAV densities are recorded based on the Virginia Institute of Marine Science (VIMS) Annual Distribution Studies measurement system. Density is estimated based on crown cover.

# BALTIMORE CITY MONITORING PROGRAMS

## Introduction

Baltimore City has two separate water quality monitoring programs: source water monitoring in the watersheds of the water supply reservoirs, and monitoring related to Baltimore City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Discharge Permit. These are both long-term monitoring efforts. Data collected by this monitoring is used to look for trends over time in addition to its use in the assessment of current water quality.

## Source Water Monitoring

### *Liberty, Loch Raven and Prettyboy Reservoirs In-Lake Monitoring*

Baltimore City samples these reservoirs to determine water quality problems; to monitor trends related to restoration and/or perturbations (e.g., development, drought) in the watershed; to better understand the environmental conditions that result in algal blooms, which cause taste and odor problems in the water supply and cause higher levels of disinfection byproducts; and to determine the relationship between in-lake stations and raw water at the treatment plants.

There are 12 in-lake reservoir monitoring stations distributed among these three reservoirs. At each of these stations, a vertical series of samples and field measurements are taken at discrete depths in the water column. Some stations, including the primary sampling stations located near the raw water withdrawal intakes, are sampled in all seasons. The primary stations are sampled more frequently than the other stations. Baltimore City maintains a database of the sample results going back as far as 1981.

### *Reservoir Tributary Monitoring*

Baltimore City samples at 16 stations on tributaries to these reservoirs in order to monitor trends in nutrient and sediment loadings; to relate these trends to activities in the watershed (drought, development, restoration); to relate tributary loadings to receiving water data; and to identify pollutant sources. Baltimore City partially funds the U.S. Geological Survey to maintain flow gauging stations at 11 of these stations. Each month, during dry weather, a baseline sample is collected at each station. In addition, whenever possible, stormwater samples are collected at 6 of these stations using automated samplers. Baltimore City maintains a database of the sample results going back as far as 1982.

## Monitoring Related to NPDES Stormwater Permit

### *Stream Restoration Monitoring*

<u>Moores Run Long-term Discharge Characterization</u>

*Chemical Monitoring*: Baltimore City began sampling and the U.S. Geological Survey began measuring flows at the stream station at Moores Run at Radecke Avenue and the nested station at Hamilton (Todd) Avenue in 1995. The goal is to monitor at least 12 storm events per year at both stations. Automated samplers are used to collect discrete samples and samples are selected to represent the ascending, peak and descending limbs

of the storm. Event mean concentrations (EMCs) are calculated using the flow data and the discrete sample results. In addition to the storm samples, baseline (dry weather) samples are collected monthly. This data is used to characterize runoff, estimate annual pollutant loads, and monitor trends in loadings and relate these to changes in the watershed (e.g., development, restoration).

*Biological Monitoring:* Annual fish and benthic invertebrate sampling is conducted at 4 stations that are associated with the long-term discharge characterization monitoring at the Hamilton Avenue and Radecke Avenue stations.

*Physical Monitoring:* This includes geomorphologic stream assessment and stream habitat assessment. The City contracted with the U.S. Fish and Wildlife Service (USF&W) to conduct a detailed geomorphologic stream assessment of the Moores Run upstream of the monitoring station at Radecke Avenue, and to develop standard operating procedures for conducting similar assessments in future years. USF&W completed its first survey in October 2003. In May 2004, USF&W published the physical monitoring standard operating protocol they developed for Baltimore City. The USF&W conducted a second survey of the Moores Run in the summer of 2005. Baltimore City conducts an annual habitat assessment survey of the upper Moores Run watershed. The survey area covers Moores Run from the newly constructed quadruple cell outfall at Hamilton Avenue downstream to Radecke Avenue, and the Moores Run tributary at Todd Avenue.

Biddison Run

Baltimore City collects monthly baseline (dry weather) samples and annual fish and benthic invertebrate samples at the two Biddison Run stations that are associated with the planned restoration. Information on this project can be found in Section VII under "Herring Run Watershed Capital Improvements- Open Channel Improvements Biddison Run". Sampling began at these stations in October 2002. See the topic below "Partnerships with Volunteer Organizations" for a discussion of the partnership between Baltimore City and the Herring Run Watershed Association (HRWA) in collecting the baseline samples.

Stony Run

Baltimore City established the Linkwood stormwater monitoring station in Stony Run to use for both the Maryland Stormwater Design Manual monitoring and assessing future restoration in Stony Run. Another sampling station, Idlewylde, was established on the West Branch of the Herring Run in Baltimore County to use a control for this study. The U.S. Geological Survey provides flow monitoring at these two stations. The first monthly baseline (dry weather) samples from these two stations were collected on June 14, 2005, and the first stormwater samples were collected June 29, 2005. The U.S. Fish and Wildlife Service submitted a proposal to conduct a limited geomorphic stability assessment in the Stony Run. The survey work will be done in the summer of 2005.

Watershed 263

Baltimore City began collecting storm composite samples and weekly grab (mostly dry weather) samples in September 2004 at the monitoring stations at Lanvale Street and Baltimore Street. This sampling is done in partnership with staff from the Baltimore Ecosystem Study.

### *Pilot Area Street Sweeping Study*

This study was conducted between July 2002 and June 2004. The area chosen to study was the watershed upstream of the Hamilton NPDES stormwater monitoring station. This area contains 12 acres of street surface. The purpose of this study was to estimate the contaminant loadings contained in debris collected by street sweeping. Baltimore City is participating in a new street sweeping study with the Center for Watershed Protection, Baltimore County and U.S. Forest Service in Watershed 263. The results from this study should be available in two years.

### *Biological Monitoring*

Baltimore City conducts sampling for fish and benthic invertebrates within three of the four major watersheds- Gwynns Falls, Jones Falls and Herring Run- using a combination of random and fixed site sampling. Each year one major watershed is chosen for the random sampling- thirty random sites are chosen for that watershed. The purpose of this program is to monitor trends in fish and benthic invertebrate communities in Baltimore City streams associated with restoration and/or environmental perturbation; and to measure the health of living resources for targeting restoration.

### *Dry Weather Monitoring*

Baltimore City conducts two types of dry weather chemical screening surveys: stream impact sampling (SIS) and ammonia screening (AS). SIS began in May 1997, and AS began in September 1998. The data from these surveys are used primarily for the detection of illicit discharges. The data is also used for trends over time analyses, and to look for changes in ambient water quality associated with changes in the watershed (e.g., restoration).

Currently there are 36 SIS stations, and 46 AS stations (33 stations are visited for both SIS and AS). SIS surveys are done once per month, and AS surveys are done three to four times per month. For both surveys, field measurements are taken of ammonia, chlorine, conductivity, dissolved oxygen, pH and water temperature. For SIS, additionally a stream sample is collected and is analyzed by the labs for 15 parameters, including nitrogen, phosphorus, metals and fecal coliform counts. During 2004, Baltimore City made 1,740 station visits for a total of 16,290 water quality parameter measurements.

When the survey results point to a possible illicit discharge, a Pollution Source Tracking (PST) investigation is begun. Occasionally, PST investigations are generated by citizen complaints. It should be noted that some investigations are discontinued because the pollution trail is lost or becomes indeterminate. Often this is due to the intermittent nature of the pollution source.

### *Exterior Lead Paint Removal Waste Control Program*

Baltimore City requires a permit for exterior lead paint removal work. In 2004 fines were increased for working without a permit. In addition, language was added to the City's Building Code that requires a minimum bond posting when obtaining a permit. During 2004, 568 sites were permitted. Baltimore City conducted 246 site inspections that resulted in 87 stop work notices and the documentation of 6 illegal discharges.

***Partnerships with Volunteer Organizations***

The Jones Falls Watershed Association (JFWA) conducts ammonia screening in the Jones Falls Watershed. This is a voluntary effort. Baltimore City supplies JFWA with reagents for the tests used in the field. When JFWA finds a new problem in the streams, they inform Baltimore City, and Baltimore City investigates.

Baltimore City approved a contract with JFWA in February 2005 for $12,500 to perform outreach services relating to the stream restoration projects in Stony Run. JFWA will involve area residents, students and others in a process of participation to keep these communities informed and involved in these restoration projects.

Baltimore City had the assistance of the Herring Run Watershed Association (HRWA) in collecting monthly samples at the two Biddison Run stations that are associated with the planned restoration (see Section VII under "Herring Run Watershed Capital Improvements- Open Channel Improvements Biddison Run"). Sampling began at these stations in October 2002. For the first three-year contract HRWA was paid $9,000. Baltimore City renewed its contract with HRWA on March 30, 2005, for another three years for $14,040. HRWA also collected the dry weather stream impact samples (SIS) in the Herring Run Watershed from March 2004 through February 2005, and was paid $12,000 for this service. Baltimore City approved a new contract with HRWA on July 15, 2005, for $15,868 for one year to help with ammonia screening in the Herring Run.

# IMPERVIOUS SURFACE AND BALTIMORE STREAMS

In recent years much effort has been expended in increasing our understanding on how impervious surfaces affect our streams, lakes, and reservoirs. This section will discuss our understanding of impervious surface impacts and how impervious surfaces in Baltimore City and Baltimore County watersheds affect our aquatic resources.

## What are Impervious Surfaces and How are They Measured?

***Impervious surfaces*** are those surfaces that prohibit rain or snow melt from soaking into the ground. They include such things as roads, parking lots, driveways, sidewalks, and roofs. In winter frozen ground can act as an impervious surface and many urban soils are so compacted that they also can act as an impervious surface. Impervious surface cover is often expressed as a percent cover of a watershed, subwatershed or drainage area and may be called ***total impervious cover***. Additional terms that may be encountered are ***directly connected impervious cover*** and ***effective impervious cover***. These terms refer to impervious cover that drains directly to a storm drain system or water body. If the down spouts from your house direct water to your driveway or the road, then your rooftop is part of the directly connected impervious cover. If those down spouts direct water to your yard, then they are not part of the directly connected impervious cover. The stormwater has a chance to soak into your yard and thereby reduces the amount of water directed to the stream and allows pollutants to be adsorbed.

There are a number of ways to estimate the amount of impervious surface within a watershed including, satellite imagery, land use and associated percentages, and direct measures of roadway, parking lot and building footprints. The different methods of calculating impervious cover will be presented and Scotts Level Branch subwatershed in the Gwynns Falls watershed will be used to demonstrate how to calculate the impervious cover by each method.

### *Satellite Imagery*

Satellite imagery uses different bands of light reflected from the earth's surface to determine impervious surface. A satellite image is made up of many units called pixels, like the dots that make up a photograph. The size of a pixel is ~90 feet on a side, or ~1/5 of an acre. Typically, a person analyzing a satellite image will take an aerial photograph and determine what values in the light bands indicate forest, fields and grass, impervious cover, and mixed impervious cover. The person doing the analysis will then check the classification by looking at another aerial and seeing how well the pixel classification works (is the parking lot classified as impervious cover, etc.). Better estimates of impervious cover can be made up developing more breaks in the classification that may correspond to 25%, 50%, 75%, and 100% impervious cover. The more refined the classification the more effort is needed to create the classification and to reduce the uncertainty.

Baltimore County has used satellite imagery to display impervious cover within the county and to provide estimates of the amount of impervious cover. A five category classification was used with two impervious cover categories; impervious cover and

mixed impervious cover. Figure IV-1 shows the satellite image classification for Scotts Level Branch. A mostly forested, stream valley park runs through the middle of Scotts Level Branch watershed. As can be seen from Figure IV-1 only a few areas of the stream valley park show up as forest. This is due in part to the size of the pixels. The forest cover in the park is not very wide in some areas and therefore does not show up in the classification. If we calculate the percent impervious cover using the satellite imagery classification data we find that the estimate of impervious cover is 38.7%.

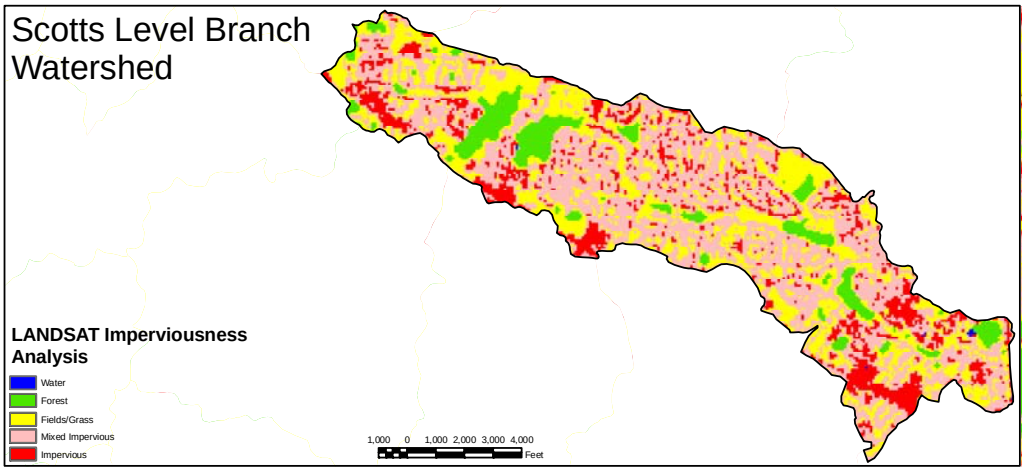



Figure IV-1: Scotts Level Branch Satellite Imagery. Percent impervious cover can be calculated by using the impervious cover associated with each pixel from the image.

### *Land Use*

A number of studies have looked at the relationship between land use and the amount of impervious cover associated with that land use. A study conducted by the Center for Watershed Protection (Cappiella and Brown, 2001) looked specifically at the various land use categories, within the Chesapeake Bay drainage area, and the mean impervious cover associated with each. Table IV-1 is modified from Cappiella and Brown 2001 to include equivalent Maryland Department of Planning land use codes.

Table IV-1: Percent Impervious Cover Associated with Different Land Uses

| Land Use Category | Land Use Code | Sample Number | Mean % Impervious Cover |
|---|---|---|---|
| Agriculture | 21,22,23,25 | 8 | 1.9 |
| Open Urban Land | 18 | 11 | 8.6 |
| 2 Acre Lot Residential | 11 | 12 | 10.6 |
| 1 Acre Lot Residential | 11 | 23 | 14.3 |
| ½ Acre Lot Residential | 11 | 20 | 21.2 |
| ¼ Acre Lot Residential | 12 | 23 | 27.8 |
| 1/8 Acre Lot Residential | 12 | 10 | 32.6 |
| Townhome Residential | 13 | 20 | 40.9 |
| Multifamily Residential | 13 | 18 | 44.4 |
| Institutional | 16 | 30 | 34.4 |
| Light Industrial | 15 | 20 | 53.4 |
| Commercial | 14 | 23 | 72.2 |

As can be seen with from this table, some of the land use codes, for example code 11, which is low density residential is associated with three categories of residential development in the Cappiella and Brown study. The land use is determined by interpretation of aerial photography using a set of rules. Boundaries, using these rules, are created in a Geographic Information System (GIS) to produce a land use map. The Maryland Department of Planning land use data is readily available and is periodically updated. The land use distribution in Scotts Level Branch is shown in Figure IV-2.

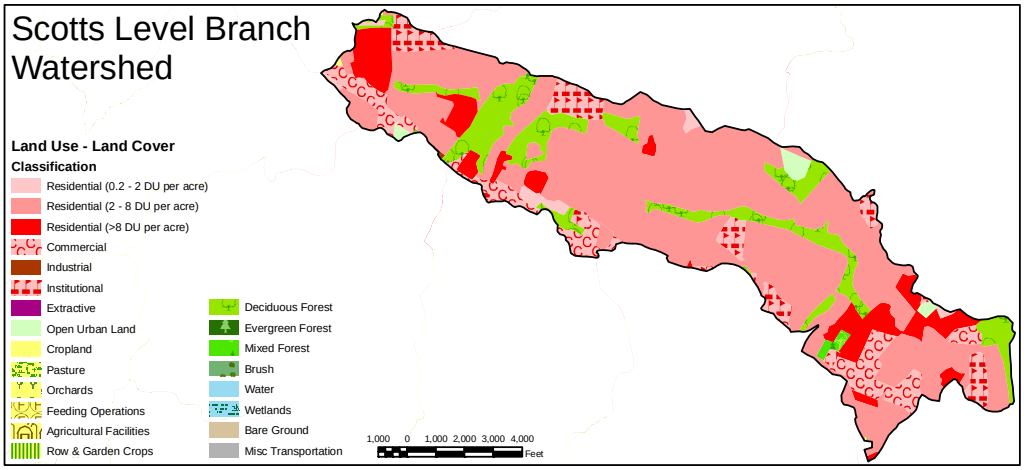



Figure IV-2: Scotts Level Branch Land Use. The land use can be used to calculate the impervious cover by using the percent impervious associated with each land use type.

As can be seen from the figure most of Scotts Level Branch is classified as medium density residential. As in the satellite image analysis, much of the forested stream valley does not show up, mainly because it is a narrow linear feature that does not show due to the rules for creating the land use data layer. If we use the average mean percent impervious cover for each land use we can calculate the overall impervious cover and the total percentage of impervious cover in Scotts Level Branch. That calculation indicates that impervious cover accounts for 30.5% of the land surface in Scotts Level Branch.

### *Building, Roadway, and Parking Lot Footprints*

A final way to calculate the impervious cover in a watershed or drainage area is to use the foot print of the buildings, roads, parking lots, and if available driveways and sidewalks. These foot prints are created by drawing an outline around all of these features from aerial photography in a Geographic Information System (GIS). This is a time consuming procedure and so many jurisdictions do not include sidewalks and driveways in the final data layer. This will result in an under estimate of the amount of impervious in the watershed. Figure IV-3 shows the foot prints of the structures (buildings and sheds) and car habitat (roads, parking lots) in Scotts Level Branch.

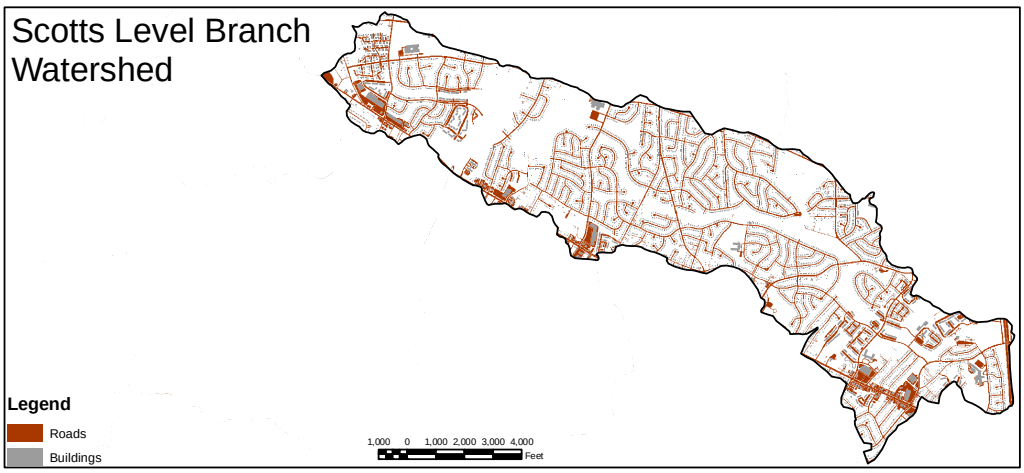



Figure IV-3: Scotts Level Branch Roadway and Building Footprint. The roadway and building footprints can be used to calculate impervious cover directly.

The location of structures is evident in the figure and areas of higher concentration of impervious cover are noticeable along the southern edge of the watershed. These areas represent commercial development (both buildings and parking lots) along the Liberty Road corridor that borders the southern edge of the watershed. By adding up all of the areas for the individual buildings, roads, and parking lots the impervious cover can be calculated for the watershed. This method of calculating impervious cover results in a number of 24.2%. The addition of the sidewalks and driveways would add another several percentage points to the total impervious cover.

As can be seen above the method used to calculate the impervious cover can affect the result ranging from 38.7% for satellite imagery, to 30.5% for land use, down to 24.2% for impervious cover foot prints. The sequence of methods presented represent an increasing level of accuracy, but at an increasing cost due to the staff time required to prepare the GIS data layers. In this report we use the foot print method, which will slightly under estimate the total amount of impervious cover due to the lack of representation of sidewalks and driveways.

## Impervious Surface Impacts on Aquatic Systems

The Center for Watershed Protection has developed an impervious surface model to predict stream quality based on the amount of impervious cover in a drainage area. Stream quality can be a measure of the habitat, the biological community, or the chemical/physical characteristics of the stream. This model is shown graphically in Figure IV-4. The model would predict slight impact in drainage areas with less than 10% impervious cover. These watersheds would be sensitive in that an increase in impervious cover would result in degradation of stream quality. Watersheds that have an impervious cover between 10% and 25% are impacted and would show signs of degradation. The possibility exists to restore these streams to some semblance of a normally functioning stream. When the impervious cover exceeds 25% the streams are usually damaged with much of the stream either piped or channelized. Management of these streams may focus on the reduction of downstream impacts through pollutant load reduction, but the ability

to return the stream to normal functions is remote. Once the impervious cover exceeds 60% in a watershed most of the natural stream system is gone. Again, restoration may focus on protecting downstream resources through pollutant load reduction. In both the damaged and severely damaged streams an additional restoration goal will be to make the remaining stream system aesethically pleasing and an amenity to the community.

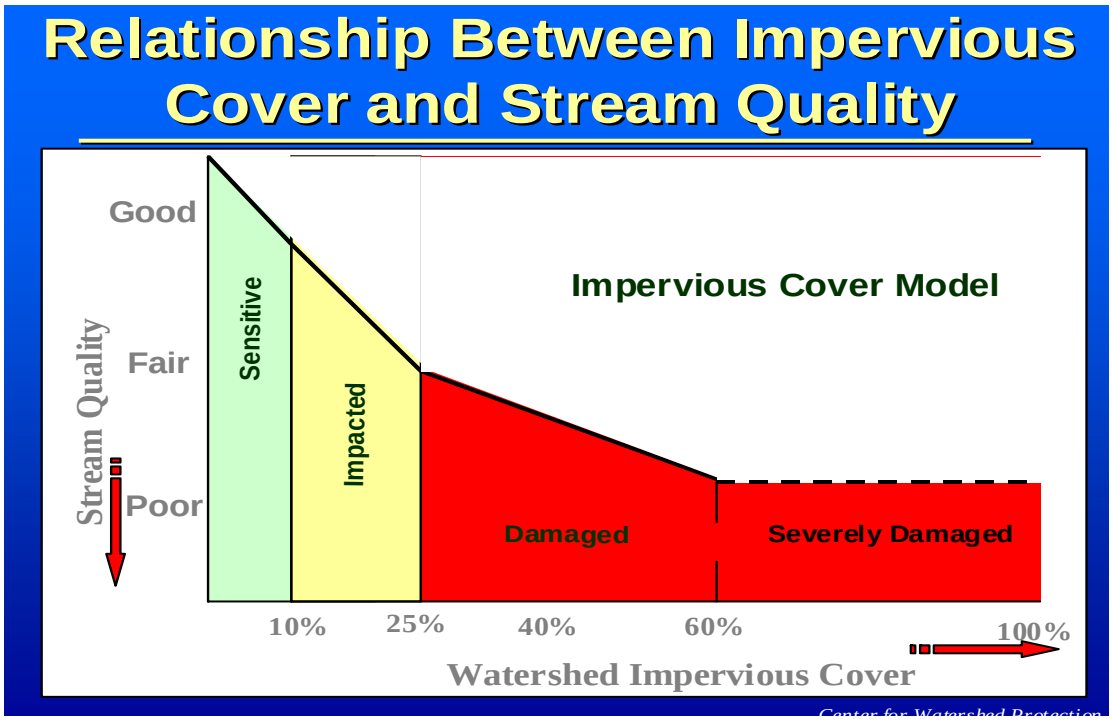



Figure IV-4: Center for Watershed Protection Impervious Cover Model showing the relationship between impervious cover and stream quality.

The following sections look at some of the impacts of impervious surfaces based on local (Baltimore City and Baltimore County) data. Examples of habitat destruction, biological impacts and chemical relationships to impervious cover are presented.

***Habitat Impacts***

Rain that falls on impervious surfaces will not soak into the ground. This rainwater, in urban watersheds, is usually directed to a storm drain system that discharges the water directly into the stream. This results in a greater amount of water in the stream than in a watershed that contains forest cover. This water has a high amount of energy and results in stream erosion that we have all seen in urban watersheds. The stream erosion can result in the degradation of stream habitat. The stream habitat are those areas were aquatic organisms live including the stream bed, banks, leaf litter packs, woody debris and the terrestrial buffer area adjacent to the stream.

Baltimore County contracted with Tetra Tech, Inc. to prepare a Water Quality Management Plan for the Patapsco River within Baltimore County. As part of the preparation of the plan the percent impervious cover was calculated for small drainage areas for use in a hydrologic model. The streams within the planning area were walked and the amount of erosion was recorded. By overlaying the information of stream

erosion on the impervious cover it is possible to look at the relationship between the two. The map on the facing page shows this relationship. The red and green colored streams are impacted streams, while the blue streams had a low amount of erosion. The drainage areas with the darker colors had a higher amount of stream discharge, due mainly to the amount of impervious cover. Almost all of the streams in the darker areas are shown as impacted, while those streams in the light area are show with minimal impacts.

***Biological Impacts***

Baltimore County and Baltimore City both conduct biological monitoring, as has been described earlier in the report. Using the data from the Baltimore County biological monitoring program the relationship between biological condition and percent impervious cover was investigated. The biological condition of a stream is measured by a set of community variables called a Benthic Index of Biological Integrity (BIBI). Figure IV-5 shows the relationship between the BIBI stream condition and the percent impervious cover based on the drainage area for each of the 192 biological monitoring sites. A significant negative correlation of r= -0.68 was found between the BIBI and the percent impervious cover.

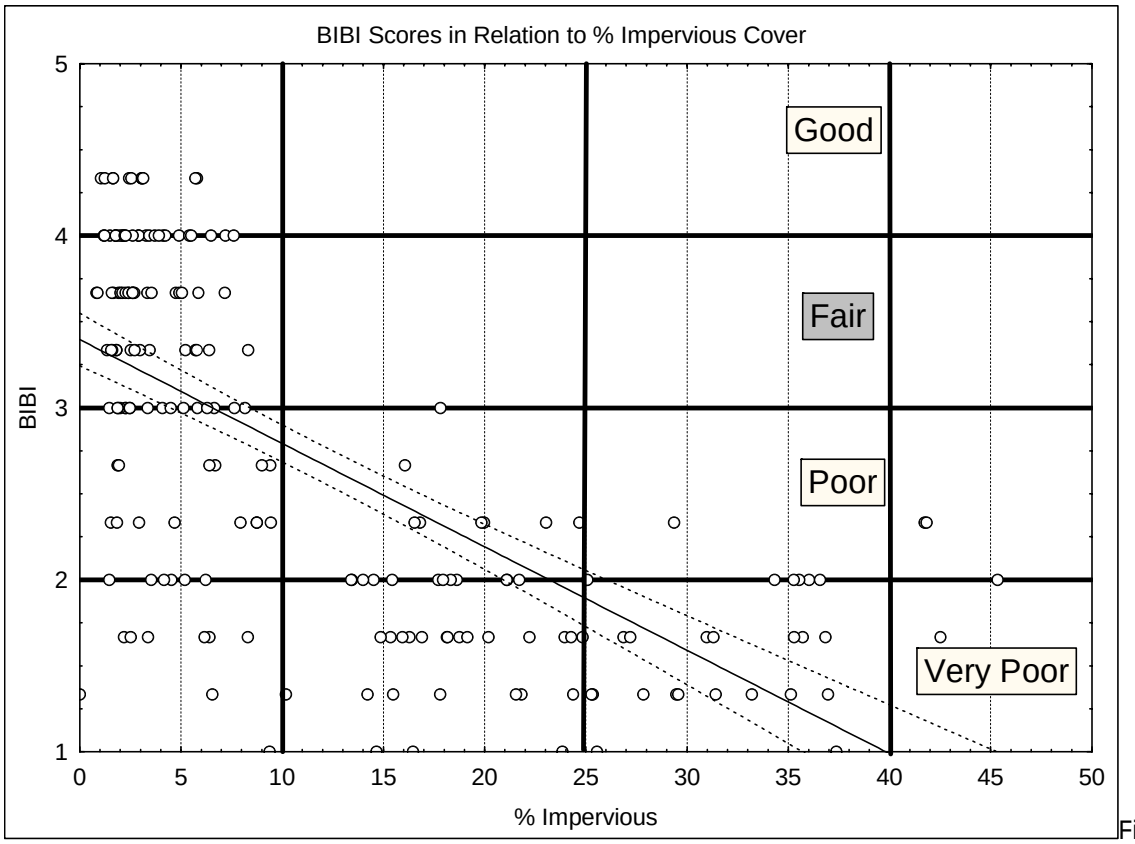
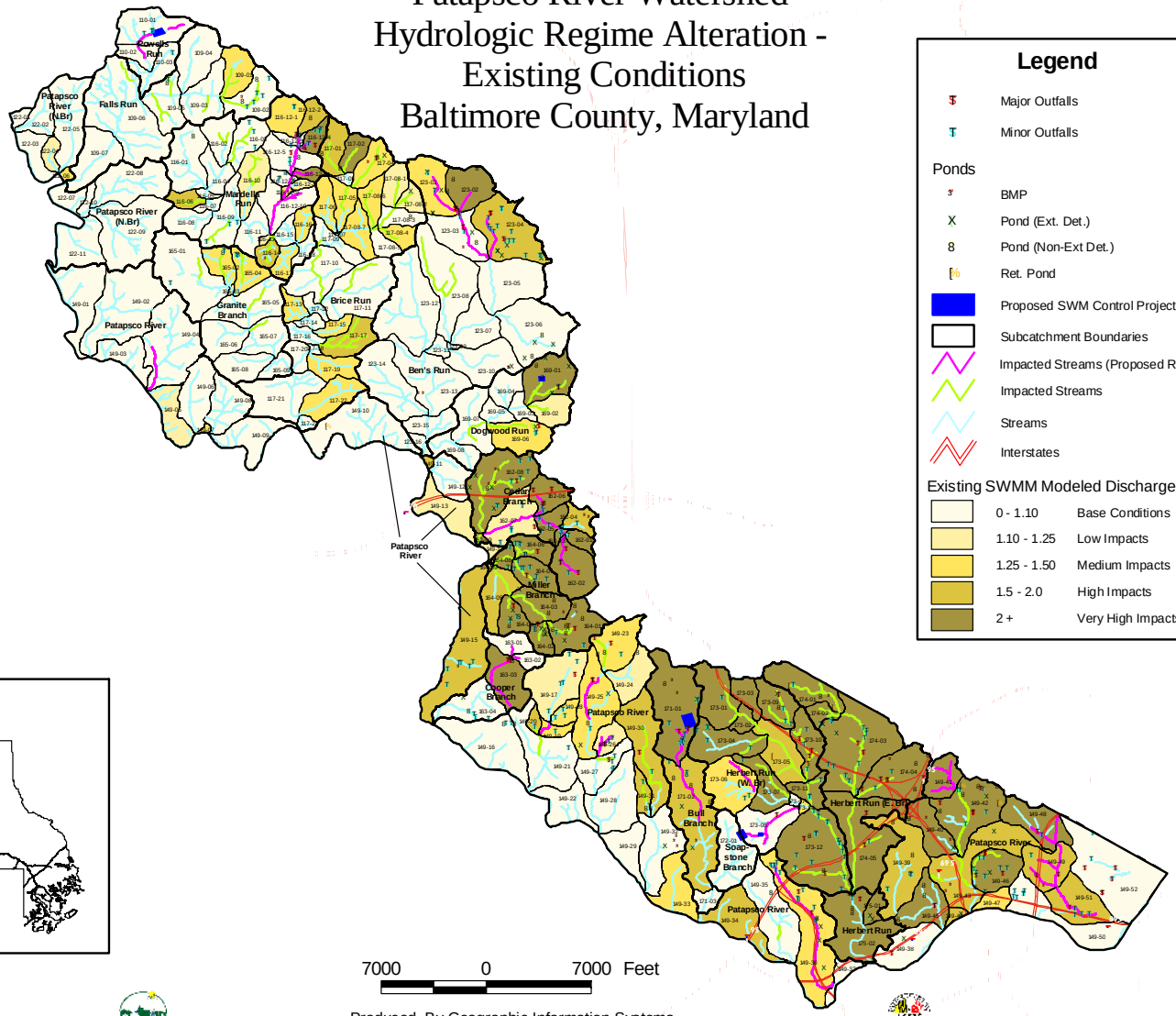



Figure IV-5: Patapsco/Back River and Gunpowder River Basin/Deer Creek BIBI Scores and Percent Impervious Cover.

Using the Center for Watershed Protection (CWP) impervious cover model, Figure IV-5 shows divisions (blue lines) at 10%, 25%, and 40% impervious cover; and the division in the biological condition (red lines). The CWP impervious cover model indicates that below 10% impervious cover the biological condition is usually good to

# Patapsco River Watershed
# Hydrologic Regime Alteration - Existing Conditions
# Baltimore County, Maryland




## Legend

- Major Outfalls
- Minor Outfalls

Ponds

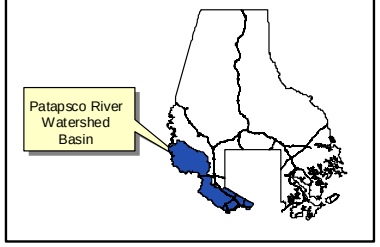
- BMP
- Pond (Ext. Det.)
- Pond (Non-Ext Det.)
- Ret. Pond
- Proposed SWM Control Project
- Subcatchment Boundaries
- Impacted Streams (Proposed Restoration)
- Impacted Streams
- Streams
- Interstates

Existing SWMM Modeled Discharge Ratio $\left(\frac{Q_{existing}}{Q_{pristine}}\right)^n$

| | |
|---|---|
| 0 - 1.10 | Base Conditions |
| 1.10 - 1.25 | Low Impacts |
| 1.25 - 1.50 | Medium Impacts |
| 1.5 - 2.0 | High Impacts |
| 2 + | Very High Impacts |

N

Enlarged Area




SOURCE DATA:

Maryland State Plan NAD27

STREAMS
BALTO. COUNTY DEPRM
Scale Of Data-1:2,400
Date Of Data-1954

MAJOR AND SUB-WATERSHEDS
BALTO. COUNTY DEPRM
Scale Of Data-1:2,400
Date Of Data-1986

MAJOR AND MINOR OUTFALLS
BALTO. COUNTY DEPRM
Scale Of Data-1:2,400
Date Of Data-1994

ROADS
BALTO. METRO COUNCIL
Scale Of Data-1:24,000
Date Of Data-1999

STORM WATER MANAGEMENT PONDS
Balto. County DEPRM
Scale Of Data-1:2,400
Date Of Data-1997

The property delineations shown on this map are only representations of actual surveys and are intended for general use only.

Due to scale variations, the locations of features on the map may be shifted from their true ground positions.

Impacted and Proposed Impacted Stream Data, Subcatchment Boundaries, and Existing SWMM Modeled Discharge Rate obtained by Tetra Tech, Inc.

Produced By Geographic Information Systems
Baltimore County Department of Environmental Protection and Resource Management

j:\wkgps\depr\projects\h2o_mgleldon\patapsco_basin.apr (Hydrologic Regime - Existing 2)

fair. Between 10% and 25% impervious cover, the biological condition of streams deteriorates to a generally poor condition and above 25% impervious cover, the biology of the stream is severely impacted. As can be seen from Figure IV-5, the biological data generally conforms to the predictions of the impervious cover model. There are however, a number of samples that have low impervious cover, but are in poor or very poor biological condition. In order to investigate why that might occur an additional analysis was conducted.

Using the drainage areas derived for each biological monitoring site, Maryland Department of Planning 2002 land use was overlain to determine the percent land use cover for each monitoring site. The land use was generalized to three uses, urban, agriculture, and forest. Figure IV-6 shows the results of the application of a quadratic regression analysis to the data. This type of graph is called a ternary graph. It shows the relative proportion of the three generalized land uses on the three axes. The points on the graph represent the land use proportions of the individual monitoring sites.

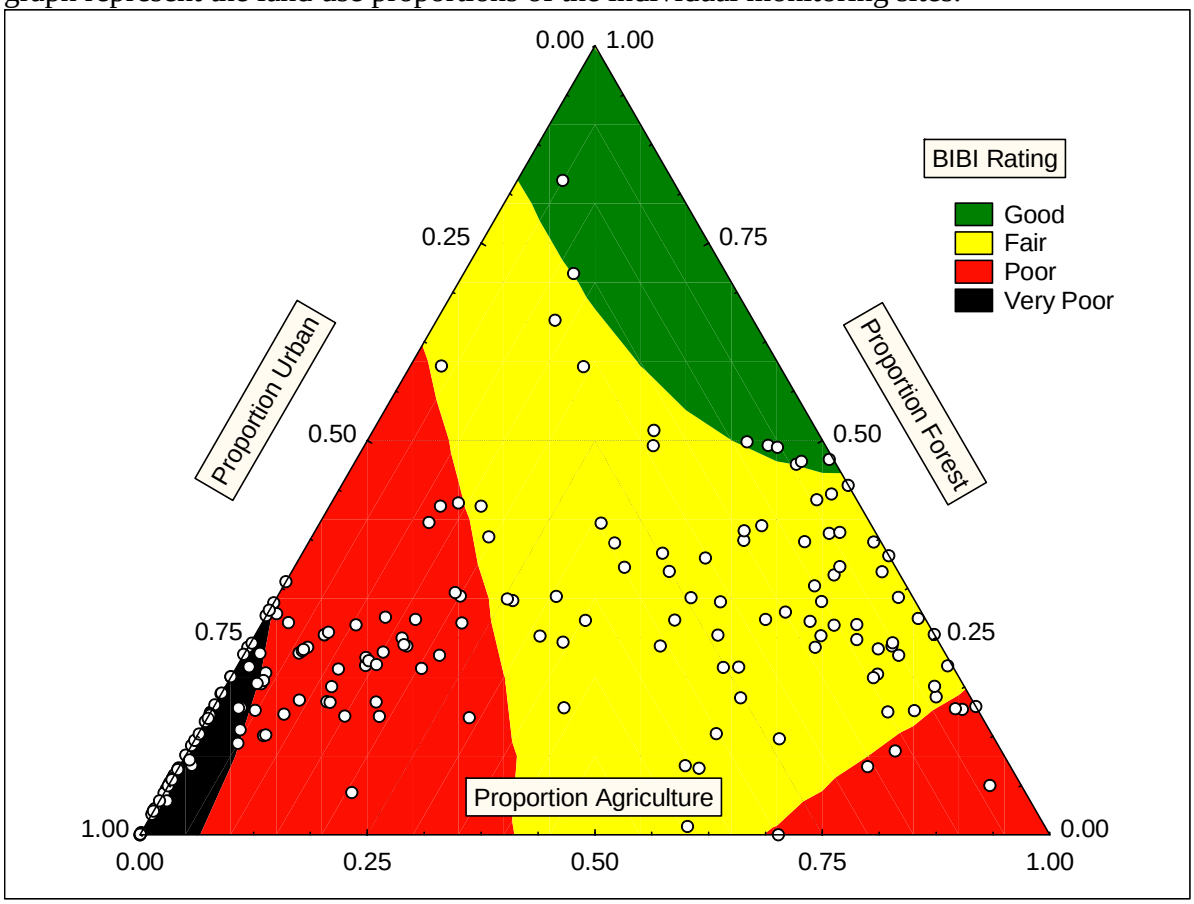



Figure IV-6: Ternary graph showing the relationship between generalized land use and BIBI scores.

Based on this analysis, high percentages of forest cover will result in good BIBI ratings. Once the proportion of agriculture increases beyond ~55% (right axis), the BIBI rating will decrease to fair, and beyond ~80% the BIBI rating will be poor. Urbanization has the effect of reducing the BIBI faster (left axis), with only ~15% urban land use resulting in a reduction of the rating to fair. At ~40% urban land use the BIBI will drop to poor and at ~70% urban land use the BIBI will be very poor. The bottom axis which represents zero forest land use shows an increasing BIBI as the proportion of agriculture

land use increases and the urban land use decreases. At about 90% urban land use and 10% agriculture land use the BIBI increases from very poor to poor, and at ~43% urban land use and 57% agriculture land use the BIBI increases from poor to fair. The BIBI decreases again from fair to poor when the proportion of urban land is ~70% and agriculture land use is 30%. Part of this may be an artifact of the land use classification process, where rural subdivisions with forest cover or at least turf cover are classified as urban, but have less impervious cover and less resultant impacts on the stream systems.

From this analysis it can be seen that agricultural land use can account for poor and very poor biological scores, even when the percent impervious cover is low.

### *Chemical Impacts*

The chemistry of a stream will change with increasing urbanization. Both Baltimore City and Baltimore County have stream chemistry monitoring programs. The results presented below are from the Baltimore County Baseflow Monitoring Program, the Baltimore City Reservoir Tributary Monitoring Program, and the Finished Drinking Water Monitoring Program.

As with the biological monitoring program, the drainage areas to the chemical sampling sites were determined and the percentage of impervious cover was calculated based on the foot print method. Data from both Patapsco/Back River Basin and the Gunpowder River Basin/Deer Creek was used in the analysis. A significant relationship was found between the percent impervious cover and seven water quality parameters (Total Solids, Chloride, TKN (Patapsco Basin only) nitrate/nitrite nitrogen (Gunpowder Basin), Total Copper, Total Zinc, Dissolved Zinc and Hardness). Select relationships are displayed in Figure IV-7, showing the Patapsco/Back River Basin separate from the Gunpowder River Basin.

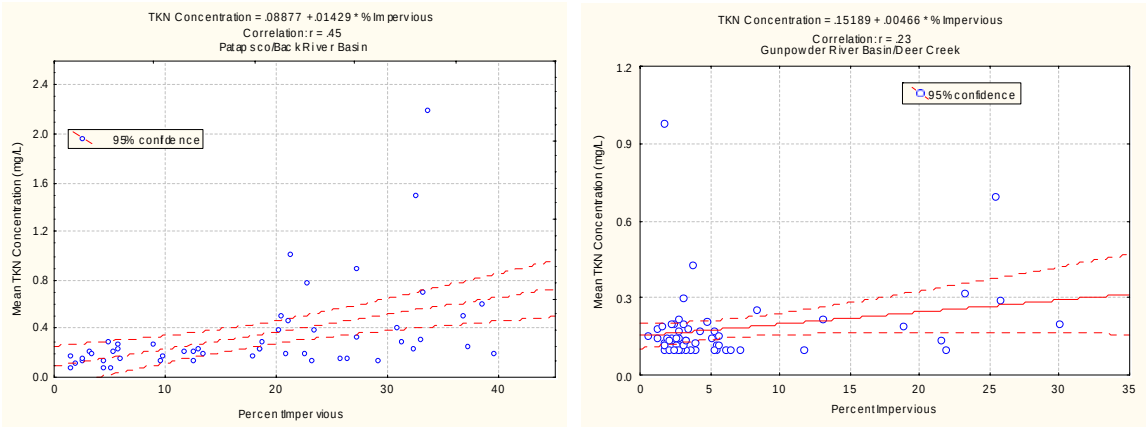



Figure IV-7: Significant Correlations Between Percent Impervious Cover and TKN, Total Zinc, and Dissolved Zinc.

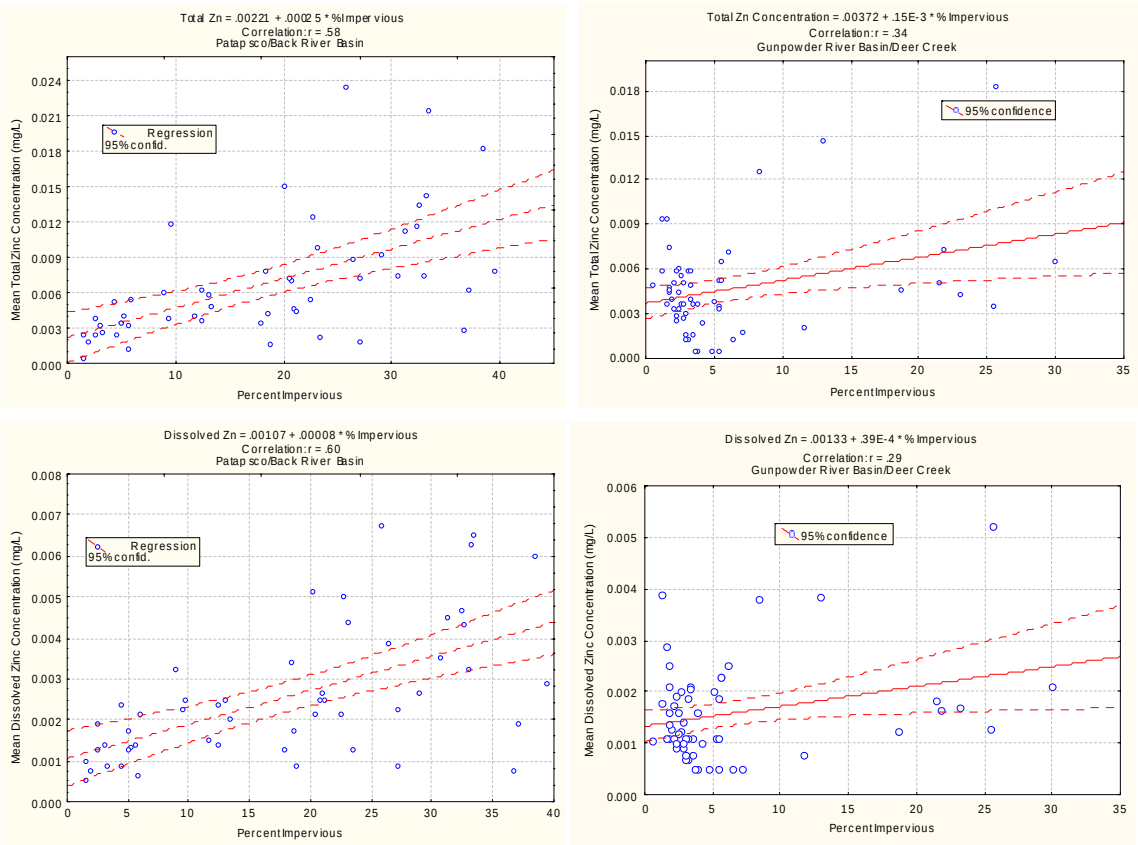



Figure IV-7: Significant Correlations Between Percent Impervious Cover and TKN, Total Zinc, and Dissolved Zinc (continued).

As can be seen from Figure IV-7, there is a great deal of scatter in the data points, particularly at higher percent impervious cover sites. The relationships are all positive (i.e. pollutant concentrations increase as impervious cover increases) with the exception of nitrate/nitrite nitrogen (not displayed). The emerging problem of chlorides and sodium in our drinking water is highlighted in the next section.

## ***Disturbing Trends in Chloride and Sodium Concentrations***

There is a disturbing trend of increasing chlorides seen in the dry weather samples from the tributaries of the water supply reservoirs. An example is shown in Figure IV-8, which gives the results for Morgan Run- a tributary of Liberty Reservoir. This trend is also evident at the Liberty Reservoir Intakes sampling station (see Figure IV-9), and in the finished water from the Ashburton Water Filtration Plant (see Figure IV-10), which treats the water from Liberty Reservoir. The finished water from both of Baltimore's water filtration plants has similarly shown an increase in sodium concentration (see Figures IV-11 and IV-12). There has not been sufficient analysis done to determine the causes for these increases. However, the strong positive correlation between chlorides concentration and the percentage of impervious area shown in Figure IV-13, points to development as one likely cause. For consideration of the possible effects of increased urbanization in the reservoir watersheds, Figure IV-14 compares first the difference in geometric mean of the chlorides concentration from the first five years (1983-1987) of sampling in Morgan Run to the last five years; and second compares the geometric mean for chlorides for Morgan Run, which has a watershed with a relatively low amount of

urbanization, to that for Beaver Dam Run, a reservoir sub-watershed with much more development, and to that for Dead Run, a stream within Baltimore City.

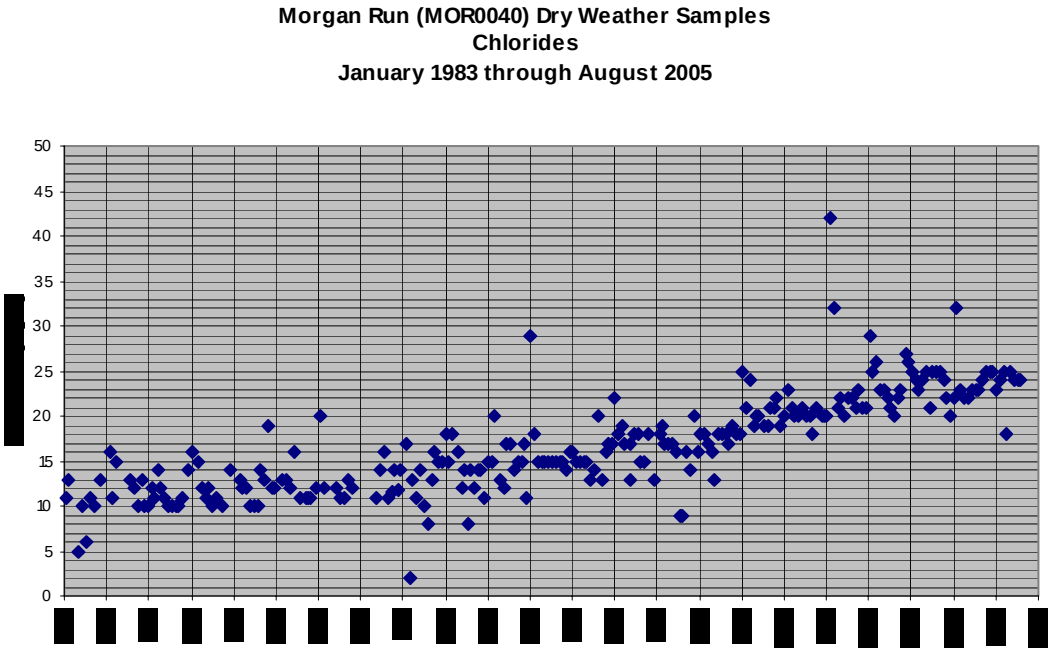



Figure IV-8: Morgan Run (MOR0040) Dry Weather Samples Chlorides January 1983 through August 2005.

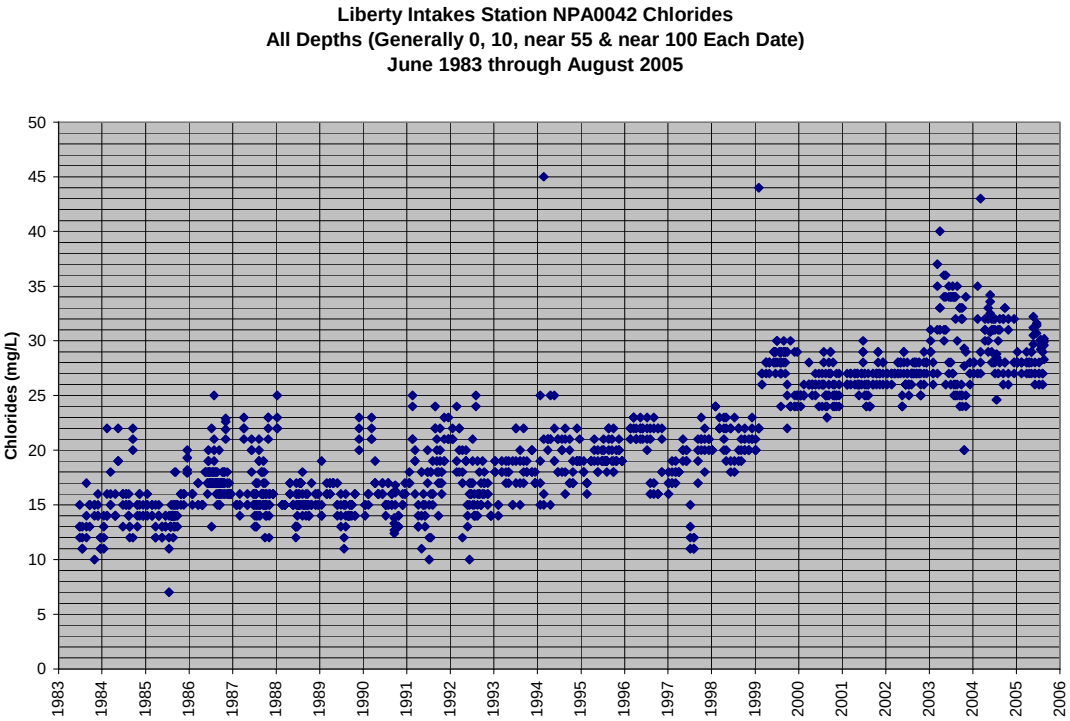



Figure IV-9: Liberty Intakes Station NPA0042 Chlorides All Depths (Generally 0, 10, near 55 & near 100 Each Date) June 1983 through August 2005.

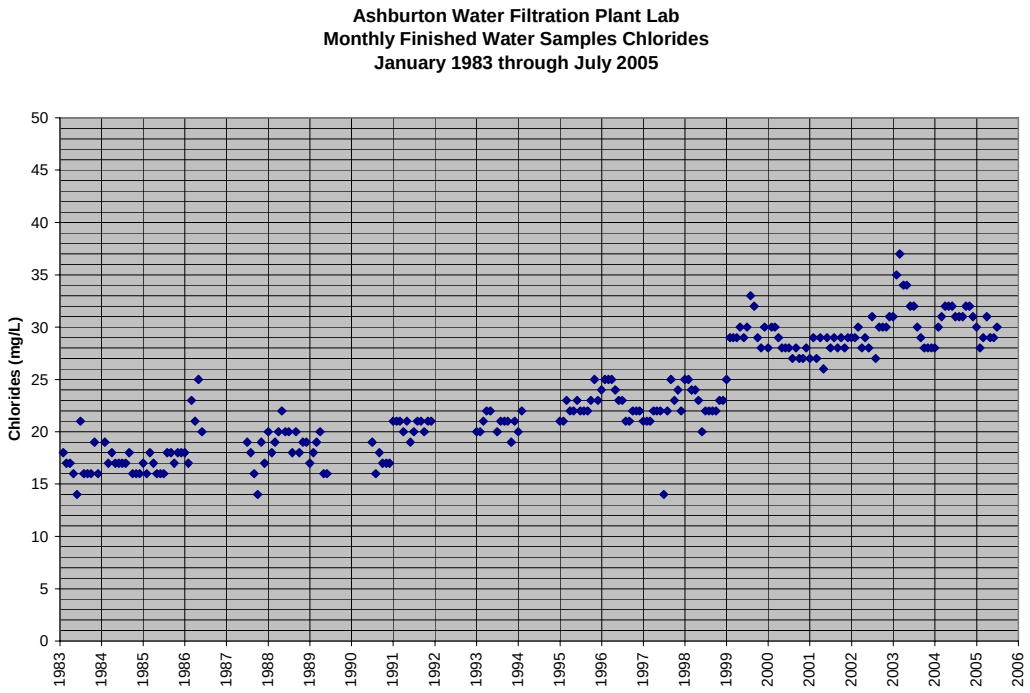



Figure IV-10: Ashburton Water Filtration Plant Lab Monthly Finished Water Samples Chlorides January 1983 through July 2005.

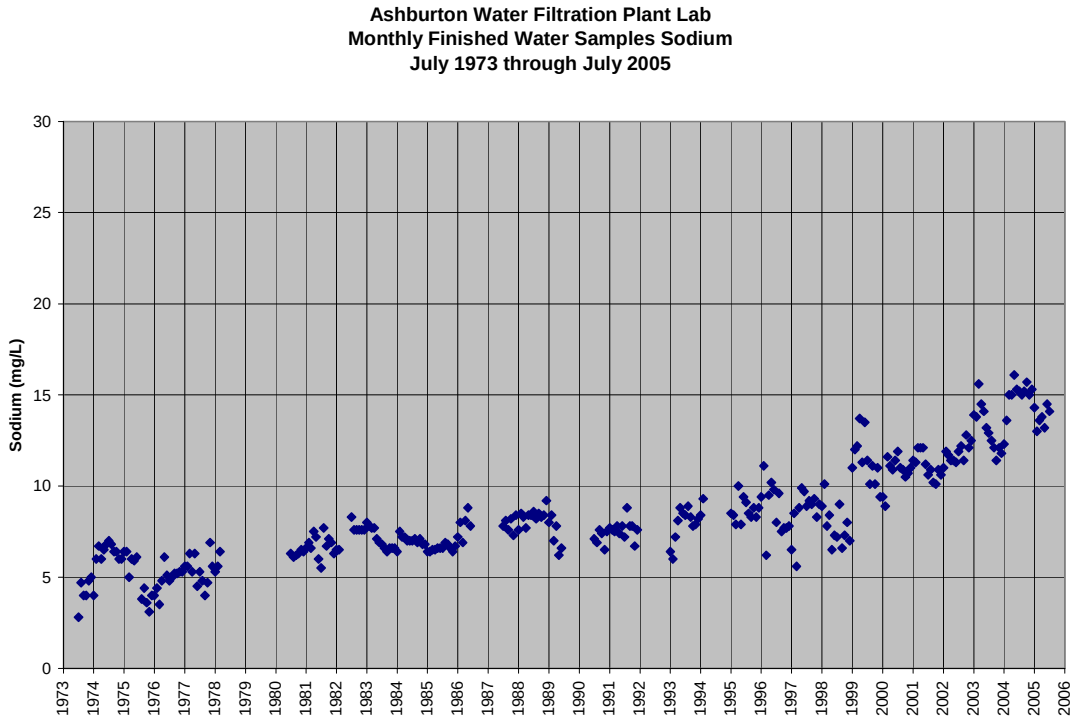



Figure IV-11: Ashburton Water Filtration Plant Lab Monthly Finished Water Samples Sodium July 1973 through July 2005.

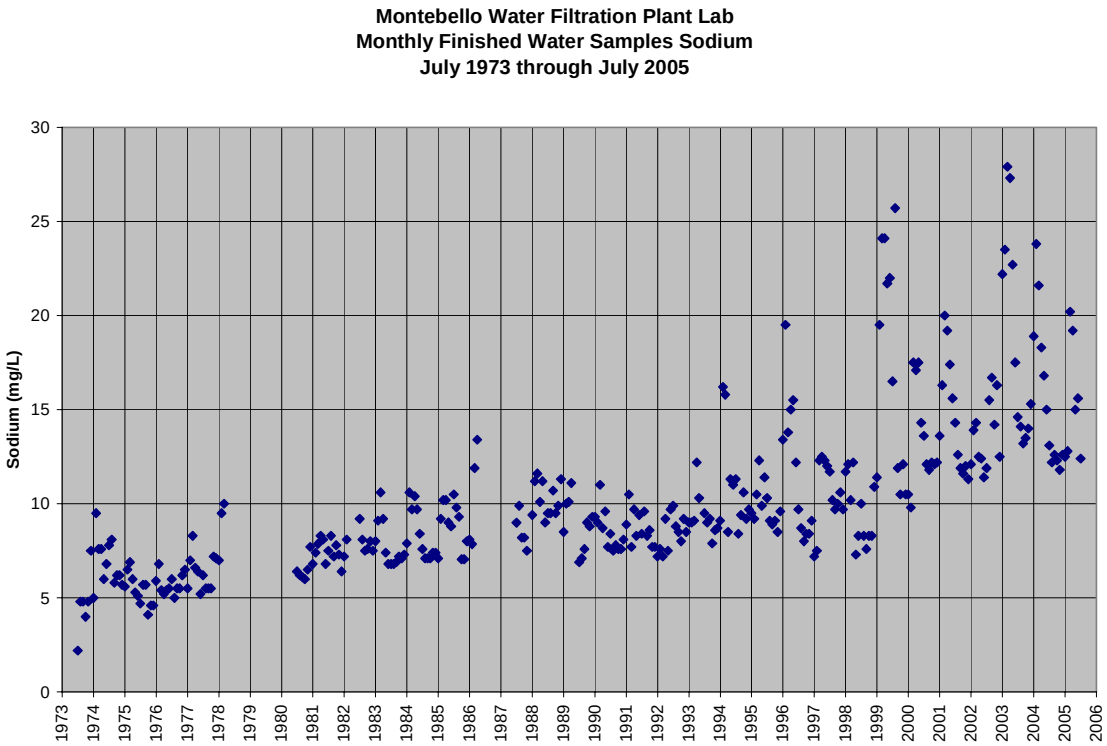



Figure IV-12: Montebello Water Filtration Plant Lab Monthly Finished Water Samples Sodium July 1973 through July 2005.

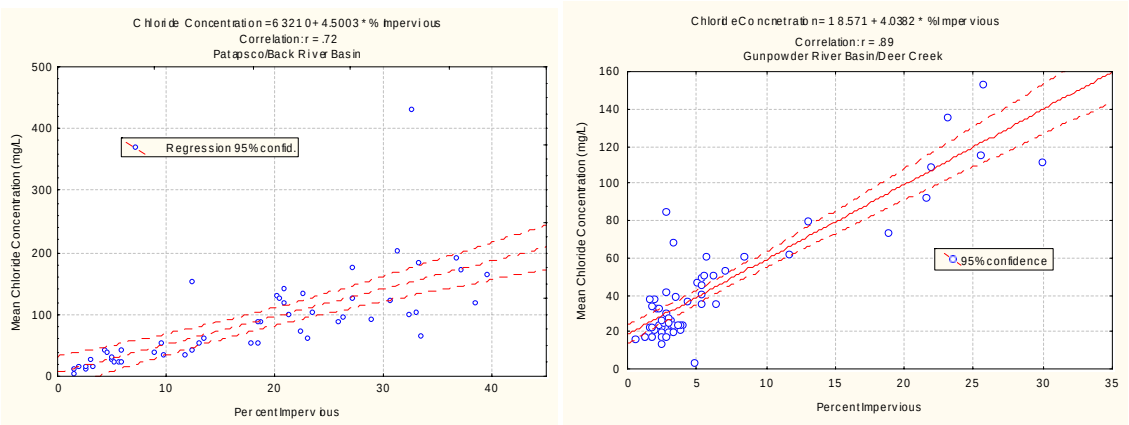



Figure IV-13: Significant Correlations Between Percent Impervious Cover and Chlorides.

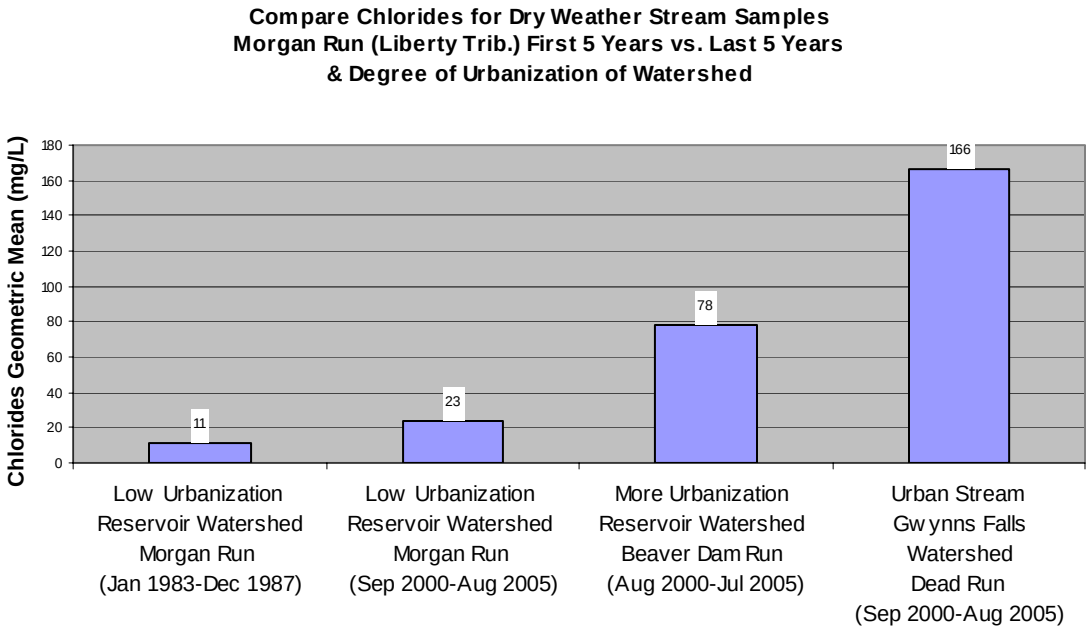



Figure IV-14: Compare Chlorides for Dry Weather Stream Samples Morgan Run (Liberty Trib.) First 5 Years vs. Last 5 Years & Degree of Urbanization of Watershed.

## Impervious Cover in Baltimore Region

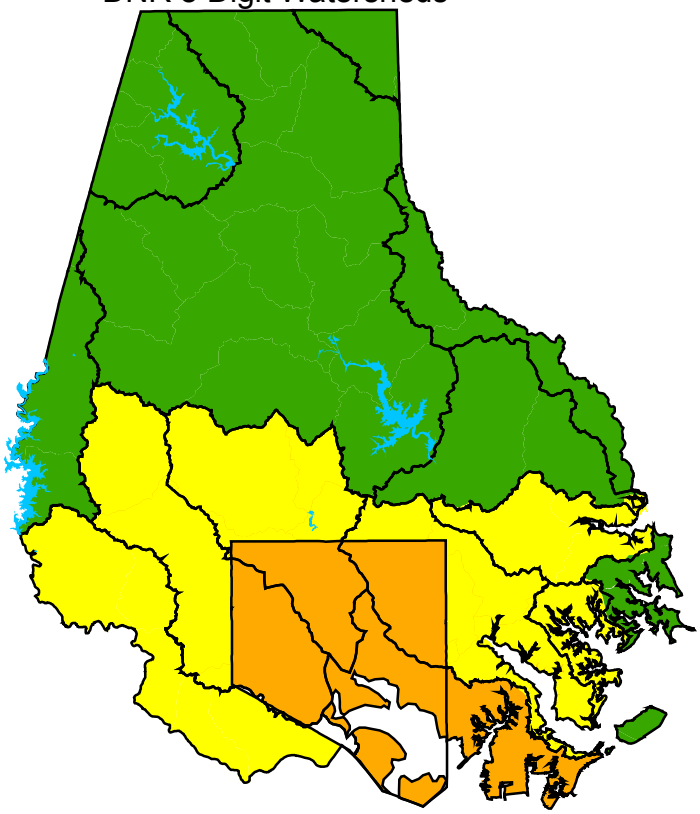
We have looked at how to measure impervious cover and the effects of impervious cover on stream quality. The question then is what is the impervious cover in the watersheds of Baltimore County/Baltimore City. The answer depends in part on what scale we choose to measure impervious cover. Impervious cover is presented at three scales; the major watershed scale (14 major watersheds), the Maryland Department of Natural Resources (DNR) 12-digit scale, and the Baltimore County named streams scale. In each case the amount of impervious cover is calculated by the foot print method, and county and city portions of the drainage areas are shown separately. We did not have a city GIS layer for the finer scale (named stream), therefore that is omitted from the map.

At the major watershed scale seven watersheds in the county are in the Sensitive Watershed (<10% impervious) category of the impervious cover model, mainly in the northern portion of the county. The County portions of the watersheds surrounding the city are in the Impacted Watershed (10%-25% impervious) category, with the exception of the Baltimore Harbor watershed, which is in the Damaged Watershed category. The city portions of these watersheds are all in the Damaged Watershed category.

The DNR 12-digit scale impervious map results in little change in the city, with the exception of the extreme southern portion where, due to the delineation of the watersheds, some tidal waters are included in the calculation of the impervious cover. In the county, this finer scale results in expansion of Damaged Watershed category into Back River, Jones Falls, and a small portion of Gwynns Falls. A large portion of Jones Falls (the northwest portion) is now designated as Sensitive Watershed, and a portion of

# Impervious Cover by Watershed

DNR 8 Digit Watersheds



8 Digit Watersheds

**Impervious Cover**

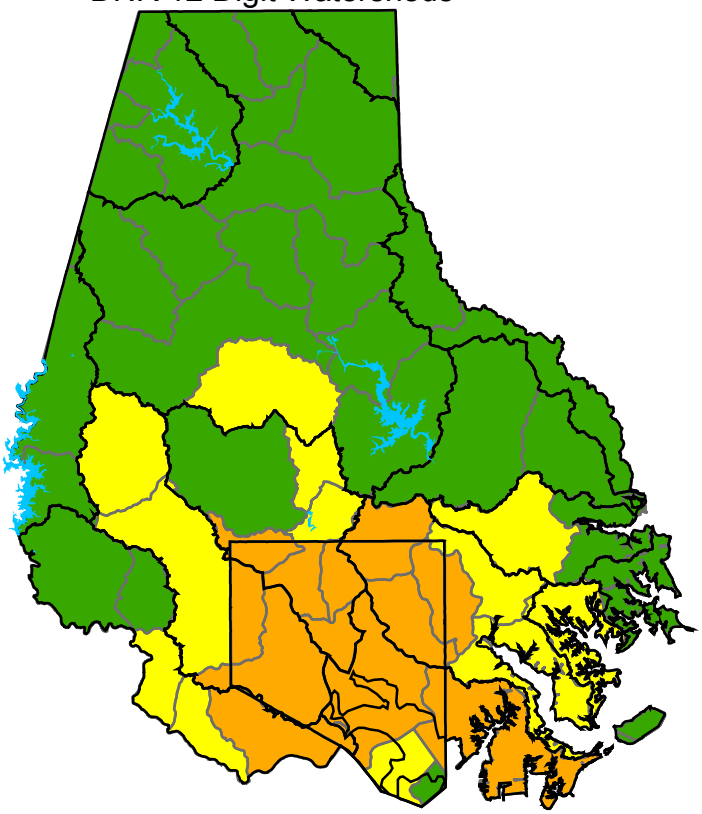
0% to 10%

10% to 25%

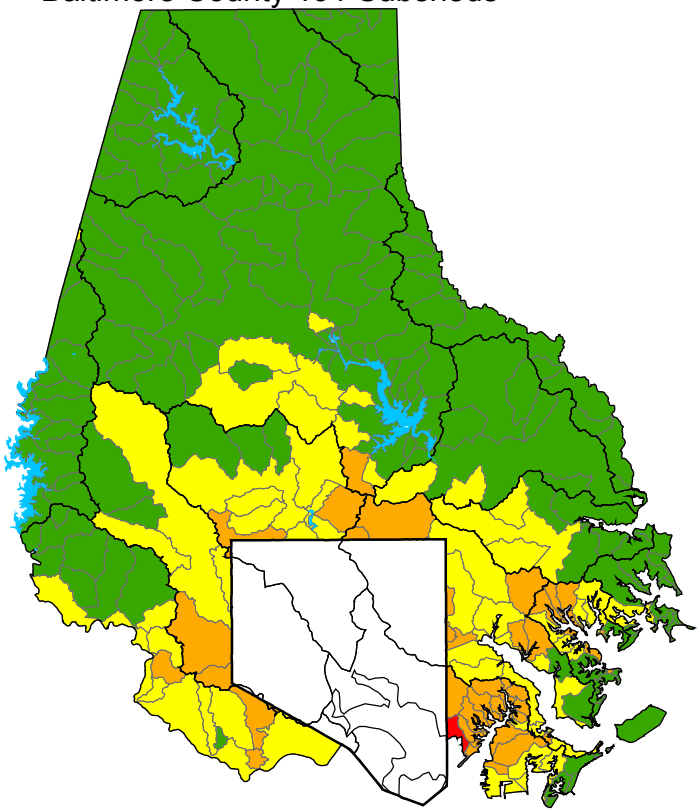
25% to 60%

60% to 100%

DNR 12 Digit Watersheds



Baltimore County 191 Subsheds



4 2 0 4 8 12 Miles

1:552,000 1 inch equals 46,000 feet

N W E S

Prepared by Geographic Information Services, Baltimore County
Department of Environmental Protection and Resource Management
Z/SHARED/DESHARED/2004gisBACKUP/
WATERSHEDS/ImperviousnessByWatershed3ways.mxd

Loch Raven watershed falls in the Impacted Watershed category, while the lower Bird River improves to the Sensitive Watershed category.

The finer scale Baltimore County named streams map further refines the designation of drainage areas. For the first time the Severely Damaged category shows up (a portion of the Baltimore Harbor watershed). In the Back River and Baltimore Harbor watersheds some areas of green (Sensitive Watershed) appear and additional areas of the Damaged Watershed category show up in Middle River, Back River, Loch Raven, Jones Falls and Gwynns Falls watersheds.

What does this mean? It means that scale makes a difference. There will be pockets of relatively un-impacted stream systems in urban watersheds, which may be able to support aquatic system functions, and there will be areas within larger watersheds that will be impacted by impervious surfaces, even if the there is a low impervious cover percentage watershed wide. It implies that to conduct effective watershed management and restoration the focus needs to be at a finer scale to account for both localized impacts and to protect smaller areas within the urban system that are still functioning. This should be kept in mind when looking at the next section on Impaired Waters Listings, where the listings are typically at the Major Watershed and DNR 12-digit subwatershed scale.

## References

Cappiella, K. and K. Brown. 2001. *Impervious Cover and Land Use in the Chesapeake Bay Watershed.* Center for Watershed Protection. Ellicott City, MD.

# MARYLAND SECTION 303(D) LIST

The federal Clean Water Act requires that states assess water quality every two years and publish a list of those waters failing to meet water quality standards. This list of impaired waters is called the "303(d) List". Water bodies listed as impaired may require a detailed analysis of pollution sources known as Total Maximum Daily Load (TMDL). Maryland's draft 2004 Integrated 303(d) List for Baltimore City and County is depicted in the maps on the following pages.

## Why compile a 303(d) list?

The Clean Water Act of 1972 requires states, territories, and authorized tribes to: 1) develop water quality standards for all jurisdictional surface waters; 2) monitor these waters; and 3) identify and list those waters not meeting water quality standards. A ***water quality standard*** is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as fishing, swimming, drinking water supply, and oyster propagation and harvest. Each use has associated water quality criteria, both numeric and narrative.

## How does Maryland's Integrated 303(d) List relate to TMDLs?

Either a water quality analysis (WQA) or a Total Maximum Daily Load (TMDL) must address all impairing substances or pollutants identified on Part-5 of Maryland Integrated 303(d) List. A ***Water Quality Assessment*** (WQA) is completed when current watershed monitoring data support delisting a water body (i.e., putting it on Part-6 of the Integrated List) because water quality standards are being attained. TMDLs are completed when a water body continues to violate water quality standards. A TMDL is the amount of a pollutant or stressor that a water body can assimilate and still attain water quality standards, as well as a margin of safety. The TMDL requires the identification and reduction of sources of the impairing substance in the watershed that is necessary to attain water quality standards. In some cases, erroneous listings are removed with an explanation, which may include wrong criteria applied, refinement of subbasin or additional data (under the Good Cause Provision [CFR130.7]). Such listings do not require a WQA or TMDL. The Maryland Department of the Environment website that deals with TMDLs is:
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp.

The maps presented in this report show the 303(d) listings for sediment, bacteria, nutrients, and biology impairment, in the City and County. They are color coded based on the status of the development of the TMDL, with green being completed, blue scheduled for completion in one year, and red not initiated yet. Those watersheds with no color are not listed as being impaired. In some cases this may be due to the lack of sufficient data to make a determination of impairment. The biological impairment listings are based on 12-digit watersheds, which are smaller scale drainage areas. Table V-1 shows the watershed impairment listing for the 14 watersheds in Baltimore County/Baltimore City for sediment, nutrients, and bacteria.

Table V-1: Watershed Impairments

| Watershed | Nutrients | Sediment | Bacteria |
|---|---|---|---|
| Deer Creek | | | |
| Prettyboy Reservoir | X | | X |
| Loch Raven Reservoir | X | X | |
| Lower Gunpowder Falls | X | | |
| Little Gunpowder Falls | X | | |
| Bird River | | X | |
| Gunpowder River | X | X | |
| Middle River | X | X | |
| Liberty Reservoir | X | X | X |
| Patapsco River | X | X | |
| Gwynns Falls | X | X | X |
| Jones Falls | X | X | X |
| Back River | X | X | X |
| Baltimore Harbor | X | X | |

Due to the complexity of the listings, metals and other toxics have not been displayed in maps. Table V-2 shows the status for completed TMDLs, as well as, completed WQAs. As can be seen from the table, the TMDLs that have been completed to date are for mercury and chlordane, with only one nutrient TMDL completed (Back River). Much of the monitoring conducted has found that watersheds originally designated as impaired for metals are not actually impaired by metals. Notably, the Bird River watershed has been found not to be impaired by nutrients. For access to the status of the TMDLs, WQAs and the documents supporting both go to the MDE website at: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Sumittals/index.asp.

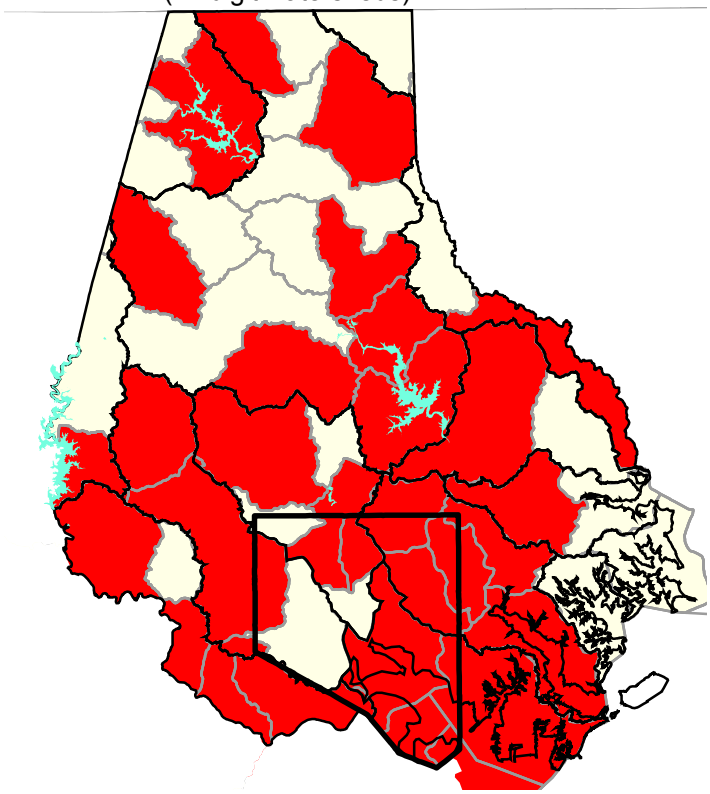
Table V-2: Completed TMDLs and WQAs

| Watershed | Constituent | Year |
|---|---|---|
| | Completed TMDLs | |
| Prettyboy Reservoir | Mercury | 2004 |
| Loch Raven Reservoir | Mercury | 2004 |
| Lake Roland | Chlordane | 2001 |
| Back River | Chlordane | 2001 |
| Baltimore Harbor | Chlordane | 2001 |
| Back River | Nutrients | 2005 |
| | Water Quality Assessments (delisted for impairment) | |
| Back River | Zinc | 2004 |
| Baltimore Harbor – NW Portion | Chromium | 2005 |
| Baltimore Harbor – NW Portion | Zinc & Lead | 2005 |
| Bear Creek | Chromium | 2005 |
| Bear Creek | Zinc | 2005 |
| Bird River | Nutrients | 2005 |
| Jones Falls | Copper & Lead | 2004 |
| Jones Falls | Zinc | 2003 |
| Liberty Reservoir | Chromium & Lead | 2003 |
| Little Gunpowder Falls | Metals | 2003 |
| Loch Raven Reservoir | Metals | 2003 |
| Lower Gunpowder Falls | Metals | 2003 |
| Lower North Branch – Patapsco River | Metals | 2005 |
| Middle River | Lead & Cadmium | 2003 |
| Prettyboy Reservoir | Metals | 2003 |

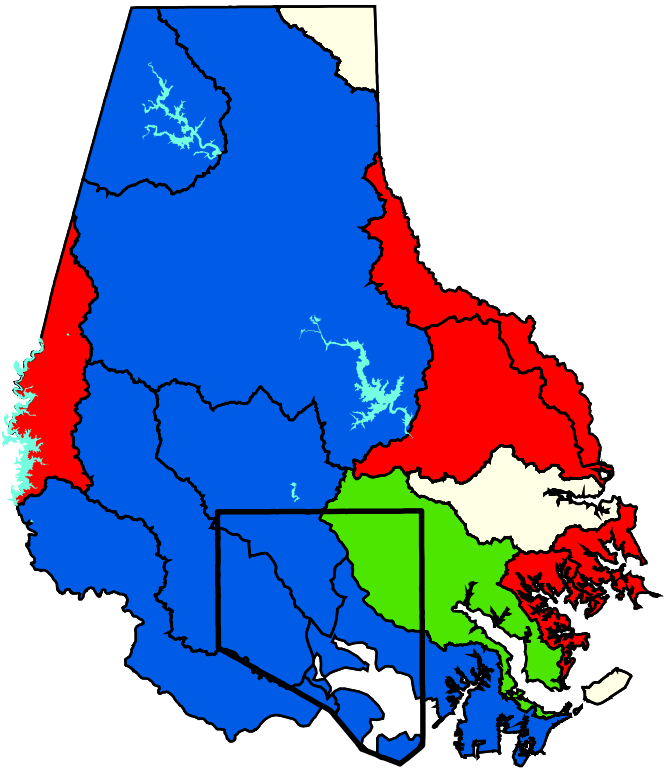
Note: Excerpts for the above narrative were taken from the above-mentioned MDE website.

# Impaired Watersheds "303(d) Listed" in Baltimore City and County

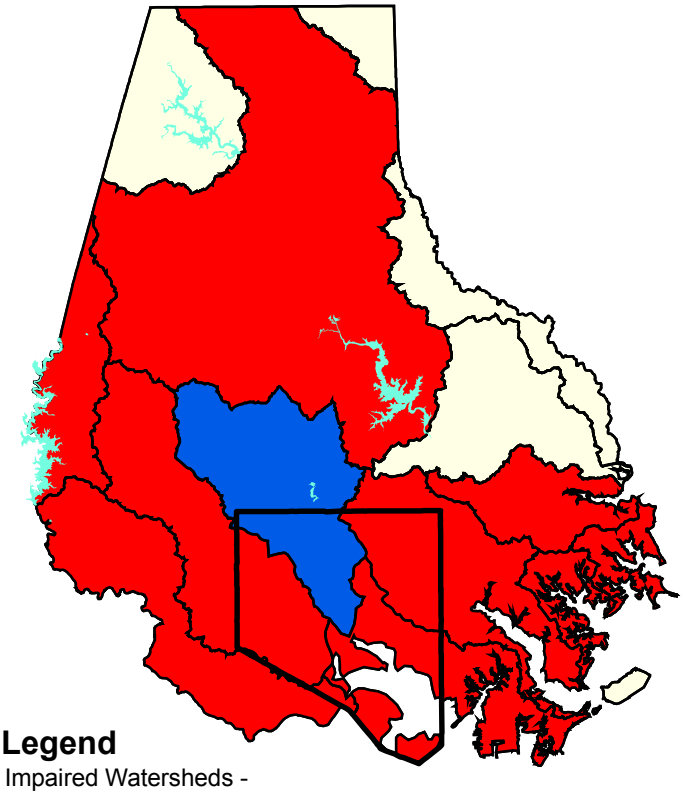
Watersheds Listed for Biology
(12 digit watersheds)



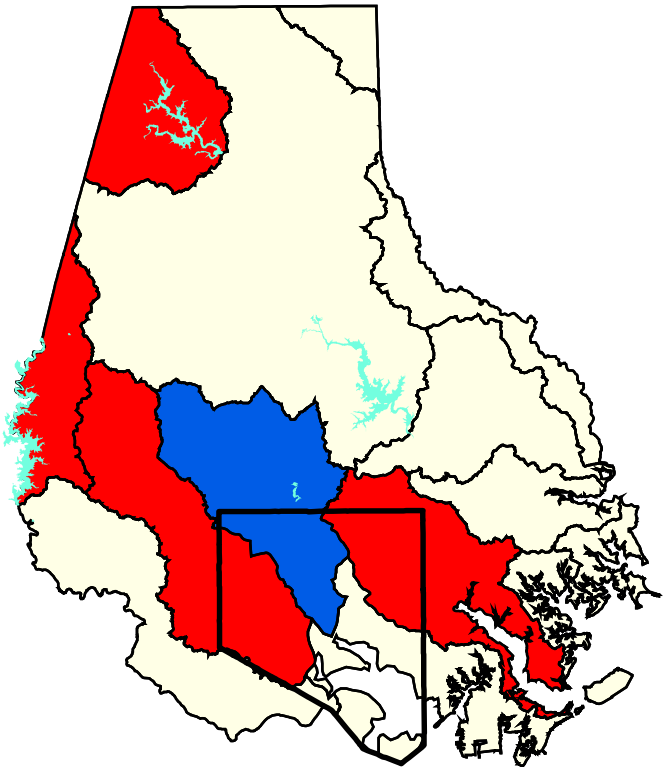
Watersheds Listed for Nutrients



Watersheds Listed for Sediment



Watersheds Listed for Bacteria



**Legend**

Impaired Watersheds -
TMDL Plan Status

- Plan Complete
- Pending within 1 Year
- Not Initiated Yet
- Unimpaired Watersheds
- Reservoirs

Prepared by Geographic Information Services, Baltimore County
Department of Environmental Protection and Resource Management
D/GIS_projects/Watersheds/ImpairedWatersheds2005.mxd

# ENVIRONMENTAL RESTORATION PROGRAMS

## Baltimore County Waterway Improvement Program

In 1987 DEPRM implemented a capital program for the assessment and identification of water quality problems and implementation of design and construction of watershed restoration projects, including preparation of watershed management plans, stormwater conversions and retrofits, stream and wetland restoration, shore erosion control, and waterway dredging. Restoration is especially important in communities built prior to environmental regulatory programs. The program seeks to protect, restore and improve the water resources of the County. The program structure is based on the County's fourteen (14) major watersheds in order to provide a comprehensive framework of protection and restoration of the County's natural resources. Projects are prioritized in part based on opportunities identified in watershed management plans. Project funding is supported primarily by County General Obligation Bonds and supplemented by State funds from the Maryland Departments of the Environment and Natural Resources through the Storm Water Pollution Control, Small Creeks and Estuaries, and Waterway Improvement cost-share programs. FY 1988-2005 allotments have totaled over $50 million, including $17 million in State cost-share funds. The County's proposed FY2006-2011 budget for this program is $28 million. The Waterway Improvement Program funds the following types of projects:

### *Stormwater Conversion Projects*

These projects involve the conversion of existing stormwater detention (dry) ponds to extended-detention with shallow marsh or retention (wet) pond facilities that provide water quality benefits in addition to runoff volume control. These projects are often constructed in conjunction with stream channel restoration. As of January 1, 2005, ten conversion projects treating 593 acres of drainage area had been constructed.

### *Stormwater Retrofit Projects*

These projects involve the installation of new stormwater best management practices (BMPs) facilities in communities developed prior to stormwater management requirements. Types of BMPs include extended-detention water quality ponds, bio-retention, stormwater wetlands and marsh, end-of-pipe storm drain outfall plunge pools, and water quality inlets. As of January 1, 2005, 24 retrofit projects treating 1,736 acres of drainage area had been constructed plus two projects under design that will treat 457 acres.

### *Stream Restoration Projects*

These projects restore highly degraded urban channels and enhance riparian ecosystems. The stream restoration projects utilize state-of-the-art techniques based on applied fluvial morphological principles and engineering hydraulics to restore and provide natural stream functions. Primary goals of these stream restoration projects are to reduce excess sediments by creating stream channel equilibrium, and enhance natural riparian and aquatic habitats by utilizing bioengineering techniques and natural materials. Projects have included removal of deteriorating concrete channels, and replacement with boulders and vegetative devices to emulate natural step pools and meanders for stream stability and velocity control. For some projects, detailed water quality, habitat, and geomorphologic monitoring is performed to assess the effectiveness of the project. DEPRM has completed 37 projects to date with many projects in design, permitting, or construction. As of January 1, 2005, a total of 12.8 linear miles of streams had been restored with 4.5 miles under design.

### *Shore Erosion Control Projects*

These projects stabilize eroding shorelines and create tidal habitat. Since program inception, nearly 15,000 feet of shoreline has been protected at numerous County waterfront parks and Hart-Miller Island Parks, at a total cost of nearly $3 million. Shoreline projects consist primarily of establishing shoreline vegetation and providing ancillary revetments or offshore structural protection, if appropriate, through gapped breakwaters.

### *Waterway Dredging Projects*

The Baltimore County Department of Environmental Protection (DEPRM) has an ongoing program to restore navigation channels for recreational boating access while protecting and enhancing aquatic habitat of the Chesapeake Bay and its tributaries. The projects include providing a channel in the center of a creek as well as individual spur channels connecting piers to the main channels. Dredging projects have companion projects in the watershed for the reduction of nutrient and sediment loading to the dredged channel. Baltimore County also collects submerged aquatic vegetation (SAV) data for all creeks that or are completed or proposed to be dredged. Submerged aquatic vegetation is considered a key indicator of the general health of a waterway. SAV growth has rebounded in many of the County's waterways and the County has been documenting and mapping these trends since 1989. This data provides the necessary information to satisfy State and Federal permit requirements and to better understand SAV growth and the limiting factors.

In 2004, the County completed a study on the effects of dredging on SAV. This study documents the resurgence of SAV after dredging in tributaries of the Chesapeake Bay in Baltimore County, Maryland. Results from five waterways are presented over a 5-year period utilizing pre- and post-dredge SAV surveys. Comparison to five reference sites and overall SAV trends are also evaluated. All five case study waterways are typical of Baltimore County waterways that require dredging of accumulated sediment runoff to restore active recreational boating access and to help minimize sediment re-suspension from prop wash. Specific SAV/Dredging relationships, if any, are masked by other variables such as climate, boating, and land use. During this retrospective study period for example, an extended period of drought and severe summer heat in 2002 was followed by the wettest year on record for 2003 rainfall. During both events SAV beds were observed to be under stress and dying back. However, in this study there appears to be more improvement in SAV habitat following well planned and implemented dredging. Avoidance and minimization of direct SAV disturbance should be pursued and balanced with providing adequate channelways for active boating that are terraced and narrowed to complement natural conditions as much as possible.

### *Community Reforestation Program*

In April 1999, DEPRM formally established the Community Reforestation Program (CRP), a continuing program of reforestation plantings that include establishing riparian and shoreline forest buffers, as well as forest connections between existing, isolated forest patches. The Program is implemented by DEPRM, utilizing funds derived primarily from fees-in-lieu of mitigation collected by Baltimore County under the Forest Conservation Act. Other County funding and support services for the program are contributed by DEPRM and the Department of Recreation and Parks though both operating and capital fund sources. The CRP provides an efficient mechanism for restoring forest cover to sensitive areas at reasonable cost by operating an in-house, four member reforestation crew, trained in proper planting techniques and critical monitoring and maintenance activities for newly planted forests, and in operating a growing out nursery of forest tree species in a range of sizes to suit individual site conditions.

Currently, this program reflects just the latest stage in a continuum of lessons learned since the plantings were begun in 1996, when DEPRM contracted individually with landscaping and environmental restoration firms for reforestation projects. When a 1998 review of the quality and costs of the projects

revealed problems with meeting objectives within the range of the mitigation fees collected, DEPRM contracted with Civic Works, Inc., a Baltimore-based non-profit youth service organization affiliated with the federal AmeriCorps program and chartered through the Governor's Office on Service and Volunteerism. Although this innovative partnership brought relief to the cost component of the program, the talents and skills needed to maintain high survival in the reforestation plantings were difficult to achieve and maintain because of rapid turnover in the corps member team composition. The benefit of having a dedicated, in-house reforestation crew has allowed DEPRM to improve planting and maintenance techniques, and to develop, test, and select machinery and materials to improve efficiency and project survival. As of fiscal year 2004, the program has successfully completed reforestation projects on approximately 100 acres of riparian sites, old agricultural fields and pastures primarily within county and state parks.

## Baltimore City Capital Improvement Program

The Capital Improvement Program (CIP) maps out the implementation phase of the watershed restoration plans. A list of the capital projects, organized by major watershed, with description and status for each project is listed below.

### *Gwynns Falls Watershed Capital Improvements*

Gwynns Falls Habitat Improvement

Cost: $300,000

*Status*: The Army Corps of Engineers (ACE) was waiting for approval from Headquarters to fund the implementation phase of the project, which would not only include stream and watershed restoration projects, but sanitary sewer rehabilitation projects as well. While approval was given in the fall of 2003, only limited funds were authorized. The City and the ACE agreed to target the remaining funding for the design of the stream restoration phase of the project (MC10). Last year the City signed a Memorandum of Understanding with the ACE to do the design. The City will be required to provide 35% in matching funds. Biohabitats, Inc., is the design firm and the design is 30% complete. Construction is scheduled for the summer of 2006, pending federal funding.

*Description*: The MC10 project site is located near Beechfield Elementary School on the Maidens Choice Run. The upstream drainage area is 1,860 acres and the length of stream being restored is 2,700 feet. A wetland is proposed next to the school. A portion of storm drain may be removed to recreate the natural stream. Part of the school parking lot will be investigated for removal. The wetlands will treat runoff from both the storm drain and the school parking lot nearby. Also a portion of Maidens Choice Run at this location will be stabilized.

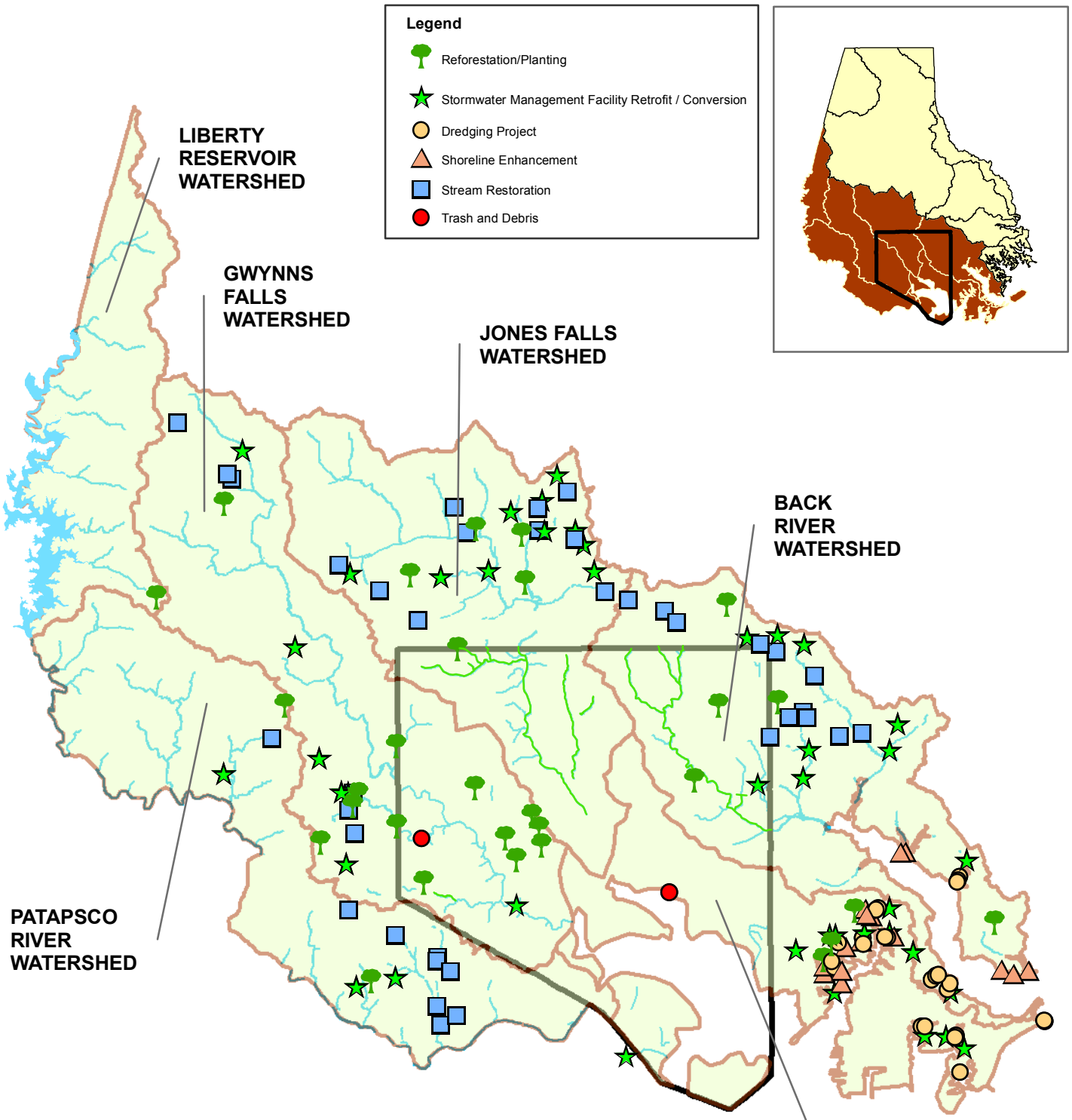
Maidens Choice Creek Wetlands Restoration/Enhancement

Cost: $1,500,000

*Status*: The design is 60 % completed and will be finalized in the fall of 2005. Construction is planned for late summer of 2005.

*Description*: This project is located in the northeast quadrant of the Caton Avenue/Benson Avenue intersection along an unnamed northwardly flowing tributary of Maidens Choice Run on the Seton Keough High School campus. This was originally a joint project with the Army Corps of Engineers to restore impaired streams within the Gwynns Falls Watershed. Maidens Choice was selected as the candidate stream for restoration as it was found to be the most impaired stream in the watershed. The City is using consultants to design the project because the Army Corps did not receive funding authorization for this project under their Civil Works Program. The proposed wetlands will treat urban runoff from approximately 255 acres of a highly urbanized area. This will help improve the water quality in the surrounding area. Additionally,

# Capital Improvement Projects
# Patapsco/ Back River Basin Watersheds




20,000 10,000 0 20,000 Feet

1 inch equals 20,000 feet

Prepared by Geographic Information Services, Baltimore County
Department of Environmental Protection and Resource Management

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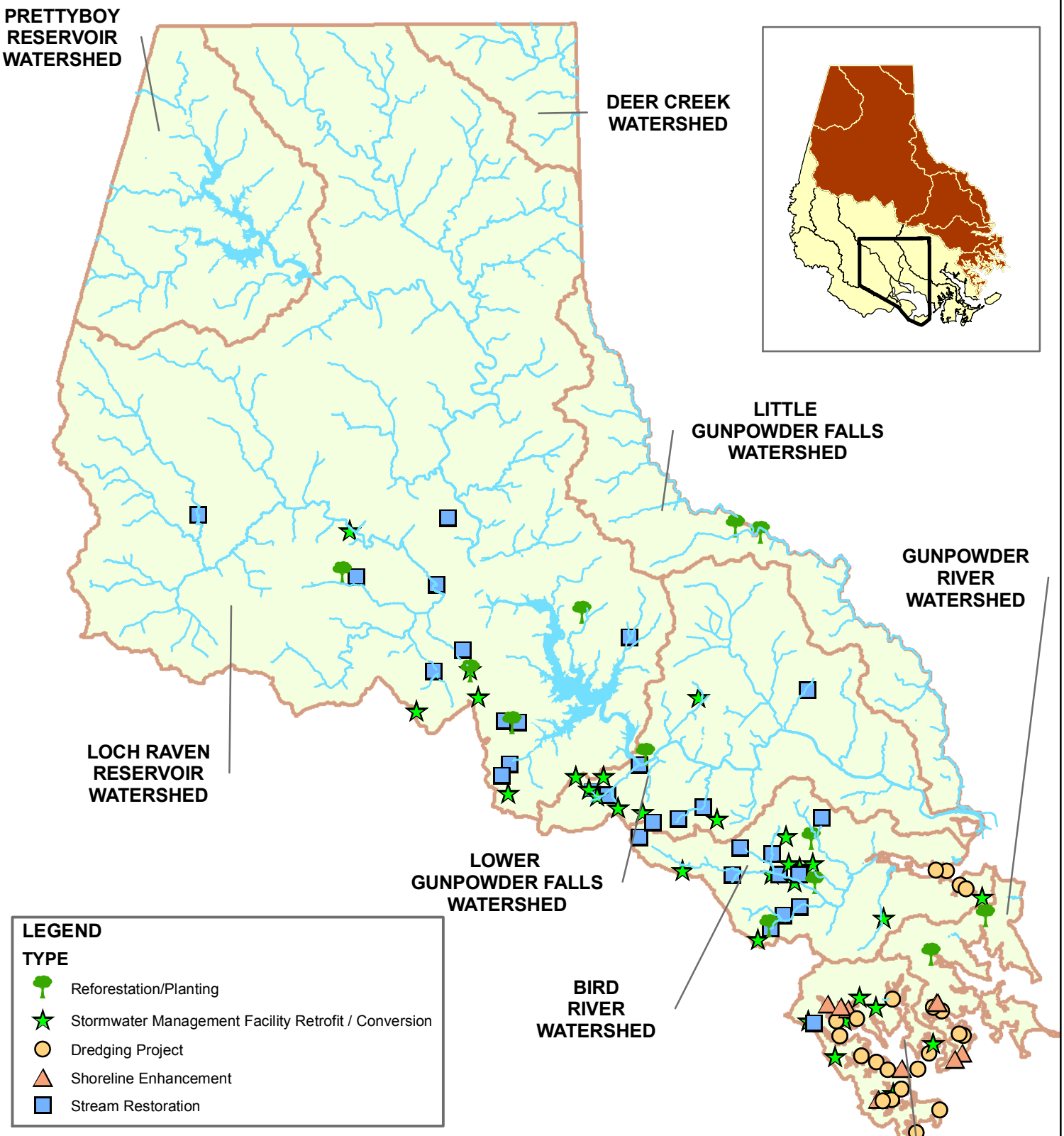
# Capital Improvement Projects
# Upper Western Shore Basin Watersheds




1 inch equals 20,000 feet

Prepared by Geographic Information Services, Baltimore County
Department of Environmental Protection and Resource Management

DESHARED/WatershedMonitoring/StateofWConf2005/2005Report/CapitalProjectsUpperWestern.pdf

the restoration of this stream will also help prevent the ongoing bank erosion, and protect the proposed wetland. This project also helps the City to satisfy its NPDES requirement and supports the Mayor's goal of making Baltimore safer and cleaner.

Gwynns Run Pollution Control Facility

Cost: $1,500,000

*Status*: Construction started in March 2003 and was completed in July 2004. An overhead pulley system across the Gwynns Run and a concrete pad were added to the design to facilitate the maintenance of the debris collection system.

*Description*: This project is located on the right bank of the Gwynns Run in the Carroll Park Golf Course. Three water quality basins- a fore bay, a wetland and a wet pond- will treat storm water diverted from the Gwynns Run. Runoff from the upstream watershed (1373 acres) is diverted into a three-stage wetland treatment train with a treatment volume of 5.8 acre-feet. A cast-in-place reinforced concrete debris collection structure using net bags is in place in the stream and at the entrance to the fore bay to collect floatable trash. Between 10 and 24 % of the annual runoff will be diverted into the system for treatment. City staff will evaluate the need to replace the debris collector bags biweekly, or after every storm (with ¼ inch or greater rainfall), whichever comes first. The overhead pulley system will facilitate removal of the debris collector bags from the debris collector structure across the Gwynns Run. A roll-off container is parked on the concrete pad to store debris. The roll-off container is transported to an existing landfill to dispose of the debris on a regular basis.

Gwynns Falls Debris Collector

Cost: $600,000

*Status*: The design phase was initiated in January 2002. The project was advertised and notice to proceed was issued on October 13, 2003. The debris collector is part of a much larger project involving the construction of a new water main and storm drain. The debris collector was completed in June of 2004.

*Description*: At the request of the Gwynns Falls Watershed Association, a site was chosen for an off-line trash and debris netting system attached to the storm drain in the vicinity of Briarcliff Rd. and Winans Way. A parallel storm drain is being designed to alleviate flooding. The watershed area to the facility is 232 acres and runoff (first half inch) is diverted into a box chamber in which the netting system is housed. After passing through the nets, the flow returns to the storm drain. The contractor will be responsible for maintaining the system during its first year of operation. The system will be inspected after each major storm or at least every two weeks. The trash will be weighed, lifted out of the junction chamber via a truck-mounted crane and removed to a landfill.

***Jones Falls Watershed Capital Improvements***

Western Run Stream Assessment Study

Cost: $69,991

*Status*: The study was completed.

*Description*: The purpose was to identify stream restoration needs on 5-6 miles of the Western Run main stem and its tributaries within the Baltimore City limits. The consultant was asked to create a database and GIS mapping of his findings: analyzing stream restoration and stabilization needs, prioritizing restoration areas, preparing concept restoration sketches and preliminary cost estimates for high priority restoration areas, and ranking the restoration needs. This study is

Phase I of this project. Phase II might be conducted, depending on availability of funds.

Open Channel Improvements- Upper Stony Run

Cost: $1,200,000

*Status*: This project was combined with a sanitary rehabilitation design in this same section of stream and advertised for construction in January 2005. Only one bid was received, and because it was substantially over the engineers' estimate, the bid was rejected. The project will be re-advertised in August 2005. Stream Restoration Contractors will be allowed to bid on the project (which was limited to Sanitary Sewer Contractors) to allow more contractors to bid on the project.

*Description*: The stream banks of Stony Run, from Northern Parkway to Wyndhurst Avenue (2,792 feet) will be improved and stabilized using "natural channel" materials (e.g., boulders, root wads, live plantings) based on Rosgen concepts. The upstream drainage area is 518 acres. The purpose of the project is to reduce erosion and sedimentation and improve the habitat of the stream channel and near-bank area. The project will also alleviate further damage to public utilities and roads by restoring the stream.

Open Channel Improvements- Middle Stony Run

Cost: $1,000,000

*Status*: The design for this project is 90% complete. Like the other Stony Run Projects, the rehabilitation of the sanitary sewer will be added to this contract to minimize disruption to the community and the environment. This project is scheduled to be advertised in the fall of 2005, with construction beginning in the late summer of 2006.

*Description*: The stream banks of Stony Run stream, from Wyndhurst Avenue to Coldspring Lane (2,700 feet) will be improved and stabilized using "natural channel" materials (e.g., boulders, root wads, live plantings) based on Rosgen concepts. The upstream drainage area is 522 acres. The purpose of the project is to reduce erosion and sedimentation and improve the habitat of the stream channel and near-bank area. The project will also alleviate further damages to public utilities and roads by restoring the stream.

Open Channel Improvements- Lower Stony Run

Cost: $1,200,000

*Status*: The study phase began in the winter of 2003. Design should begin by December 2005. Construction should begin in the summer or fall of 2006.

*Description*: Consultants will use the hydro-geomorphological assessment for the section of Stony Run below Coldspring Lane to determine the extent of the stream channel that will be restored under this phase of the project. The project length is approximately 4,300 feet, although a portion of the stream system flows through underground culverts. The upstream drainage area is 1,800 acres. The section immediately below Coldspring Lane is severely entrenched with limited floodplain area, failing gabions and concrete channels throughout. The natural channel design approach may not be applicable until after the stream passes below University Parkway. The project will try to stabilize the substrate and remove potential fish blockages.

Open Channel Improvements- East Stony Run

Cost: $1,250,000

*Status*: Consultants submitted a proposal to design restoration alternatives for East Stony Run from Homeland Avenue to Charles Street (3,600 feet). The upstream drainage area is 583 acres.

Design was initiated in 2003, and the 90% design was submitted for review in May 2005. This project was combined with the adjacent sanitary sewer rehabilitation work as well as the rehabilitation of the culvert underneath Charles Street. The project is expected to be advertised in the fall of 2005 with construction beginning in the early summer of 2006.

*Description*: The design will use the principles outlined by the Rosgen (Natural Channel Design) approach where possible. The City will be working closely with the property owners along the stream including Notre Dame/Loyola Colleges, as well as enlisting help from the Jones Falls Watershed Association.

***Herring Run Watershed Capital Improvements***

Moores Run Wetland

Cost: $1,000,000

*Status*: The design phase is completed. Construction is scheduled for the fall of 2005.

*Description*: A wetland is being designed next to Moores Run on the left bank near the intersection of Relcrest Road and Denview Way. The wetland will receive a portion of storm flow from the Moores Run, and will remove pollutants through settling and plant uptake processes. The facility should be able to treat approximately 18-19% of the upstream runoff from the entire upstream drainage area (2,800 acres). The exact degree of treatment has not been quantified.

Open Channel Drainage Facility Study Herring Run

Cost: $205,788

*Status*: The study was completed in July 2004.

*Description*: A total of 18.4 miles of stream was divided into 24 reaches (reach length varied from 1,275 feet to 7,560 feet; average reach length 4,050 ft) to assess (rank) them with respect to channel stability and habitat conditions. The parameters used to rank a reach with respect to the channel's stability are drainage area to reach, overall channel condition, bed stability, bedrock control of bed, bank stability, bank erosion hazard index (BEHI), bedrock control of banks and degree of channel incision. The maximum possible score for the channel stability ranking is 100. The higher ranked number represents relatively high stability (lower priority for stream restoration and repair). The parameters used to rank a reach with respect to the habitat are left riparian zone, right riparian zone, terrestrial habitat, riparian invasive, canopy cover, riffle embeddedness, barrier to fish movement, in-stream fish cover, pools, insect/invertebrate habitat, and human intervention. The maximum possible score for habitat stability ranking is 100. The higher ranked number represents relatively good habitat condition (lower priority for stream restoration and repair). Furthermore, the consultant developed conceptual restorations plans and construction estimates for the four poorest reaches.

Open Channel Improvements Biddison Run

Cost: $1,500,000

*Status*: The project was advertised on June 27, 2003, but was rejected because of contractual problems. The project was re-advertised in April 2005. Construction should begin in late summer or early fall of 2005.

*Description*: This project is located on Biddison Run, next to Bowley's Lane Landfill in East Baltimore. Approximately 1,500 feet of the stream, from Moravia Road to its confluence with Herring Run, will be restored to protect the existing landfill on both of its banks. The upstream drainage area is 799 acres, and the entire stream length is 9,123 feet. The consultants that

completed the Open Channel Facility Study of Herring Run evaluated the entire section of stream. This work is being reviewed, and recommendations for additional stream restoration work will be incorporated in the Biddison Run Watershed Plan that is currently being developed. The Herring Run Watershed Association will monitor the restored portion of the stream for three years after the completion of the project. The City has received a $440,850 grant from the Governor's Watershed Revitalization Partnership Program (utilizing Transportation Equity Act funds), which has to be matched by 50%. The Department of Natural Resources is administering the grant, and has made available an additional $157,459 in grant funds.

Water Quality Sampling Station- Moores Run

Cost: $100,000

Status:

*Hamilton Avenue Sampling Station*: The station modifications were completed in the spring of 2005. The monitoring equipment has been ordered and should be installed in the summer of 2005.

*Radecke Avenue Sampling Station*: The design for Radecke Avenue sampling station is 95% complete. The project is on hold because of concerns about park encroachment by the Department of Recreation and Parks. The construction cost at the alternate site is more than the budgeted amount. The station will be constructed if additional money becomes available. Otherwise, the City will continue to monitor storms using the existing set-up at Radecke Avenue.

*Description*: An automated water quality sampling station will be constructed to monitor wet weather flows and water quality on a tributary to Moores Run near Hamilton Ave. The station will house refrigerated automated samplers that can be automatically triggered by a rise in stream stage.

***Moores Run Stream Restoration***

Design Cost: $174,000

*Status*: 30% design (Concept Level) was completed in October 2004. Current cost estimate to construct the project is $1,500,000. The project was put on hold because of insufficient funds.

*Description*: The purpose of the design is to reduce channel erosion, improve habitat and protect the embankment of the Moores Run Wetland described above. The consultant studied 3,000 feet of the stream to determine the limits for the Moores Run stream restoration project. Approximately 1,700 feet of the stream, from Relcrest Road to Force Road (adjacent to the wetland facility), will be restored (or stabilized). The consultant for this project used accepted fluvial geomorphologic principals to design a stream channel system based on parameters including bank-full conditions, channel pattern, slope and shape, sinuosity, depth, flow regime, meander pattern, and stability.

***Harbor Watershed Capital Improvements***

School Greening Project

Cost: $407,000

*Status*: The design phase was initiated in the summer of 2002. To date, six schools (Gilmor Elementary, Bentalou Elementary, West Baltimore Middle, Harlem Park Middle, Hilton Elementary, and Calverton Middle) have been greened and a total of 6.75 acres of impervious area was removed. Four more schools (Ben Franklin Middle, Franklin Square Elementary, Hamilton Middle, and Brehms Lane Elementary) will be greened in the summer of 2005.

*Description*: The Department of Public Works (DPW) will be working with the Baltimore City School System and the Department of Recreation and Parks to convert unused impervious surfaces (e.g., asphalt playgrounds and parking areas) into environmentally friendly landscaping. A private developer provided funds for Calverton Middle School, as part of an offset to their storm water management requirements. DPW is working with the Maryland Port Authority (MPA) and Johns Hopkins University to use mitigation funds to green schools. Both organizations have agreed to green two schools with an approximate impervious area removal of 8 acres (100%) treatment.

Brooklyn SWM Pond

Cost: $1,500,000

*Status*: Construction was completed in November 2004.

*Description*: This project involves the construction of a shallow marsh-stormwater management extended detention pond in the Brooklyn Park area of the City. The pond was originally designed to provide water quality and flood control for the surrounding communities, but there was insufficient storage space available to mitigate storm events without causing further flooding problems. The pond was re-designed primarily to provide pollutant removal and water quality treatment for the 306 acre contributing drainage area. The pond has been sized to provide the maximum possible water quality control for smaller storm events in the available space. Approximately 75% of the one-inch storm will be treated.

Harris Creek Trash-Debris Interceptor Study

Cost: $500,000

*Status*: The design of this project was completed in the spring of 2005. The project is scheduled for construction during the late summer or early fall of 2005.

*Description*: A trash and debris netting system is being designed for the Lakewood Avenue storm drain outfall, which drains the Harris Creek watershed. The system will include a series of 4 removable nets that will be anchored by cable, just downstream of where the Lakewood drain empties into the Harbor in the Canton area. The nets are attached to a floating super-structure. Floating booms funnel the flows into the nets where trash and debris are intercepted. The disposable nets are removed by crane at approximately two-week intervals.

Bon Secours of Maryland Sandtown-Winchester Project

Cost: $30,000

*Status*: Ongoing

*Description*: This is a joint project agreement between the City and the Bon Secours of Maryland Foundation (BSMF). The BSMF has already improved 185 vacant lots in southwest Baltimore under a prior contract with the City. BSMF is in the process of greening 100 additional vacant lots within the same area. Upon completion of this current contract, Bon Secours will have improved 285 vacant lots by replacing the impervious surfaces with pervious surfaces including soil, sod, mulch, etc.

Bon Secours of Maryland Watershed 263 Project

Cost**:** $57,410

*Status***:** The agreement between the City and Bon Secours was approved in June 2005. Work should begin in early summer and continue through the fall of 2005.

*Description*: This is a joint project agreement between the City and the Bon Secours of Maryland

Foundation (BSMF). The City has been awarded $70,100 from the Coastal Non-point Source Grant Program for stream restoration and greening. The City is in the process of completing an agreement with BSMF using these grant funds to green 32 vacant lots within a 930 acre ultra-urban watershed in downtown Baltimore City. Work will begin on this project in June 2005.

# WATERSHED MANAGEMENT

## Baltimore County Watershed Planning

Baltimore County initiated watershed management plans for its major watersheds in the 1990's. These plans are primarily technical documents that include: watershed characterization, water quality modeling, stream stability assessments, and an identification of problems and solutions within the watershed. Earlier studies related to hydrology and water quality may have also been examined and included. Baltimore County has now completed watershed plans for 10 of its 14 major watersheds. The prioritization of watersheds was based on those with higher amounts of impervious surfaces.

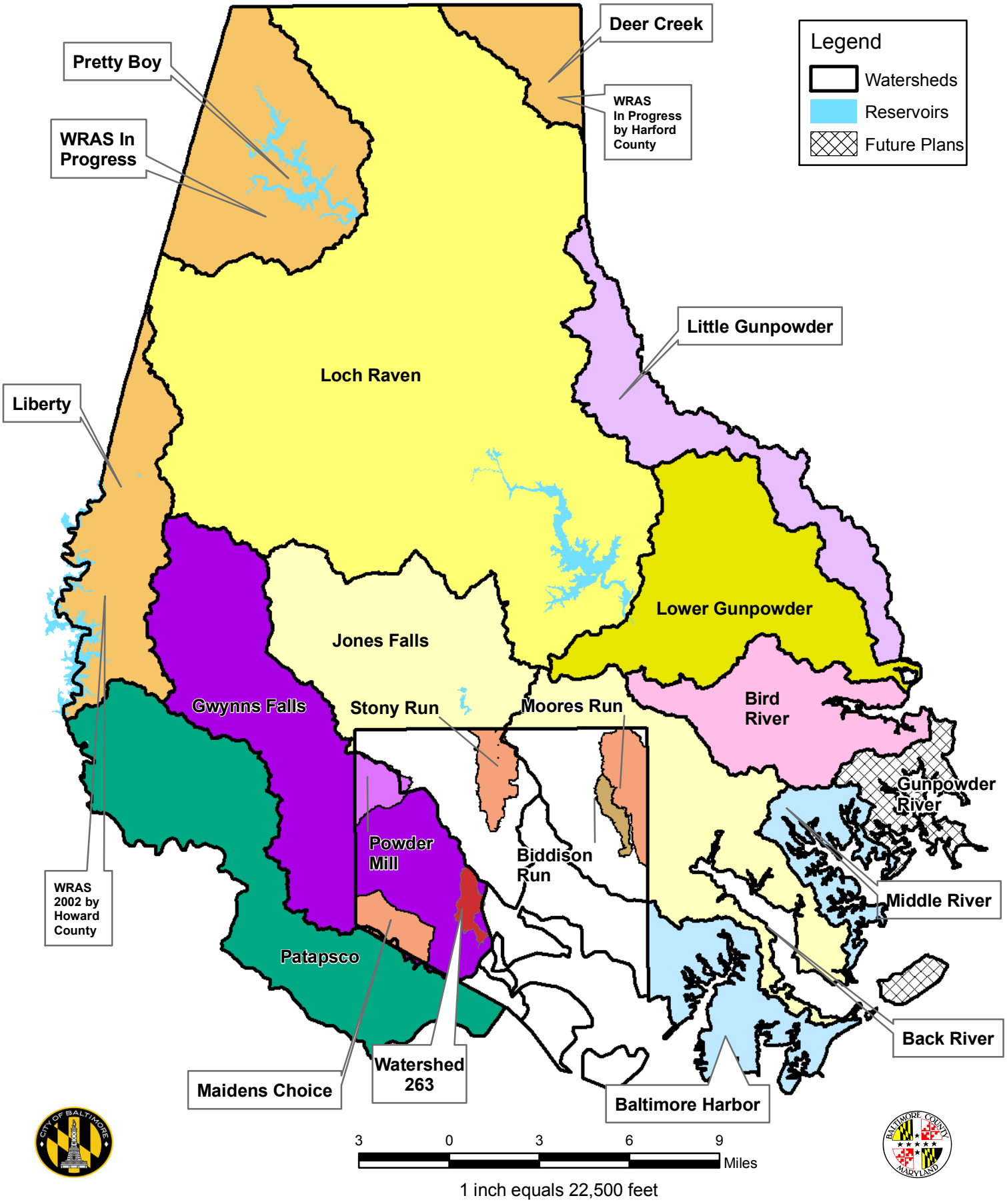
Baltimore County is currently developing Small Watershed Action Plans (SWAP). The SWAP will be prepared in collaboration with stakeholders to set protection and restoration goals for small watersheds in the county. It will outline specific actions to be taken by both the county and stakeholders in each of the watersheds to achieve protection and restoration goals. Stakeholders include business groups, community organizations, and watershed associations. Watershed associations currently implement many of the stewardship programs within the Baltimore Region. The watershed associations will help to coordinate and implement many of the restoration activities for the communities involved in the SWAP process.

Stakeholders are being urged to participate in the action planning process for a number of reasons.

- They may be aware of conditions and circumstances at the small watershed level that could affect the County's ability to accomplish desired actions.
- They represent citizens whose support is essential to make changes favorable to the watershed.
- They can become locally based experts on the watershed functions and be part of the outreach effort to other residents, businesses, and organizations.
- They can participate in watershed improvements by actions they take on their own property, whether it is via lawn care, septic system maintenance, parking lot management, reduction of impervious surfaces, planting of buffers, community education and many other practices.

The SWAP is also meant to bring together the many mandates the County is charged to meet in each individual watershed. For example, Baltimore County, along with the other local jurisdictions in Maryland, has committed to achieve the goals in Chesapeake 2000, the current Chesapeake Bay Agreement. The County is a partner in the state's "tributary strategy" program, which sets targets for nutrient reduction in order to achieve a clean Bay. The County also must meet mandates known as TMDLs (Total Maximum Daily Loads) for impaired streams and receiving waters, and has an NPDES (National Pollution Discharge Elimination System) permit that requires certain water quality goals to be met. The watershed action planning process is designed to bring all these individual mandates together at a watershed level that will help residents

# WATERSHED MANAGEMENT PLANS
# BALTIMORE CITY AND COUNTY MARYLAND

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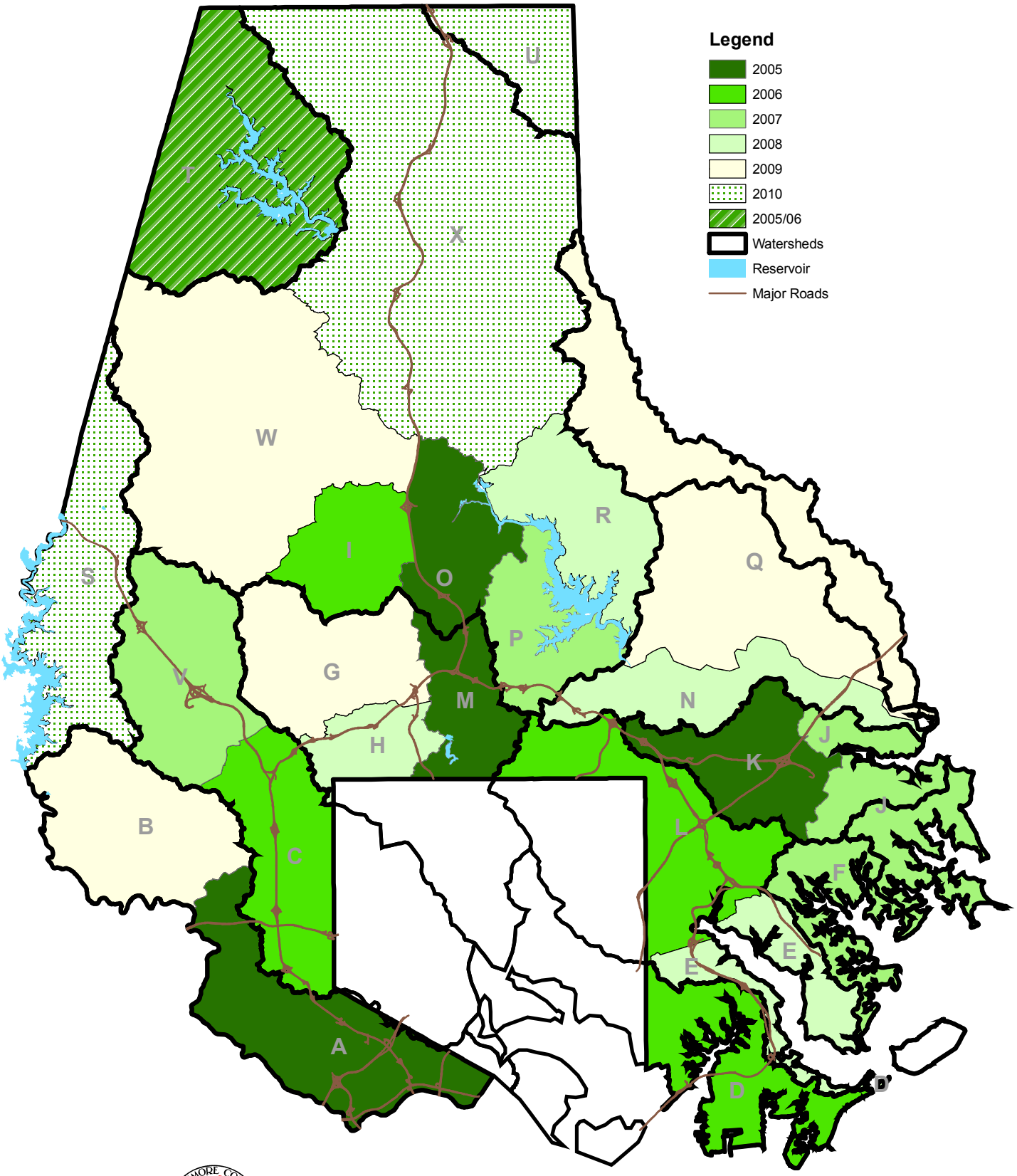
# Small Watershed Action Plans
# Baltimore County, MD




Prepared by Geographic Information Services, Baltimore County
Department of Environmental Protection and Resource Management

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understand the intent of each program, how to most efficiently meet the goals, and define the roles of the partners.

## Baltimore County and City Shared Planning Efforts

The most recently completed shared plan was for the Gwynns Falls watershed. The plan encompassed the entire watershed and was jointly funded by both Baltimore County and Baltimore City. A similar effort is underway in the Prettyboy watershed. Baltimore County and Baltimore City along with Carroll County are collaborating on a Watershed Restoration Action Strategy (WRAS) plan. The WRAS is a watershed plan for which Maryland Department of Natural Resources (DNR) and Maryland Department of the Environment (MDE) administer and provide technical assistance. Currently a stream corridor assessment along George's and Grave's Run has been completed within the City and County portion of the watershed. The assessment is planned to continue into Carroll County. The assessment identifies point source discharges to the stream, areas of stream bank erosion, and areas where the riparian buffer can be improved. Stream water samples were taken at 70 sites all throughout the watershed at road crossings. Volunteer collectors took approximately two-dozen stream insect samples in March and April of 2005. All of this information is being compiled by Maryland DNR and MDE and will be available for review in the early winter.

## Baltimore City Watershed Planning

Baltimore City's current 5-year stormwater NPDES permit requires Baltimore City to complete watershed management plans for the Gwynns Falls, the Jones Falls, the Herring Run and the Baltimore Harbor drainage before the end of the permit term, which is January 5, 2010. As was mentioned above, Baltimore City and Baltimore County worked together to complete a plan for the Gwynns Falls.

Baltimore City completed the prioritization process of selecting sub-watersheds for restoration required by this permit during the previous permit term. These watersheds contain at least 20% of Baltimore City's impervious area. In addition to the identification of Maidens Choice, Moores Run and Stony Run under the last permit, Baltimore City has selected the following three sub-watersheds to target for restoration.

- Biddison Run was selected by request of the Herring Run Watershed Association, and to build upon the on-going stream stabilization project underway in the lower portion of the watershed.
- Powder Mill was selected by consensus after discussion with Baltimore County DEPRM and the Gwynns Falls Watershed Association. The primary reason for selecting Powder Mill was that Baltimore City and Baltimore County wanted an interjurisdictional watershed in which to perform collaborative restoration efforts. The Gwynns Falls Watershed Plan provided the necessary field and desktop analysis for targeting practices in Powder Mill and a plan has been finalized.
- Watershed 263 was selected after conferring with the Parks and People Foundation. Baltimore City wanted to select a watershed that was drained entirely by underground storm drains. Other criteria included opportunities for restoration and degree of community "readiness". Watershed 263 was selected because of the numerous

opportunities for greening and impervious area removal resulting from the large number of vacant lots. Also there are several active community organizations involved in rehabilitating their neighborhoods.

Although Baltimore City will concentrate its efforts within these watersheds, Baltimore City will continue to take advantage of restoration opportunities outside of the targeted areas (e.g. school greening), especially projects with strong public support.

Before the end of the current permit term, Baltimore City needs to identify for restoration another 10% of the City's impervious surface area.

# VOLUNTEER ORGANIZATIONS

This information is provided by the following major watershed associations and volunteer organizations.

## Alliance for the Chesapeake Bay

www.AllianceChesBay.org

The Alliance for the Chesapeake Bay is a regional nonprofit organization that builds and fosters partnerships to restore the Bay and its rivers. Known as "The Voice of the Bay", the Alliance is respected as a source of unbiased information and as a neutral party on all Bay watershed issues. Through partnership building and regional cooperation, the Alliance is a coalition of educators, scientists, farmers, recreationists, environmentalists, businesses, government officials, and citizens across the Chesapeake Bay Watershed. Historically, the Alliance has been a leader in facilitating groups to come to consensus on programs that help to protect the Chesapeake Bay. Founded in 1971, the Alliance is funded by individuals, corporations, governments, and foundations. The Alliance maintains staff and offices in Baltimore, Maryland; Annapolis, Maryland; Camp Hill, Pennsylvania; Richmond, Virginia, and; Washington, DC. The Alliance also conducts related projects that extend our connections with Chesapeake Bay stakeholder groups, as well as increase our competence in habitat restoration, stewardship, citizen engagement, environmentally sound landscaping and development practices, restoration training, and river sojourns.

Through our RestoreCorps program, a program designed to mesh with the individual needs of watershed groups to build their capacity to undertake restoration, the Alliance is working or has worked with many of Baltimore City and County's watershed groups. Through these partnerships we have helped plant trees in stream valleys, designed and installed urban BayScape gardens, implemented maintenance programs on restoration sites and been a part of several "Watershed Snapshots", an annual picture of the water quality in a watershed that is taken by volunteers across the entire watershed.

Project Clean Stream is a coordinated effort by the Alliance and partners to clean trash, tires and other discarded items from area streams, stream valleys and nearby roadsides. Project Clean Stream is the area's largest one-day stream and watershed clean up effort. In 2005, 1300 volunteers cleaned over 90 sites in Central Maryland and the Eastern Shore and recovered nearly 63,000 pounds of trash. 2005 partners include local watershed associations, and local city and county government.

In 2005, the Alliance has partnered with Baltimore County, the Center for Watershed Protection, the Homebuilders Association of Maryland and several funding organizations to implement "Builders for the Bay". Builders is a local, roundtable process designed to address obstacles in the current building codes to undertake environmentally sound development.

## Friends of the Patapsco Valley and Heritage Greenway

www.patapscoheritagegreenway.org.

The Friends of Patapsco Valley and Heritage Greenway (FPVHG) is a non-profit, 501(c)(3) organization of volunteers who are dedicated to preserving, protecting, interpreting and restoring the environment, history and culture of the Valley. We translate this mission into two primary goals: 1) telling the story of the valley 2) protecting the valley. While we do not own property and we are not a governmental organization, we do try to encourage the positive management of the Patapsco Valley, including the Patapsco State Park and the surrounding communities. We also are actively involved in developing educational materials about the environment and the history of the valley. Finally, we are actively involved with interpreting the story of the valley.

In support of our Environmental Mission, we completed our sixth annual "Garlic Mustard Challenge" on May 1, 2005. FPVHG utilizes the Garlic Mustard Challenge to educate the community about the importance of understanding the balance of nature. Garlic Mustard is a native plant of Europe and was first recorded in the United States about 1868 in Long Island, New York. Settlers probably introduced it for food and medicinal purposes. Garlic Mustard, like other "invasives," poses a severe threat to native plants and animals in forest communities in much of the eastern United States. To date, volunteers have picked over 4,840 pounds of Garlic Mustard. To peak interest and make a fun event, we have a cooking contest open to both professional chefs and amateurs. Everyone gets to taste the food, which is excellent especially with the backdrop of live music from a local musician. Prizes are given to those who pick the most as well as to the winning recipes. The positive educational exposure has grown exponentially each year.

Also supporting our environmental mission, we sponsor stream and road-side cleanups throughout the year. At our January 26, 2005 annual meeting, “Parks in Crisis.” The program highlighted a park crisis, extending from our national to our local parks as our public lands suffer from inadequate and budget cuts. The Patapsco Valley State Park staff was slashed in 2005 to 13 to cover the 27-mile long park.

In support of our Historical Mission, we sell Professor Henry Sharp’s book, "The Patapsco River Valley? Cradle of the Industrial Revolution in Maryland.” It is a wonderful, descriptive book about our Patapsco Valley. FPV&HG was responsible for funding Dr. Sharp’s initial research as well as helping him write the manuscript in preparation of the publication of the book by the Maryland Historical Society. Read it!

In support of our mission to tell the story of the valley and preserve its culture, we sponsored “A Winter’s Feast” on March 6, 2005. This family-oriented program included an outdoor picnic (inside a semi-enclosed shelter), pot luck dinner, hike along the Patapsco River, sing-along songs and stories about winter in the Patapsco Valley and knot demonstrations by a local boy scout troop. Our organization also assisted the Patapsco Park staff develop interpretive signage for 13 historical locations along the Patapsco Heritage Trail within the Avalon section of the Park. In addition, we sponsored the final performance of the Patapsco Players as various members of the cast moved on in either their professional development or moved to other parts of our of the country. Their presentation of what it was like at an earlier time in the Patapsco Valley was videotaped.

The Friends of the Patapsco Valley and Heritage Greenway is a non-profit organization that believes that the Patapsco Valley is our local treasure. We are working to preserve, protect and interpret its history, culture and environment. We are working with local organizations to showcase sites and activities in Elkridge, Oella, Ellicott City, Catonsville and the Valley. You should become a member! Call 410-480-0824 or visit our web site listed above.

## Gunpowder Valley Conservancy

www.gunpowdervalley.org

The GVC is a non-profit group *dedicated to preserving the character, history and environmental integrity of the Gunpowder River watershed*. The 450 square-mile watershed covers the northeastern half of Baltimore County and smaller parts of adjoining counties. The watershed boasts some of Maryland's best trout fishing, scenic canoeing and miles of hiking trails. The two reservoirs within its boundaries--Loch Raven and Prettyboy--supply greater Baltimore with 61% of its drinking water:

GVC has programs and activities in four main areas: (1) land preservation, (2) stream restoration, (3) cleanups, and (4) area history.

- **Land Preservation.** GVC has raised over $4.3 million from public and private sources and holds conservation easements on 1000 acres in the watershed. Areas targeted for preservation include (1) the Coastal Rural Legacy Area which includes the shore areas of Baltimore County southeast of Dundalk, Essex and White Marsh, (2) the "Gunpowder River Rural Legacy Area" located east of York Road between White Hall and Sparks, and (3) other rurally-zoned farmland and forestland in other parts of the watershed.
- **Stream Restoration.** To help protect our drinking water, streams, and the Chesapeake Bay, the GVC has conducted extensive tree plantings in the watershed in partnership with local schools, scout groups, service clubs, and other conservation groups. GVC is also working with Baltimore County's Dept. of Environmental Protection (DEPRM) and local HOAs to replant forest areas in rural parts of the county and give residents knowledge and tools that help them be good stewards of the land.
- **Cleanups.** For three years the GVC has partnered with the Friends of Loch Raven, an offshoot of the GVC Streams Committee, to clean up the reservoir shores. The October 2004 cleanup attracted over 250 volunteers, including many prominent elected officials. Volunteers gathered over 200 sacks of rubbish, tires, and large pieces of debris from the shoreline's edge. The GVC also leads stream clean-ups every April as part of the statewide "Project Clean Stream" day.
- **Area History.** GVC has conducted several educational conferences on the history of the Gunpowder watershed & parks, and has been instrumental in the designation of Franklinville as a historic village. Currently, the GVC is working with the Friends of Cromwell Valley Park on the expansion of the Gunpowder Scenic Byways.

Upcoming events and contact information:

- **Sun. Oct 9th 2005 – 4th Annual Loch Raven Clean-up.** For details contact Paula Kurrus at (410) 683-3144 or email FriendsLochRaven@aol.com.
- **Sat. Oct 29th 2005 - Stream buffer tree-planting** at Dulaney Branch near Peirce's Plantation. For details contact Con Manning: 410-667-0641 or email cmanning@comcast.net
- **Land Preservation activities**: contact Ric Bryant at 410-583-5960

  or email rbryant@jsmonline.com.

For information on becoming a GVC member or to collaborate with GVC on new projects, contact Dave Greene at 410-769-9556 or email david_greene@ipswitch.com.

## Gwynns Falls Watershed Association

www.gwynnsfalls.net

The Gwynns Falls Watershed Association, (GFWA) is a non-profit volunteer organization dedicated to the protection and enhancement of the Gwynns Falls watershed as a community resource for the people of Baltimore City and County. Since its formation in 1997, it has worked with community groups to create awareness of streams and their degraded condition and conduct restoration activities within the 65 square mile watershed.

Grant funding, memberships and fundraising has enabled the organization to implement stream restoration and outreach activities, resulting in thousands of volunteer hours donated for stream cleanups, tree plantings and creating greater public awareness of the streams within the Gwynns Falls watershed. The GFWA created a Stream Watch program, through which volunteer teams are trained to monitor and report on the condition of their adopted streams.

The Restoration Partnership program with the Center for Watershed Protection (CWP) determined potential areas for stream restoration activities. Volunteers were recruited and trained to evaluate and monitor stream conditions using CWP's USA and USSR protocol within three sub-watersheds. The data collected will develop a prioritized list of restoration projects, which will be implemented with additional funding.

This spring brought a new watershed initiative to the Gwynns Falls. Thanks to Baltimore City Recreation & Parks, Conservation and Community Outreach staff and a grant from NFWF, GFWA was able to implement a very successful Weed Warrior program. Partnering with a variety of Gwynns Falls communities, GFWA organized 5 separate events aimed at removing rapidly growing invasive species and replacing them with native plants. Particularly successful projects were conducted in the Windsor Hills and Dickeyville communities.

## Herring Run Watershed Organization

www.herringrun.org

The Herring Run Watershed Association (HRWA) is a grassroots, volunteer-based watershed organization active in our watershed within Baltimore City and Baltimore County. The Herring Run watershed is 45 square miles and provides the majority of the water to Back River. The watershed is highly urbanized with degraded

streams flowing through more industrial, and denser development as it flows downstream.

The HRWA mobilizes volunteers for environmental stewardship through outreach, public education, and advocacy. Our main focus has been reducing sewage in our streams, advocating for the cleanup of contaminated landfills and changing homeowner behaviors to improve the stream. We have also been active to restore our watershed through hands-on projects that take people to the stream, show them its problems, and take actions to solve those problems. Below is a list of our activities:

Planting trees to reduce runoff:

- HRWA maintains its own native tree and shrub nursery for projects throughout the watershed. We also sell native trees and shrubs to the public. This year we have planted over 550 trees including creating 2 acres of new riparian buffers along our streams.
- HRWA has a pilot street tree survey and planting program, called the Green Streets Initiative in Belair-Edison Neighborhood in Baltimore City. This neighborhood has the lowest tree canopy coverage within the Herring Run Watershed. The community is actively involved in the revitalization of the neighborhood. Over the past two years, our surveys determined the health of the trees, numbers, and locations to plant trees. We found that there are 916 street trees and the potential to plant at least 1,500 new street trees in existing empty pits. We have also assisted in getting 70 street trees planted to date with 30 or more scheduled to occur this fall. In addition, we have located targeted blocks in the neighborhood where HRWA will create new pits and then plant a new tree. Mature street trees help to reduce stormwater runoff volumes, reduce home energy requirements, improve the community look, and clean the air. The Chesapeake Bay Trust funded this program. Baltimore City Recreation and Parks Forestry and the Parks and People Foundation have provided technical assistance. Belair-Edison Neighborhoods Inc. and Belair-Edison Community Association are partners in planning and planting.

Taking action to reduce stormwater runoff from homes:

- HRWA has a rain barrel manufacturing, education, and outreach program. We encourage communities to consider disconnecting their downspouts and provide information to create rain gardens. We sell rain barrels to the public to encourage their use. To date we have given away or sold over 90 rainbarrels, all made with the care of volunteers.

Developing watershed plans:

- HRWA is working on three sub-watershed plans for the Western Branch, Moores Run, and Biddison Run watersheds. These plans will identify community goals and projects that HRWA and volunteers can implement. HRWA collects missing stream and watershed data to supplement existing data collected by our partners. The plans will also identify focus areas for HRWA education, outreach, advocacy, and restoration programs while providing needed data to our local government partners.

Monitoring our streams for sewer overflows:

- HRWA also supports and helps organize members of the community to advocate for the cleanup of our sewer system. We train volunteers to identify and report sewer problems. We participate in the Baltimore Sanitary Sewer Oversight Committee, a coalition of advocates whose mission is to ensure that the cleanup of our sewers results in the least environmental damage.
- HRWA monitors the water quality of Baltimore City portion of the watershed. We also help to detect sewer overflows with a partnership project with Baltimore City. HRWA samples 14 sites weekly to detect sewer overflows throughout the City portion of the watershed. In addition, Stream Team Members keep an eye on the streams and report stream problems.

Creating a green urban watershed center:

- HRWA purchased its office in the summer of 2004 and the members have a vision of a vibrant urban Watershed Center. Our goal is to rehabilitate the building through green building techniques to achieve a silver level set by the US Green Building Council's Leadership in Environmental and Energy Design, LEED. Recently, we received our first funding from the Abell Foundation to begin the renovation.

HRWA was founded in the mid-nineties and continues to be strong in the areas of restoration, advocacy, and education. We feel that the next great challenge to addressing our streams health is fixing the uncontrolled stormwater that flushes our stream during every rainstorm from the consequences of impervious surface. We will need many partners to address this problem.

## Irvine Nature Center

www.explorenature.org

The Irvine Nature Center is a non-profit environmental education organization whose mission is to inspire appreciation and respect for the natural world, to increase awareness of environmental issues, and to encourage individuals to sustain earth's ecosystem. Since its inception thirty years ago, the Irvine Nature Center has provided environmental education programs and community outreach activities to engage people in sharing nature's wonder.

As the only private non-profit nature center in the region, Irvine's programs include school field trips; Schoolyard Discovery urban outreach; installing schoolyard habitats; a variety of natural history public programs for children, families, and adults; nature-themed summer camps; scout programs; volunteer naturalist training; Habitat Stewards training; and special events such as PumpkinFest, Bird-A-Thon, Native Plant Seminar and Sale, and Project Clean Stream.

Now in its 30th year, Project Clean Stream is a coordinated effort by Irvine and many partner organizations to clean trash, tires, and other discarded items from area streams and nearby roadsides. Project Clean Stream is the region's largest, and oldest, one-day stream and watershed clean up effort, and in 2004 Irvine turned the helm over to the Alliance for the Chesapeake Bay with the intention that the event will continue to

grow in size to incorporate more of Maryland's imperiled watersheds. In 2005, more than 1,200 volunteers cleaned at over 100 sites in Baltimore City and six surrounding counties.

The nature center also features, on-site, a natural history museum, hands-on exhibits in the Kids' Corner, live animals (21 species), a green house, demonstration gardens, a self-guided nature trail, and a fabulous nature store. The Center is free and open to the general public seven days a week, year round, except for major holidays. For more information contact: Irvine Nature Center, 8400 Greenspring Avenue, Stevenson, MD 21153, 410-484-2413, or via email at irvine@explorenature.org.

## Jones Falls Watershed Association

www.jonesfalls.org

The Jones Falls Watershed Association (JFWA) is a volunteer-driven grassroots organization started in 1997 to protect and restore the Jones Falls and its tributaries. The mission of the Jones Falls Watershed Association is to protect and restore the health and beauty of the Jones Falls watershed through restoration, monitoring, advocacy, and citizen awareness. The organization is credited with bringing attention back to the river and building awareness of the stream and stream valley as natural resource assets for the community.

The Jones Falls watershed encompasses fifty-eight (58) square miles including rural segments of Baltimore County at its upper reaches. The stream meanders through increasing levels of development until it emerges from a tunnel at Baltimore City's Inner Harbor.

The JFWA is a primary partner with Baltimore City on the Jones Falls Trail. The trail route will eventually connect Baltimore's Inner Harbor with Robert E. Lee Park and Lake Roland. The JFWA is assisting with signs, promotion and other trail enhancements. The watershed association also sponsors the Jones Falls Valley Celebration, the Concert Under the Arch and canoeing/kayaking events. Volunteer activities include trash cleanups, water quality monitoring, buffer plantings and outreach. Additionally, volunteers assist with outreach and work with large landowners in the watershed to improve land management practices to improve water quality.

Stream Watch is a partnership between the JFWA, the Center for Watershed Protection and the Baltimore County Department of Environmental Protection and Resource Management. The program matches neighbors with their backyard streams to provide monitoring of stream conditions. Training and more or less depending on the time commitment desired and the accessibility of the stream segment. The following is a list of adoption levels that may be selected by the volunteer:

- Stream Cleaner- Volunteers remove trash from their adopted section on a quarterly basis.
- Stream Walker - Volunteers complete an assessment form that helps describe the health of the stream and the conditions of the riparian area.

- Stream Watcher - Volunteers complete the duties of the Stream Cleaner and Stream Walker and provide more detailed information sheets on specific conditions in their adopted section.

Other Stream Watch programs occurring during the year include the Snap Shot program where members take grab samples from the stream and may also collect water insects for analysis with Maryland DNR's Maryland Biological Stream Sampling program.

This year the organization bade Christel Cothran a fond farewell and a new executive director, Halle Van der Gaag, has been named. Halle has several years of experience with urban environmental issues and community based project management. In her previous position with the Trust for Public Land, a national land conservation organization, Halle worked with partners in Baltimore City to build and implement the recently complete Gwynns Falls Trail in west Baltimore.

## Parks & People Foundation

www.parksandpeople.org
www.trees.soundprint.org/watershed 263
beslter.org
www.gwynnsfallstrail.org
www.revealbaltimore.org
www.urbanecologycollaborative.org

The Parks & People Foundation is dedicated to supporting a wide range of recreational and educational opportunities; creating and sustaining beautiful and lively parks; and promoting a healthy natural environment for all. Established in 1984, the Parks & People Foundation is a non-profit organization that strives to improve the quality of life for all people in the Baltimore area through educational and recreational programs that motivate young people and through partnerships that create and sustain green spaces.

Our staff, partners, and volunteers in the community have developed innovative solutions to issues facing Baltimore including the restoration of neighborhoods and their natural resources as well as the academic enrichment and motivation of our children. In order to realize our vision of a healthy environment where people live, work, learn and play, we have formed a strategy targeting two major fields of endeavor:

- Great Parks, Clean Streams & Green Communities - Helping to improve the physical, social and environmental quality of neighborhoods through greening activities and forming networks among communities to sustain natural resources.

- Motivating Youth - Programs nurturing children and supporting communities by working together to provide enriching activities for youth.

We are proud of our efforts to develop incredible parks and trails, such as the Gwynns Falls Trail and Greenway. Our greening programs also include community forestry, tree planting, as well as vacant lot, schoolyard and watershed restoration supported by U.S. Forest Service, Maryland Forest Service, Chesapeake Bay Trust, and many others. We also work closely with other organizations on projects that increase recreational opportunities and protect Baltimore’s natural resources including the Urban Resources

Initiative, Park Partnership Program, and Baltimore Track FAC with Baltimore City Department of Recreation and Parks, as well as Baltimore/Chesapeake Bay Outward Bound Program, Baltimore Ecosystem Study, Baltimore Alliance for Great Urban Parks, and nationally, the City Parks Alliance and the Urban Ecology Collaborative.

In urban areas across the country, we have replaced trees and grass with too much asphalt and concrete. Storm water runoff from impervious surfaces in cities can carry harmful substances such as gasoline, oil, heavy metals, bacteria, and trash to our streams and bays. In Baltimore City, Maryland, Parks & People Foundation, Baltimore City Department of Public Works, U.S. Forest Service, Baltimore Ecosystem Study, and many other partners have joined forces to clean up the runoff flowing into the harbor and into the Chesapeake Bay from Watershed 263, one of 355 storm drain watersheds in the city. Watershed 263 is a 930-acre area in west and southwest Baltimore City that encompasses 12 urban neighborhoods. Surface water that collects on streets in Watershed 263 flows untreated into the Baltimore Harbor after traveling through a 43-mile storm drain system (underground river system) that converges into one outfall pipe near the mouth of Gwynns Falls, in the Middle Branch. Water quality in the Chesapeake Bay is adversely affected by urban areas such as Watershed 263. Project partners are all making unique contributions to the common goal of measurably improving water quality and quality of life in this particular watershed area in Baltimore City. To hear the story of Watershed 263 go to http://www.trees.soundprint.org/watershed263

## Prettyboy Watershed Alliance

www.prettyboywatershed.org.

The Prettyboy Watershed Alliance (PWA) is a citizen-led organization created to promote landowner stewardship, build public-private partnerships and advocate watershed protection and restoration throughout the region. PWA received its 501(c) 3 status in July, 2005.

The Prettyboy watershed is an 80 square mile drinking water source watershed. It extends from northwestern Baltimore County into the northeastern corner of Carroll County and a sliver of York County, PA. Land-uses in the rural watershed are primarily farming-oriented with 47% of the area in agriculture and only 15% of the land developed. The remaining 38% is made up of forest, wetlands and water. The watershed is the headwaters of the Gunpowder watershed. The Prettyboy Reservoir along with Loch Raven Reservoir, downstream, provide 61% of the drinking water for the entire Baltimore Metropolitan system.

The Alliance for the Chesapeake Bay's RestoreCorps Program is currently partnered with the PWA to assist with capacity building. With this and other support, PWA has conducted public presentations throughout the watershed, including a Bayscaping Workshop and the planting of a Bayscaping Garden at the North Carroll Library in Hampstead. In October two tree plantings were conducted with volunteers at the site of the future Leister Park in Hampstead

As a recently formed watershed group the challenge continues to be creating opportunities for local stakeholders to buy into the mission and goals of the Alliance in the coming year. PWA is in the process of completing a grant (Prettyboy Watershed Education and Outreach Program) from the National Fish and Wildlife Federation. The

Alliance is working with DEPRM through the Prettyboy WRAS and anticipates continuing the relationship with DEPRM through the Stream Watch Program. This summer several members of the Alliance participated in the Stream Waders Program. A partnership is also being formed with the Baltimore County Soil Conservation District. PWA has received a grant from the Chesapeake Bay Trust to conduct a storm drain stenciling program in Carroll County. Meetings have been held with government agencies in Carroll County to begin building partnerships there. PWA has a new but very enthusiastic Board which is one of its greatest assets.

## Middle River Watershed Community Action Coalition

www.chesapeakebaymemories.org

Over the past three years, Eastern Baltimore County based Chesapeake Bay Memories Charities has engaged over 6,000 Baltimore County residents in Chesapeake Bay stewardship education and restoration activities with an emphasis on encouraging and monitoring water quality improvement.

People who learn, live, work and play in the Middle River watershed want a more focused collaborative water quality improvement effort. To effectively address implementation of this effort, the Charity recently established the Middle River Watershed Community Action Coalition.

Middle River Watershed Community Action Coalition's mission will be to make measurable progress in restoring Middle River watershed water quality by actively reaching, educating, organizing and engaging the Middle River watershed community in the following:

- local watershed issues identification, prioritization, and development of action plans to address them, and
- water quality improvement and potential restoration project identification, information gathering, planning, implementation and monitoring.

Gradually over a 3-year period this will become an expanded interconnected community-wide effort to increase stakeholder awareness, organization, action, ownership, and pride in ongoing active participation in informed effective collaborative local level Chesapeake Bay stewardship and connections to regional efforts.

Want to help get others informed, excited, and active in being a part of this effort? Contact Chesapeake Bay Memories Charities, 1000 Beech Drive, Middle River, MD 21220, 410-918-2225, or via e-mail at penny@chesapeakebaymemories.org.

# RESOURCE LIST

| *Organization* | *Support* |
|---|---|
| **The Alliance for the Chesapeake Bay**<br>Mr. David Bancroft, Director<br>Phone: 410-377-6270<br>www.acb-online.org/<br>Mail@acb-online.org | Project Tech Support<br>Watershed Awareness<br>Information<br>BayScaping |
| **Baltimore City**<br>Mr. Bill Stack<br>Division of Environmental Services<br>WQ Management Office<br>Phone: 410-396-0732<br>Bill.stack@baltimorecity.gov | Regional Watershed Coordination<br>City Water Quality Data<br>Greening Schools Program |
| **Baltimore City Department of Recreation and Parks**<br>Mr. Nathaniel Massaquoi, Public Information Officer<br>Phone: 410-396-7900<br>bcrpgeninfo1@baltimorecity.gov<br>http://www.ci.baltimore.md.us/government/recnparks/ | Nature Centers<br>Trail Systems |
| **Baltimore County Department of Environmental Protection and Resource Management (DEPRM)**<br>Phone: 410-887-3733<br>deprm@co.ba.md.us<br>www.baltimorecountyonline.info/deprm | Local Regulations<br>Green Schools Program<br>Capital Projects<br>Regional Watershed Coordination |
| **Baltimore County Department of Public Works**<br>Recycling Division<br>Mr. Clyde F. Trombetti, Jr.<br>Phone: 410-887-2000<br>www.co.ba.md.us/Agencies/publicworks/recycling/index.html<br>publicworks@co.ba.md.us | Solid Waste Management<br>Recycling<br>Education |
| **Baltimore County Department of Recreation and Parks**<br>Mr. Jan Cook, Local Open Space<br>Phone: 410-887-2505<br>Fax: 410-825-3305<br>rpnorthwest@co.ba.md.us<br>www.co.ba.md.us/Agencies/recreation/index.html | Nature Centers – Oregon Ridge, Marshy Point, Days Cove, Cromwell Valley<br>Education Programs<br>Natural History |
| **DNR Forester for Baltimore County**<br>Mr. Rob Prenger<br>Cub Hill Ranger Station<br>Phone: 410-665-5991 | Community Greening Committee<br>Right-of-Way Planting Permits |
| **Baltimore County Forestry Board**<br>Mr. Glen Ferenschak<br>Phone: 410-887-3518<br>www.bcfb.sailorsite.net/<br>mlnoland@bcpl.net | Tree Planting Projects<br>Schoolyard Reforestation<br>Wildlife Habitat Program<br>Schoolyard Assessment<br>Teacher Training |

# RESOURCE LIST

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|---|---|
| **Baltimore County Public Schools**<br>Mr. C. David Copenhaver, Science Coordinator<br>Phone: 410-887-2063<br>ccopenhaver@bcps.org<br>www.bcps.org | Administration – Baltimore County Public Schools |
| **Bear Creek Watershed Association**<br>no coordinator at present | Coordination of Local Watershed Activities |
| **Businesses for the Bay**<br>MDE<br>Ms. Laura Armstrong 410-537-4119<br>Ms. Mary Lynn Wilhere 1-800-968-7229x719<br>www.b4bay.org<br>larmstrong@mde.state.md.us | Pollution Prevention Program for Businesses<br>Recognition Program |
| **Center for Watershed Protection**<br>Mr. Tom Schueler<br>Phone: 410-461-8323<br>center@cwp.org<br>www.cwp.org | Watershed Data<br>Presentations<br>Workshops and Training<br>Technical Assistance<br>Water Quality Information |
| **Chesapeake Bay Foundation** (CBF)<br>Philip Merrill Environmental Center<br>Phone: 410-268-8816<br>Chesapeake@cbf.org<br>www.cbf.org/site/PageServer | Raingardens Manual<br>School Programs<br>Demonstration Sites |
| **Chesapeake Bay Program**<br>410 Severn Avenue / Suite 109<br>Annapolis, MD 21403<br>Tel: (800) YOUR-BAY / Fax: (410) 267-5777<br>http://www.chesapeakebay.net/index.cfm | Bay Program Publications<br>Meeting Minutes<br>Calendar of Events<br>Grants and RFPs |
| **Chesapeake Bay Trust**<br>Ms. Kerri Bentkowski<br>Phone: 410-974-2941<br>kbentkowski@cbtrust.org<br>www.chesapeakebaytrust.org | Grant Funding |
| **Environmental Concern**<br>Ms. Mandy Burch, Restoration Specialist<br>Phone: 410-745-9620<br>restoration@wetland.org<br>www.wetland.org | POW guide (Planning of Wetlands)<br>Training Workshops |
| **Friends of the PatapscoValley and Heritage Greenway**<br>Mr. Kit Valentine<br>Phone: 410-747-4325<br>kibe@juno.com<br>www.patapscoheritagegreenway.org | Coordination of Local Watershed Activities |

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| **Gunpowder Valley Conservancy**<br>Mr. Charles Conklin<br>Phone: 410-661-1233<br>cconklin@comcast.net<br>www.gunpowdervalley.org | Coordination of Local Watershed Activities |
| **Gwynns Falls Watershed Association**<br>Mr. Eric Jones<br>Erik.N.Jones@ssa.gov<br>www.gwynnsfalls.net | Coordination of Local Watershed Activities |
| **Herring Run Watershed Association**<br>Ms. Mary Roby, Director<br>Phone: 410-254-1577<br>Mroby@herringrun.org<br>www.herringrun.org | Coordination of Local Watershed Activities |
| **Irvine Nature Center**<br>Mr. W. T. Dixon Gibbs Jr., Director<br>Phone: 410-484-2413<br>irvine@explorenature.org<br>www.explorenature.org/ | Project Tech Support<br>Habitat Stewards Training<br>School Programs<br>Native Plant Sales<br>Annual Conference |
| **Jones Falls Watershed Association**<br>Ms. Halle Vander Gaag, Program Director<br>Phone: 410-261-3515<br>hvandergaag@greaterhomewood.org<br>www.greaterhomewood.org | Community Organizing<br>Volunteering<br>Events<br>Planning and Coordination<br>Landscape Assessment |
| **Living Classroom Foundation**<br>Mr. Scott Raymond, V.P. of Education<br>Phone: 410-685-0295 x217<br>Scott@livingclassrooms.org<br>www.livingclassrooms.org | Educational Programs<br>Teacher Training<br>Staff Development |
| **Maryland Biological Stream Survey**<br>Mr. Paul Kazyak<br>Phone: 410-260-8607<br>http://www.dnr.state.md.us/streams/mbss/<br>Stream Waders:<br>http://www.dnr.state.md.us/streams/mbss/mbss_volun.html | Biological Data<br>County Technical Reports<br>Publications<br>Stream Waders Citizen Program |
| **MD Association for Environmental and Outdoor Education** (MAEOE)<br>Ms. Carol Towle<br>Phone: 410-827-7145<br>director@maeoe.org<br>www.maeoe.org | Green Schools Program<br>Annual Conference<br>Schoolyard Habitat Partners<br>Environmental Education Training |

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| **MD Cooperative Extension**<br>Baltimore County Office<br>Phone: 410-531-5973<br>WT4@umail.umd.edu<br>www.agnr.umd.edu/MCE/index.cfm | Information<br>BayWise Landscaping<br>Yardstick Program<br>Pest Management |
| **MD Department of Agriculture**<br>Mr. Earle Canter, Urban Nutrient Specialist<br>Phone: 410-841-5959<br>canterme@mda.state.md.us<br>http://www.mda.state.md.us | Guidelines: Urban Nutrient Management Plans<br>Training |
| **MD Department of Natural Resources**<br>Ms. Cindy Etgen<br>cetgen@dnr.stae.md.us<br>www.dnr.state.md.us | Green Schools Program<br>Tree-Mendous MD<br>Storm Drain Stenciling<br>Grant Funding |
| **MD Department of the Environment**<br>Mr. Kendl P. Philbrick, Secretary<br>Phone: 410-537-3000<br>www.mde.state.md.us | Businesses for the Bay Program<br>Funding<br>Hazardous Waste Issues |
| **MD Native Plant Society**<br>consultants@mdflora.org<br>www.mdflora.org | Native Plants<br>Invasive Species<br>Plant Lists |
| **MD State Department of Education**<br>Phone: 410-767-0100<br>www.msde.state.md.us | Environmental education |
| **Parks and People Foundation**<br>Mr. Guy Hager<br>410-448-5663<br>info@parksandpeople.org<br>www.parkandpeople.org | Watershed organizing & restoration<br>Urban forestry<br>Small grants<br>Park partnerships<br>Surveys and planning |
| **Soil Conservation Service District Office**<br>Agricultural Building<br>Phone: 410-666-1188<br>bcscd@yahoo.com<br>www.mda.state.md.us/balt/balt.htm | Nutrient Management Program |
| **Towson University**<br>Ms. Jane Wolfson, Environmental Science and Studies Program<br>Phone: 410-704-4920<br>Jwolfson@towson.edu | University Science Contact |
| **Total Maximum Daily Load**<br>Maryland:<br>http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp<br>US EPA National: http://www.epa.gov/OWOW/tmdl/index.html<br>US EPA Region 3: http://www.epa.gov/reg3wapd/tmdl/index.htm | Total Maximum Daily Load (TMDL) information |

# RESOURCE LIST

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|---|---|
| **Tree-Mendous MD Program**<br>Ms. Terry Galloway<br>Phone: 410-260-8517<br>Tgalloway@dnr.state.md.us | Native Plants |
| **UMBC – Baltimore Ecosystem Study (BES)**<br>Mr. Ken Belt<br>Phone 410-455-8011 | Research |
| **US Fish and Wildlife Service**<br>Phone: 410-573-4500<br>www.fws.gov | BayScaping<br>Wetlands and Ponds<br>Schoolyard Habitat Program |
| **Valleys Planning Council**<br>Ms. Teresa Moore<br>Phone: 410-337-6877<br>www.thevpc.org | Community Stewardship<br>Land Preservation |

**THE BALTIMORE WATERSHED AGREEMENT**

**MEMORANDUM OF UNDERSTANDING**
**BY AND BETWEEN**
**THE MAYOR AND CITY COUNCIL OF BALTIMORE**
**AND**
**BALTIMORE COUNTY**
**FOR**
**WATERSHED MANAGEMENT COOPERATION**

**THIS MEMORANDUM OF UNDERSTANDING** made this _____ day of _____, 2002 by and between the Mayor and City Council of Baltimore, a municipal corporation of the State of Maryland (hereinafter referred to as "Baltimore City") and Baltimore County, Maryland, a body corporate and politic of the State of Maryland (hereinafter referred to as "Baltimore County").

**WHEREAS**, although politically independent, Baltimore City and Baltimore County are part of a greater metropolitan area, having developed in relation to one another historically and geographically. Citizens of Baltimore City and Baltimore County value and enjoy the recreational, economic, and aesthetic water resources associated with streams in our inter-jurisdictional watersheds, including the Baltimore Harbor and the Patapsco and Back Rivers and other tidal waterways; and

**WHEREAS**, this geographical relationship dictates that the quality of surface water resources within these systems is influenced by water sources originating in the Gwynns Falls, Jones Falls, Back River, and Baltimore Harbor watersheds of Baltimore County. Inter-jurisdictional cooperation is also critical for the management and protection of Baltimore City-owned municipal water supply reservoirs and other facilities located in Baltimore County; and

**WHEREAS**, in 1993 and 2000, Baltimore City and Baltimore County each signed local Partnership Agreements with the State of Maryland to work cooperatively as part of Chesapeake Bay Tributary Strategy Teams in the development and implementation of watershed protection and restoration programs. Baltimore City and Baltimore County seek to strengthen partnerships and cooperative efforts with federal and state agencies in carrying out those agreements, and desire to coordinate strategies that address Chesapeake Bay Agreement goals and objectives for natural resources and habitat, including protection and restoration of forest corridors and wetlands; and

**WHEREAS**, the major inter-jurisdictional watersheds are served by citizen-based watershed organizations and regional non-profit water quality and natural resource organizations, all of which interact with the environmental agencies and programs of Baltimore City and Baltimore County; and

**WHEREAS**, Baltimore City and Baltimore County, in response to provisions of the Federal Clean Water Act pertaining to non-point sources of water pollution and as authorized by the Maryland General Assembly, entered into a regional Reservoir Watershed Management Agreement with other jurisdictions and agencies in 1979. The Agreement was strengthened in 1984 and re-affirmed in 1990. Baltimore City and Baltimore County will continue to work cooperatively to protect the regional drinking water supplies through the management program facilitated by the Baltimore Metropolitan Council; and

**WHEREAS**, Baltimore City and Baltimore County must each implement watershed-based efforts to control and reduce sources of non-point source pollution, under jurisdiction-wide permits issued in 1993 and 1999 to Baltimore City and in 1995 and 2000 to Baltimore County under the continuing Municipal Separate Storm Sewer System program issued by the Maryland Department of the Environment to meet provisions of the Federal Clean Water Act's National Pollutant Discharge Elimination System (NPDES); and

**WHEREAS**, future environmental regulatory programs will place an increasing responsibility on Baltimore City and Baltimore County. Through increased cooperation and coordination, Baltimore City and Baltimore County can promote unified strategies to meet their responsibilities more effectively and efficiently and can collaborate in seeking funding for programs. A watershed agreement will assist in securing the necessary funding for enhanced stormwater maintenance, coordination of watershed monitoring, and implementation of restoration programs; and

**WHEREAS**, enhanced coordination between Baltimore City and Baltimore County will help the jurisdictions comply with revised water quality criteria and standards and will facilitate the development and implementation of programs in response to Total Maximum Daily Loads (TMDLs) as required by the Federal Clean Water Act.

**NOW THEREFORE, THIS MEMORANDUM OF UNDERSTANDING WITNESSETH** that, in consideration of the mutual covenants set forth herein, and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

**I**. Baltimore City and Baltimore County hereby acknowledge that they embrace common goals for management of the natural resources of shared watersheds, including the national water quality goal to protect and restore the physical, chemical, and biological integrity of waters; the goal to protect, conserve, and restore forest resources to provide sustainable ecological and economic benefits; and to otherwise manage air, land, and water resources for the environmental, economic, recreational, and aesthetic benefits of the citizens

of Baltimore City and Baltimore County and this region.

**II.** Baltimore City and Baltimore County hereby agree to work to improve cooperative inter-agency management of environmental resources, including coordination of watershed management planning, water quality monitoring programs, data collection and management, public lands and wildlife management, computer mapping, and operational and capital restoration program implementation and tracking.

**III.** Baltimore City and Baltimore County hereby agree to work cooperatively with watershed associations and interested organizations to develop and implement coordinated education and restoration programs and projects to benefit water quality and protect natural resources of the region.

**IV.** Baltimore City and Baltimore County hereby agree to establish a working committee of principals from respective agencies to coordinate implementation of this Memorandum of Understanding ("Committee"). The Committee will meet regularly, with meetings open to the public, and will form subcommittees as needed. The Committee will annually review progress and prepare recommendations for future work.

**V.** The Committee will meet at least annually with recognized watershed associations to review work of the prior year and identify future work needs.

**VI.** The Mayor of Baltimore City and the County Executive of Baltimore County agree to annually prepare a "state of our watersheds" report outlining progress and establishing priorities for future work.

**VII.** This Memorandum of Understanding shall commence upon execution by the parties and shall continue for four (4) years, unless terminated sooner by either party. It may be renewed, at the discretion of the parties, for additional four (4) year periods.

**VIII.** This Memorandum of Understanding constitutes the entire and full understanding of the parties hereto, and may not be modified except by means of a written amendment.

**IX.** The Recitals are incorporated herein.

**X.** This Memorandum of Understanding shall be governed by and construed under the laws of the State of Maryland.

**IN WITNESS WHEREOF,** the parties hereto have caused this Memorandum of Understanding to be executed the day and year first above written.

**ATTEST/WITNESS:**

By:_____
Custodian of the City Seal

**MAYOR AND CITY COUNCIL OF BALTIMORE**

By:_____
Martin O'Malley, Mayor

**ATTEST/WITNESS**

By:_____

**BALTIMORE COUNTY, MARYLAND**

By:_____
C. A. Dutch Ruppersberger
County Executive

**APPROVED AS TO FORM AND LEGAL SUFFICIENCY**

By:_____
Assistant City Solicitor

By:_____
Assistant County Attorney

**APPROVED**

By:_____
George L. Winfield, Director
Baltimore City Department of Public Works

By:_____
David A.C. Carroll, Director
Baltimore County Department of
Environmental Protection and
Resource Management