SEVERN RIVER
Watershed Management Master Plan

Current Conditions Report

December 6, 2002

KCI TECHNOLOGIES

ANNE ARUNDEL COUNTY MARYLAND

CH2MHILL

SEVERN RIVER

Watershed Management Master Plan

Current Conditions Report

Submitted to:

Anne Arundel County
Department of Public Works
Bureau of Engineering
2662 Riva Road
Annapolis, MD 21401-7374

Submitted by:

KCI Technologies, Inc.
10 North Park Drive
Hunt Valley, MD 21030

In Association With:

CH2M Hill
13921 Park Center Road, Suite 600
Herndon, VA 20171

December 2002

Revised July 2003

ANNE ARUNDEL COUNTY
MARYLAND

KCI TECHNOLOGIES

CH2MHILL

ACKNOWLEDGEMENTS

The Current Conditions Report was prepared by staff from KCI Technologies and CH2M HILL with review from Anne Arundel County personnel. Funding and support was provided by Anne Arundel County as part of the Severn River Watershed Management Master Plan.

The principal authors were:

Bill Frost, PE	Project Manager, KCI
Tara Ajello, PE	Project Manager, CH2M HILL
Mike Pieper	Senior Environmental Scientist, KCI,
Lindsay Nicoll	Environmental Scientist, KCI
Andrea Poling	GIS Specialist, KCI
Mike Miller	Environmental Scientist, KCI

Support was provided by:

Bill Medina	Project Engineer, KCI
Nate Drescher	GIS Specialist, KCI
Yung-Tsung Kang	GIS Programmer, CH2M HILL
Mark Unwin	GIS Specialist, CH2M HILL

Internal review of the report was provided by:

Laurens van der Tak, PE	Senior Engineer, CH2M HILL
Steve Cohen, PG	Senior Environmental Scientist, KCI

The authors would like to thank the following individuals for their review, comments and advice through the course of the project:

Charlie Abrahamson	Office of Planning and Zoning
Ronald Bowen	Department of Public Works
Doug Burkhardt	Department of Public Works
Ginger Ellis	Office of Planning and Zoning
Ron Etzel	Department of Public Works
Carolyn Gaulke	Office of Information Technology
David Gillum	Office of Information Technology
Darryl Hockstra	Department of Public Works
Sally Hornor	Severn River Commission
Janis Markusic	Office of Planning and Zoning
Chuck Matheny	Department of Inspections and Permits
Rich Olsen	Department of Public Works
Jeff Opal	Anne Arundel Soil Conservation District
Chris Phipps	Department of Public Works
John Scarborough	Department of Public Works
Mary Searing	Department of Public Works
Chris Victoria	Office of Planning and Zoning
Lois Villemaire	Office of Planning and Zoning
Lina Vlavianos	Severn River Commission

ACRONYMS

AASCD	Anne Arundel County Soil Conservation District
B-IBI	Benthic Macroinvertebrate Index of Biotic Integrity
BMP	Best Management Practices
CMP	Corrugated Metal Pipe
CN	Curve Number
Cu	Total Copper
CWP	Center for Watershed Protection
DEM	Digital Elevation Models
DO	Dissolved Oxygen
DPW	Anne Arundel County Department of Public Works
EMC	Event Mean Concentration
EPA	United States Environmental Protection Agency
FHWA	Federal Highway Administration
F-IBI	Fish Index of Biotic Integrity
GIS	Geographic Information Systems
GPS	Global Positioning System
HDPE	High-Density Polyethylene
I&P	Anne Arundel County Department of Inspections and Permits
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MPHI	Maryland Physical Habitat Index
MSHA	Maryland State Highway Administration
NOx	Nitrate and Nitrite
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NURP	Nationwide Urban Runoff Program
NVPDC	Northern Virginia Planning District Commission
Pb	Total Lead
PCS	Permit Compliance System
PVC	Polyvinyl Chloride
RTE	Rare, Threatened and Endangered Species
RCP	Reinforced Concrete Pipe
SAV	Submerged Aquatic Vegetation
SCS	Soil Conservation Service
SSD	Stage - Storage - Discharge
SSPRA	Sensitive Species Project Review Area
SWM	Stormwater Management
Tc	Time of Concentration
TIN	Triangulated Irregular Network
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TPL	Trust for Public Land
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
WMS	Watershed Management System
WMT	Watershed Management Tool
WRF	Water Reclamation Facility
Zn	Total Zinc

TABLE OF CONTENTS

List of Tables

List of Figures

Appendices

Unbound Appendices

1.0 Introduction

1.1 Project Background

Anne Arundel County is currently developing a multi-phased Watershed Management Plan for the Severn River. The Severn River watershed, located entirely in Anne Arundel County, is experiencing a variety of stressors. The estuarine part of the River is currently on the 303(d) list for nutrients, sediment and bacteria. In addition, there are concerns about the buildup of toxic metals in the sediments.

As a tributary to the Chesapeake Bay, the Severn River is also facing issues that are affecting aquatic resources Bay-wide. These include increases in nutrient loadings, algae growth, reduced dissolved oxygen (DO) and loss of submerged aquatic vegetation (SAV).

The watershed is under pressure from continued residential and commercial development. Impacts of urbanization and pollution from existing sources need to be reduced and managed properly to preserve and improve habitat quality, reduce flooding, and improve water quality.

The vision of this Watershed Management Master Plan is to provide an implementable blueprint and tools to facilitate land use and infrastructure planning and development decisions by County staff and stakeholders to protect the resources of the Severn River. The Plan is one of a series of watershed studies which are being conducted to meet the conditions of the National Pollutant Discharge Elimination System (NPDES) stormwater permit issued by the Maryland Department of the Environment (MDE). Experience from earlier studies has shown the information developed from them was compiled in large volumes of text, and was not in a readily useable format. Therefore, in keeping with the vision, to be responsive to the needs of the staff and stakeholders, and to be more effective in the way in which the watershed studies are conducted, the Severn River Watershed Management Master Plan includes two elements:

1) A watershed study that will characterize the watershed's land use, natural resources, water quality and hydrologic conditions; assess future conditions with computer models of drainage and water quality; identify and rank problems, and recommend potential improvement projects.

2) The development of a Watershed Management Tool (WMT) that will link the watershed data and models to give the County staff and stakeholders information on how changes in land use, zoning, best management practices, and other watershed conditions affect the Severn River and its tributaries.

This report is a characterization of the current conditions of the watershed and tributary streams to the tidal Severn. Subsequent phases of the study will include an assessment of future conditions and additional model development. The work on the development of the WMT is on-going.

In Phase I of the Watershed Management Master Plan, the existing environmental studies and Geographic Information System (GIS) coverages for the watershed were assessed and a data gap analysis was completed. This formed the basis for the work done in Phase II. The results of Phase II, a characterization of the current watershed conditions, are included in this report. Specific tasks for Phase II included the following:

Update and create GIS layers

- Land Use
- Imperviousness
- Stream Coverage
- Inventory and map stormwater management (SWM) facilities
- Delineatesubwatersheds and catchments
- Model hydrology and pollutant loads (TR-20 and PLOAD) for current conditions
- Conduct a stream assessment on all perennial streams
- Sample dry weather flow
- Collect detailed stream assessment data at 15 stations

Use of the Report

The Current Conditions report is intended to characterize the condition of the Severn River watershed, organized at the subwatershed level, or the level of the major tributaries to the River. The information presented here will be used to identify problem areas in later phases of the study. The confidence level of the information varies depending on its source:

- GIS data updates are current as of January 2000, the date of the orthophotography used. Information from mapping and GIS analysis is based on a variety of sources, created at various times by various agencies. It is generally at a planning level of accuracy and should be used for spatial analysis at a scale that aggregates to catchments, at the 50 to 100 acre level.

- Stream assessment data is based on recent fieldwork and is accurate as of May 2002.

- Model results for TR-20 and PLOAD have not been calibrated and are useful only for relative comparisons between subwatersheds. Annual pollutant load calculations, in particular, have been derived for each subwatershed and are only to be used for relative comparisons. They represent point and non-point source loads but do not take into account atmospheric deposition or baseflow loads and as a result they do not represent the total load to the Seven River.

1.2 Environmental Setting

In Phase I of the study, a data gap analysis was completed. The results can be found in the *Severn River Watershed Management Master Plan Phase I Final Report* (KCI 2002). In that report, existing environmental and watershed information was compiled, including reports on estuary hydrodynamics, toxicology, biological condition, water quality, pollutant loading, flow and gauge data, and GIS coverages of watershed parameters. A summary of the information compiled in Phase I is presented below to give a description of the existing physical and biological resources within the region and the Severn River Watershed specifically.

Physiography

The Severn River watershed is located within the Coastal Plain physiographic province. The Coastal Plain is the youngest province in the state, and is made up of unconsolidated sedimentary deposits. The layers of the Coastal Plain were deposited by streams flowing from the adjacent Piedmont Province and were also deposited in a shallow marine environment (MDNR 1987).

The topography within the watershed ranges from nearly level to very steep. Steep slopes (greater than 15%) border the headwater tributaries and downstream floodplains along the northern and southern shoreline of the Severn River (Glaser 1976). Deep V-shaped valleys have been formed where small streams have cut through the soft unconsolidated material of the Coastal Plain, and broad alluvial floodplains are located adjacent to both large and small streams (USDA-SCS 1973). Elevations range from sea level, along the shores of the Chesapeake Bay, to 300 feet.

Geology and Soils

Geology

The geology within the watershed is dominated by sand, gravel, silt, and clay of the Cretaceous age. Present in lesser quantities is sand, clay, silt, greensand, and diatomaceous earth of the Tertiary age, and sand, silt, gravel, clay, and peat of the Quaternary age. The Potomac Group, consisting of the Raritan and Patapsco Formations, Arundel Clay, and Patuxent Formation, is dominant along Severn Run and its tributaries. The Aquia Formation is the dominant geologic formation along the lower third and at the mouth of the Severn River. Lowland Deposits is present in moderate amounts at the mouth and within the southern shore of the upper third portion of the Severn River. Monmouth, Matawan, and Magothy Formations are located along and near the northern and southern shorelines within the middle third of the Severn River. The Calvert Formation and Upland Deposits are present within the watershed in minimal amounts and in isolated areas (MGS 2002). The associated rock types and formations within the watershed are briefly described below:

Aquia Formation – Characterized as dark green to gray-green, argillaceous, highly glauconite, well-sorted fine to medium-grained sand. Contains locally indurated shell beds. Thickness ranges from 0 to 100 feet.

Calvert Formation – The Plum Point Marls Member consists of fine-grained argillaceous sand and sandy clay that is dark green to dark bluish gray, and contains prominent shell beds and locally silica-cemented sandstones. The Fairhaven Member consists of greenish-blue diatomaceous clay that turns pale gray due to weathering. It also contains fine-grained sand that is pale brown to white in color, and greenish blue sandy clay. Thickness ranges from 0 to 150 feet.

Lowland Deposits – Consists of gravel, sand, silt, and clay. Sand and gravel is medium to coarse-grained, with cobbles and boulders near the base. Reworked Eocene glauconite is commonly found. Contains varicolored silts and clays, dark gray lignitic silty clay. Remains of estuarine to marine fauna can be found in some areas. Thickness ranges from 0 to 150 feet.

Magothy Formation – Consists of loose, white, cross-bedded, lignitic sands and dark gray, laminated silty clays. In western Anne Arundel County it consists of white to orange-brown, iron stained, surrounded quartzose gravels. It is absent in the outcrop southwest of the Patuxent River. Thickness ranges from 0 to 60 feet.

Matawan Formation – Consists of sand and silt that is dark gray, micaceous, glauconitic, argillaceous, and fine-grained. Thickness ranges from 0 to 70 feet.

Monmouth Formation – Consists of micaceous, glauconitic, argillaceous, fine to coarse-grained sand that is dark gray to reddish brown in color. Thickness ranges from 0 to 100 feet.

Potomac Group – Consists of interbedded quartzose gravels, protoquartzitic to orthoquartzitic argillaceous sands, and silts and clays that are dark gray and multicolored. Thickness ranges from 0 to 800 feet. The Potomac Group is comprised of the Raritan and Patapsco, Arundel Clay, and Patuxent Formations.

Raritan and Patapsco Formations – Variegated silts and clays of gray, brown, and red colors. Lenticular, cross-bedded, argillaceous, sub rounded sands, and minor gravels. Thickness ranges from 0 to 400 feet.

Arundel Clay Formation – Consists of lignitic clays that are dark gray and maroon. Abundant siderite concretions are present. This soil formation is present only in the Baltimore-Washington area. Thickness ranges from 0 to 100 feet.

Patuxent Formation – Consists of angular sands and sub rounded quartz gravels that are moderately sorted, cross-bedded, argillaceous, and white or light gray to orange-brown in color. Silts and clays are subordinate and predominately pale gray in color. Thickness ranges from 0 to 250.

Upland Deposits – Consists of gravel and sand that is commonly orange-brown, and is locally limonite cemented. Minor silt and red, white, or gray clay. Consists of the lower gravel member and upper loam member in Southern Maryland. Thickness ranges from 0 to 50 feet.

Soils

According to the *Soil Survey of Anne Arundel County, Maryland* (USDA-SCS 1973), the Evesboro-Rumford-Sassafras association is the dominant soil association in the northwestern portion of the watershed, with the Loamy and clayey land-Muirkirk-Evesboro association present in minimal quantities. The Evesboro-Rumford-Sassafras association is described as gently sloping to moderately steep, consisting of excessively drained and well-drained sandy and loamy soils. The Loamy and clayey land-Muirkirk-Evesboro association is described as nearly level to steep, with well-drained loamy and clayey soils, and excessively drained sandy soils. The dominant soil association within the southeastern portion of the watershed is the Monmouth-Collington association, with the Elkton-Othello-Mattapex association present in minor quantities. The Monmouth-Collington association is described as being nearly level to moderately steep, with well-drained sandy and loamy soils. The Elkton-Othello-Mattapex association is described as being level to sloping, with poorly drained and moderately well drained loamy soils (USDA-SCS 1973).

Aquifers

Within the Severn River watershed lie four geologic formations that are hydrologically characterized as aquifers. These formations consist of the Aquia, Magothy, Patapsco-Raritan, and Patuxent Formations. The Patapsco-Raritan and Patuxent Formations consist of interchanging confining beds and aquifers throughout the profile. The Monmouth Formation is characterized as a poor aquifer in places throughout the area (Lucus 1976).

The Patuxent and Patapsco-Raritan Formations are the water bearing formations within the Potomac group and are the most heavily used aquifers in Maryland. The Patuxent Formation is a multi-aquifer unit and is a very productive water-bearing formation. Its transmissivity ranges from 130 sq. ft. per day to 10,700 sq. ft. per day, and has typical storage coefficients ranging from 0.001 to 0.00001. In Maryland, the best well yields for the Patuxent Formation range from a few hundred to 1,200 gallons per minute

(gpm). The Patuxent formation has generally good natural water quality in most updip locations (up gradient in the aquifer) (MDNR 1987).

The Patapsco-Raritan Formation is also a multi-aquifer unit that is irregularly stratified, and a very productive ground water source. The transmissivity of the Patapsco-Raritan Formation ranges from 160 sq. ft. per day to 6,700 sq. ft. per day, and has typical storage coefficients ranging from 0.005 to 0.00005, but could be as much as 0.15. Wells in this formation have specific capacities that range from less than 1 to approximately 13 gallons per minute (gpm) per foot of drawdown. The natural water quality in most updip areas is good within the Patapsco-Raritan Formation (MDNR 1987).

The Magothy Aquifer is one of the most extensive aquifers in the Coastal Plain Area of Maryland. In general, the aquifer has the potential to yield moderate to large quantities of ground water. Its transmissivity ranges from 500 sq. ft. per day to over 12,000 sq. ft. per day, the highest values occurring in central Anne Arundel County. Storage coefficients for the formation average approximately 0.0001. Wells in this formation normally yield from 5 to 400 gpm, with drawdown capacities ranging from 1 to 7 gpm/ft. The Magothy aquifer has a natural water quality suitable for most uses (MDNR 1987).

The Aquia Formation acts as an aquifer over approximately 1,600 square miles. The transmissivity of the aquifer ranges from 100 to 5,500 sq. ft. per day, and the storage coefficient ranges from 0.001 to 0.004 and may be as high as 0.15. Generally, well yields range from 4 to 350 gpm, and has a drawdown capacity ranging from 1 to 20 gpm/ft. Overall, the natural water quality is good and is suitable for domestic use without treatment in most cases (MDNR 1987).

Unique Ecology

In 1971, the Severn River was designated as one of Maryland's Scenic Rivers. Many unique and ecologically important natural features can be found within the borders of its watershed.

Within the state of Maryland, Anne Arundel County possesses the highest quantity of bogs, which qualify as wetlands of special state concern. Bogs and wetlands of special state concern within the Severn River Watershed with unique habitat and flora, which may have carnivorous plants, include Dicus Mill and Gumbottom Complex (Arden Bog). Bogs and wetlands of special state concern that have Atlantic white cedar (*Chamaecyparis thyoides*) present include Arlington Echo, Cypress Creek, Lakewood, Carrollton, Forked Creek and Sullivan's Cove (SRA 2000). These areas are important as they serve as water filters, improving water quality within the watershed, and creating habitat for rare, threatened and endangered flora and fauna that depend on bog habitat.

During 2001, volunteers planted 1,000 Atlantic White Cedars in the Severn River Watershed. The trees were planted along Howard's Branch (BRC in this study), located adjacent to the Sherwood Forest and the Downs in the Crownsville, MD area (AACo 2002).

One state park is located in the Severn River watershed. Sandy Point State Park consists of 786 acres along the Chesapeake Bay that includes recreation facilities such as beaches, hiking trails, historic interests, and other recreational activities (MDNR 2002).

Greenways have been established and continue to be implemented in the watershed. The largest undeveloped forest tract is 300 acres and located in Crownsville, MD along the Severn River. This area has been put into a conservation easement through the Trust for Public Land (TPL 2000). The Severn Run Natural Environment Area is an area along Severn Run that is owned by the Maryland Department of Natural Resources (MDNR) and set aside for the protection of Severn Run.

Jabez Branch, the largest tributary to Severn Run, is the only Coastal Plain stream that supports a naturally reproducing population of brook trout. Jabez Branch has a series of springs and dense forest cover that provide the cool water necessary for brook trout reproduction (Vlavianos 2001).

Rare Threatened and Endangered Species

Information on current and historical Rare, Threatened and Endangered Species (RTE) present within the County is located in Table 1.1 and Table 1.2. The information is current as of November 7, 2002 and represents a compilation of information from the Department of Natural Resource's Wildlife and Heritage Service's Biological and Conservation Data system. The list includes 19 animal species and 108 plant species. The key for the State rank and status are located after Table 1.2. Four species on County RTE list also have federal status. These include the bald eagle (*Haliaeetus leucocephalus*), sensitive joint-vetch (*Aeschynomene virginica*), chaffseed (*Schwalbea Americana*) and swamp pink (*Helonias bullata*).

County GIS data includes a Sensitive Species Project Review Area (SSPRA) coverage, which should be utilized in environmental review. SSPRAs give the general locations of documented RTE species. The coverage is created and updated by Wildlife and Heritage Service staff, and includes non-attributed, buffered polygons. The coverage does not specifically delineate habitats of RTE species. The coverage incorporates various types of regulated areas under the Critical Area Criteria and other areas of concern statewide, including: Natural Heritage Areas, Listed Species Sites, Other or Locally Significant Habitat Areas, Colonial Waterbird Sites, Waterfowl Staging and Concentration Areas, Nontidal Wetlands of Special State Concern, and Geographic Areas of Particular Concern. Therefore, the coverage provides an overview of all state-regulated and designated areas involving sensitive and listed species.

Although the SSPRA coverage contains the most complete single source of data on Maryland's rare, threatened, and endangered species and significant natural communities, it does not represent an exhaustive nor comprehensive inventory of these environmental elements throughout the state. Current field surveys by qualified biologists should be conducted to verify presence or absence. The SSPRA data layer contains dynamic information. Staff of the Wildlife and Heritage Service conduct field surveys and gather new information throughout the year. Thus, the SSPRA data layer will be revised regularly to incorporate the new information.

Table 1.1 Rare, Threatened, and Endangered Animal Species of Anne Arundel County

Common Name	Scientific Name	State Rank	State Status
Eastern tiger salamander	*Ambystoma tigrinum*	S2	E
Golden-banded skipper	*Autochton cellus*	S1	E
Glassy darter	*Etheostoma vitreum*	S1 S2	E
Peregrine falcon	*Falco peregrinus*	S1B	E
Spotfin killifish	*Fundulus luciae*	S2	
Common moorhen	*Gallinula chloropus*	S2B	I
Map turtle	*Graptemys geographica*	S1	E
Bald eagle	*Haliaeetus leucocephalus*	S2 S3B	T*
Hydrophilid beetle	*Hydrochara occulta*	SU	
Black rail	*Laterallus jamaicensis*	S2 S3B	I
Noctuid moth	*Meropleon titan*	SU	
Redbelly water snake	*Nerodia erythrogaster erythrogaster*	S2 S3	
Stripeback darter	*Percina notogramma*	S1	E
Northern pine snake	*Pituophis melanoleucus*	SR	
Pied-billed grebe	*Podilymbus podiceps*	S2B	
Sora	*Porzana Carolina*	S1B	

Common Name	Scientific Name	State Rank	State Status
A hydrophilid beetle	*Sperchopsis tessellatus*	S2	
Least tern	*Sterna antillarum*	S2B	T
Tidewater amphipod	*Stygobromus indentatus*	S1	

Table 1.2 Rare, Threatened, and Endangered Plant Species of Anne Arundel County

Common Name	Scientific Name	State Rank	State Status
Sensitive joint-vetch	*Aeschynomene virginica*	S1	E*
Thread-leaved gerardia	*Agalinis setacea*	S1	E
Small-fruited agrimony	*Agrimonia microcarpa*	SU	
Woodland agrimony	*Agrimonia striata*	S1	E
Single-headed pussytoes	*Antennaria solitaria*	S2	T
Short's rockcress	*Arabis shortii*	S2	T
Curtiss' three-awn	*Aristida curtissii*	SU	
Woolly three-awn	*Aristida lanosa*	S1	E
Giant cane	*Arundinaria gigantea*	S2	
Silvery aster	*Aster concolor*	S1	E
Bog aster	*Aster nemoralis*	SE	
Willow aster	*Aster praealtus*	S1	
Mosquito fern	*Azolla caroliniana*	SU	
Small-fruited beggar-ticks	*Bidens mitis*	S1	E
Grass-pink	*Calopogon tuberosus*	S1	E
Coast sedge	*Carex exilis*	S1	E
Shoreline sedge	*Carex hyalinolepis*	S2 S3	
Hop-like sedge	*Carex lupuliformis*	S1	
Inflated sedge	*Carex vesicaria*	S1	T
Velvety sedge	*Carex vestita*	S1	E
American chestnut	*Castanea dentata*	S2 S3	
Leatherleaf	*Chamaedaphne calyculata*	S1	T
Red turtlehead	*Chelone obliqua*	S1	T
Wild lupine	*Lupinus perennis*	S2	T
Climbing fern	*Lygodium palmatum*	S2	T
Anglepod	*Matelea carolinensis*	S1	E
Climbing milkweed	*Matelea obliqua*	S1	E
Sweet pinesap	*Monotropsis odorata*	S1	E
Thread-like naiad	*Najas gracillima*	SU	X
Larger floating-heart	*Nymphoides aquatica*	S1	E
One-sided pyrola	*Orthilia secunda*	SH	X
Roughish panicgrass	*Panicum leucothrix*	SU	
White fringed orchid	*Platanthera blephariglottis*	S2	T
Crested yellow orchid	*Platanthera cristata*	S2	T
Pale green orchid	*Platanthera flava*	S2	
Marsh fleabane	*Pluchea camphorata*	S1	E
Clammyweed	*Polanisia dodecandra*	S1	E
Dense-flowered knotweed	*Polygonum densiflorum*	S1	E
Bushy knotweed	*Polygonum ramosissimum*	SH	X
Stout smartweed	*Polygonum robustius*	SH	X
Clasping-leaved pondweed	*Potamogeton perfoliatus*	S2	
Redheadgrass	*Potamogeton richardsonii*	SH	X
Spiral pondweed	*Potamogeton spirillus*	S1	
Beach plum	*Prunus maritima*	S1	E
Water-plantain spearwort	*Ranunculus ambigens*	SH	X
Hairy snoutbean	*Rhynchosia tomentosa*	S2	T

Common Name	Scientific Name	State Rank	State Status
Wister's coralroot	*Corallorhiza wisteriana*	S1	E
Hazel dodder	*Cuscuta coryli*	SH	X
Pretty dodder	*Cuscuta indecora*	SH	
Smartweed dodder	*Cuscuta polygonorum*	S1	E
Rough cyperus	*Cyperus retrofractus*	S2	
Trailing tick-trefoil	*Desmodium humifusum*	SH	X
Few-flowered tick-trefoil	*Desmodium pauciflorum*	S1	E
Stiff tick-trefoil	*Desmodium strictum*	S1	E
Glade fern	*Diplazium pycnocarpon*	S2	T
White spikerush	*Eleocharis albida*	S1	E
Pale spikerush	*Eleocharis flavescens*	S1	
Salt-marsh spikerush	*Eleocharis halophila*	S1	E
Matted spikerush	*Eleocharis intermedia*	S1	E
Beaked spikerush	*Eleocharis rostellata*	S2	
Seven-angled pipewort	*Eriocaulon aquaticum*	S1	E
Cluster fescue	*Festuca paradoxa*	SH	X
Pumpkin ash	*Fraxinus profunda*	S2 S3	
Coast bedstraw	*Galium hispidulum*	S1	E
Box huckleberry	*Gaylussacia brachycera*	S1	E
Striped gentian	*Gentiana villosa*	S1	E
Yellow avens	*Geum aleppicum*	S1	E
Kentucky coffee-tree	*Gymnocladus dioicus*	S1	
Hoary frostweed	*Helianthemum bicknellii*	S1	E
Swamp pink	*Helonias bullata*	S2	E*
Crested coralroot	*Hexalectris spicata*	SH	X
Dwarf iris	*Iris verna*	S1	E
New Jersey	*Juncus*	S1	E

Common Name	Scientific Name	State Rank	State Status
Capitate beakrush	*Rhynchospora cephalantha*	S1	E
Grass-like beakrush	*Rhynchospora globularis*	S1	E
Clustered beakrush	*Rhynchospora glomerata*	S2	T
Spongy lophotocarpus	*Sagittaria calycina*	S2	
Dwarf prairie willow	*Salix tristis*	S1	
Northern pitcher-plant	*Sarracenia purpurea*	S2	T
Chaffseed	*Schwalbea americana*	SX	X**
Smith's clubrush	*Scirpus smithii*	SU	X
Water clubrush	*Scirpus subterminalis*	S1	E
Tall nutrush	*Scleria triglomerata*	S1 S2	
Snowy campion	*Silene nivea*	S1	E
Halberd-leaved greenbrier	*Smilax pseudochina*	S2	T
Hairy goldenrod	*Solidago hispida*	SH	X
Hard-leaved goldenrod	*Solidago rigida*	SH	X
Showy goldenrod	*Solidago speciosa*	S2	T
Long-leaved rushgrass	*Sporobolus asper*	S1	
Hyssop-leaved hedge-nettle	*Stachys hyssopifolia*	SU	
Featherbells	*Stenanthium gramineum*	S1	T
Bog fern	*Thelypteris simulata*	S2	T
Coastal false asphodel	*Tofieldia racemosa*	SX	X
Pale mannagrass	*Torreyochloa pallida*	S1	E
Climbing dogbane	*Trachelospermum difforme*	S1	E
Large marsh St. John's-wort	*Triadenum tubulosum*	S1	
Narrow-leaved bluecurls	*Trichostema setaceum*	S1	
Narrow-leaved horse-gentian	*Triosteum angustifolium*	S1	E
Two-flowered bladderwort	*Utricularia biflora*	S1	E
Horned	*Utricularia*	SH	

Common Name	Scientific Name	State Rank	State Status
rush	*caesariensis*		
Brown-fruited rush	*Juncus pelocarpus*	S1	E
Potato dandelion	*Krigia dandelion*	S1	E
Narrow-leaved pinweed	*Lechea tenuifolia*	SH	X
Long-awned diplachne	*Leptochloa fascicularis*	SU	

Common Name	Scientific Name	State Rank	State Status
bladderwort	*cornuta*		
Fibrous bladderwort	*Utricularia fibrosa*	S1	E
Northern blue violet	*Viola septentrionalis*	SU	
Graybark	*Vitis cinerea*	SU	
Small's yelloweyed-grass	*Xyris smalliana*	S1	E

State Rank
S1: Highly State Rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor making it vulnerable to extirpation. MDNR's Natural Heritage Program actively tracks species with this rank.
S2: State Rare. Imperiled in Maryland because of rarity (typically 6-20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor making it vulnerable to extirpation. MDNR's Natural Heritage Program actively tracks species with this rank.
S3: Rare to uncommon with the number of occurrences typically in the range of 21-100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. MDNR's Natural Heritage Program does not actively track species with this rank.
SE: Established but not native to Maryland; it may be native elsewhere in North America.
SH: Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.
SR: Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report.
SU: Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State.
SX: Believed to be extirpated in Maryland with virtually no chance of rediscovery.
B: This species is migratory and the rank refers only to the breeding status of the species. Such a migrant may have a different rarity for non-breeding populations.

State Status
E: Endangered: a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.
T: Threatened: a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.
X: Endangered Extirpated; a species that was once a viable component of the flora or fauna of the State, but for which no naturally occurring populations are know to exist in the State.

Notes:
* Federal Status (LT)- Taxa listed as threatened: likely to become endangered within the foreseeable future throughout all or significant portion of their range
** Federal Status (LE)- Taxa listed as endangered; in danger of extinction throughout all or significant portion of their range

Forests

Three forest associations are found within the Severn River watershed, including the Chestnut-Post Oak-Blackjack Oak, Tulip Poplar, and River Birch-Sycamore Associations. The Tulip Poplar Association is the dominant association and can be found throughout the watershed. This association is dominated by the presence of red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), Virginia creeper (*Parthenocissus quinquefolia*), black gum (*Nyssa sylvatica*), white oak (*Quercus rubra*), and spicebush (*Lindera benzoin*). The Chestnut Oak-Post Oak-Blackjack Oak Association is present in moderate amounts and is located around the northern third of the Severn River. This association is dominated by the presence of red maple, black gum, white oak, sassafras (*Sassafras albidum*), greenbriers (*Smilax*), Japanese honeysuckle (*Lonicera japonica*), mountain laurel (*Kalmia latifolia*), and southern arrowwood (*Viburnum dentatum*). The River Birch-Sycamore Association is present in minor amounts and, where present, is located along the tributaries to the Severn River. The River Birch-Sycamore Association is dominated by the presence of red maple, poison ivy (*Toxicodendron radicans*), Virginia creeper, greenbriers, sweet gum (*Liquidambar styraciflua*), Japanese honeysuckle, and southern arrowwood (Brush et al. 1976).

Surface Water Resources

The Maryland Biological Stream Survey (MBSS) conducted by MDNR has rated the state of Maryland's streams. MBSS data is interpreted and applied to the statewide, basin, and county levels. The following highlights the results of MBSS data as it relates to Maryland's streams.

Maryland

In general, Maryland's streams are categorized as having poor habitat, poor to fair biological health, and elevated nutrients, while supporting a diversity of biological life. The following provides a description of MBSS data as it is related to the entire state of Maryland.

Within Maryland, only 20% of all stream miles have good physical habitat quality, 52% are in poor condition, and as much as 27% of Maryland's stream miles are poorly protected from stormwater runoff with no vegetated buffers (Boward et al. 1999). Based on a combined fish and benthic macroinvertebrate Index of Biotic Integrity (F-IBI and B-IBI), approximately 12% of Maryland's stream miles were rated to be in good condition, 42% were rated fair, and 46% were rated poor (Boward et al. 1999). The F-IBI and B-IBI are used statewide and focus on the response of biological indicators (fish and benthic macroinvertebrates) to stressors such as pollutants and habitat condition (Roth et al. 1997).

Land use plays a key role in the overall biological integrity within watersheds. When upstream imperviousness exceeded only 2%, pollution-sensitive brook trout were never found. Based on a combined F-IBI and B-IBI, stream health is not rated as good when watershed impervious area is greater than 15%. Watershed imperviousness greater than 25% yields conditions that allow only pollutant tolerant species to survive. Approximately 57% of Maryland's streams have unnaturally elevated levels of nutrients, which are generally higher in watersheds containing more agricultural land use (Boward et al. 1999).

West Chesapeake Basin

The MBSS data were analyzed at the basin level. The Severn River watershed is contained within the West Chesapeake basin, which includes parts of Anne Arundel County. In general, water quality within the West Chesapeake basin is good and does not continually exceed the required State water quality criteria (MDNR 1998, cited in Ostrowski et al. 1999).

Approximately 33% of the stream miles had high levels of nitrate (>1 mg/l) and dissolved oxygen levels were above the minimum Maryland State standard (5 ppm) within 82% of the stream miles (Ostrowski et al. 1999).

Twenty percent of the stream banks were rated as badly eroded, and 20% of the stream miles had trash and human refuse present in abundant amounts. Stream miles were rated as well shaded within 82% of the basin (Ostrowski et al. 1999).

In 1997, species diversity within the basin was low, including an overall density of 3,158 fish per stream mile. Six species collected in 1997 are not indigenous to the Chesapeake Bay. The MDNR F-IBI rated approximately 50% of the streams as Good or Fair and the remaining streams were rated as Poor or Very Poor (Ostrowski et al. 1999).

The MDNR B-IBI rated approximately 95% of the stream miles as Poor or Very Poor in their ability to support diverse benthic macroinvertebrate populations. Pollution tolerant species comprised a large amount of the benthic macroinvertebrates collected in 1997 (Ostrowski et al. 1999).

Anne Arundel County

The MBSS data has also been analyzed within the boundaries of Anne Arundel County. During 1994 to 1997, MBSS sampled 85 sites within Anne Arundel County, and an additional 42 sites in the county were qualitatively sampled for fish (Millard et al. 2001). In general, the overall ecological health of the streams within Anne Arundel County was rated as Poor.

Throughout the county the average F-IBI score was rated as Poor, just below the Fair range. Fish species such as American eel, eastern mudminnow, and black nose dace, considered to be pollution tolerant, were regularly collected. While no federally listed species were encountered, the glassy darter, listed as endangered in Maryland, was collected, and the American brook lamprey, a species of special interest, was found at 4% of the sites (Millard et al. 2001).

The average B-IBI within the county was rated as Poor. Benthic macroinvertebrate collections yielded 172 genera, while a single site was host to 30% of the taxa collected, and may be considered rare within the state (Millard et al. 2001).

The highest rated streams in the county considering F-IBI and B-IBI scores are Lyon's Run and Deep Run. Low rated streams include an unnamed tributary to Muddy Creek, Flat Creek, Gumbottom Branch, and unnamed tributary to the Patuxent River, a section of the Little Patuxent River, Bacon Ridge Branch, and an unnamed tributary to Smith Creek (Millard et al. 2001).

Overall, physical habitat in Anne Arundel County was rated as Fair (Millard et al. 2001). Values for nitrate (NO_3) averaged 1.0 mg/L, and no streams were above the limits set forth by the United States Environmental Protection Agency (EPA) for drinking water of 10 mg/L (Millard et al. 2001).

Severn River Watershed

MBSS data was collected at 15 sites throughout the Severn River watershed during 1997. These sites include 11 along Severn Run, and one site along Mill Creek, Jabez Branch, an Unnamed Tributary to Deep Ditch, and Schultz Run (ST2 in this study). The average Physical Habitat Index (PHI) score of the sampled sites was within the fair range, scoring very close to the good range. The average F-IBI and B-IBI scores were rated as Poor. The average F-IBI score was near the Fair range, while the average B-IBI score was in the middle of the Poor range.

2.0 Methods

2.1 GIS Data

GIS updates were required to support watershed characterization, analysis, and modeling. Descriptions of the work done for specific coverages are given below. In general, existing County data and orthophotography from VARGIS were used to update or change coverages, or in some cases to create new ones. These coverages form the basis for all the spatial analysis done for the project.

Catchment Delineation

Watershed, subwatershed and catchment boundaries are the basis for most of the analytical work for this study. The watershed is the drainage area of the Severn River estuary. Subwatersheds are based on tributaries to the Severn River, and in the case of Severn Run, on major branches. Catchments are the smallest level of drainage areas for the study. The scope of work recommended approximately 80 subwatersheds made up of 875 catchments averaging 50 acres in size to support the detail needed for modeling and analysis.

Subwatersheds were based whenever possible on earlier delineations done by DNR and the Severn River Commission. Fifty-four tributaries were identified. Five of the larger tributaries (Severn Run, Jabez Branch, Gumbottom Branch, Mill Creek, and Whitehall Creek) were further subdivided so that all the subwatersheds would be a similar size. When this process was complete, there were 33 areas draining directly to the tidal portion of the river. These were lumped for analysis into one subwatershed. There were 73 subwatersheds when the delineation was completed.

Most of the subwatersheds represent the drainage area to a single tributary stream. Several subwatersheds, particularly the smaller ones on the north shore, represent drainage to a cove. These may contain two or three small streams that do not connect.

Catchments were delineated on 1"=200' maps created using the County's raster storm drain maps overlaid with vector contours, streams, roads, and buildings. Drainage areas have been delineated based on inlets and street drainage along with the topography.

The catchments were delineated in two steps. In the first step, they were delineated based on drainage areas to the headwaters of all first order streams and on confluences with larger order streams. In this pass, there were approximately 1,400 catchments. In the second step, they were revised by joining smaller catchments and splitting larger ones, which resulted in a total of 500 catchments of more uniform size. They were combined based on an effort to keep them at a similar size, to find the flows at key outfall points, and to rationalize the drainage network. After this step, an additional 100 areas were delineated to the large SWM ponds in the watershed, which will help provide information for TR-20 modeling.

Stream Coverage

Updates to the stream layer were undertaken as part of the quality control and GIS processes associated with the stream assessment. Stream assessment procedures are presented in Section 2.5. Situations where the fieldwork indicated differences from the map were resolved as follows:

- Where the map indicated a stream and there was a perennial stream, no changes were made
- Where the map indicated a stream and there was an ephemeral channel, an attribute was added to indicate it is ephemeral
- Where the map indicated a stream, but there was no defined channel, the linework was deleted.
- Where there was no stream on the map but a perennial stream was identified, it was added based on global positioning system (GPS) survey in the field
- Where there was no stream on the map, but an ephemeral channel was identified, a point was added at the confluence with the perennial channel
- Where the map indicated a stream and the stream appeared to go underground and re-emerge further downstream, an attribute was added to indicate the segment as floodway

Existing Land Use

Land use maps are the basis for runoff and pollutant loading calculations for the modeling effort. A map of existing land use which met the need for hydrologic and pollutant load calculations was developed for this project. The County's 1995 land use coverage was used as a basis for the updates. A set of 14 land use codes was developed to represent the watershed. These landuse codes are listed in Table 2.1. The procedure for developing the land use map was as follows:

- Delineation was done on 1"=600' maps consisting of the 2000 orthophotography overlaid by the 1995 land use coverage.
- The minimum mapping unit was 1 acre. Smaller areas were lumped into the surrounding land use.
- Linework was changed by deleting and adding boundaries. Polygons were created or removed to fix gross errors. Vertices on existing polygons were not adjusted.
-

Table 2.1 Existing Land Use Codes

Code	Land Use Type	Description
COM	Commercial	Retail and office uses
IND	Industrial	Industries and industrial parks
OPS	Open Space	Open, recreational, utility, or vacant space maintained in turf,
R11	Residential 1 Acre lots	Single-family residential, 1-acre lot size
R12	Residential 1/2 Acre lots	Single-family residential, 1/2-acre lot size
R14	Residential 1/4 Acre lots	Single-family residential, 1/4-acre lot size
R18	Residential 1/8 Acre lots	Single or multi-family residential or townhouse, 1/8-acre avg. lot size
R21	Residential 2 Acre lots	Single-family residential, 2-acre lot size
RWD	Residential Woods	Single-family residential, wooded lots
SRC	Single Row Crop	Agriculture
TRN	Transportation	Highway and railroad right-of-way
WAT	Water	Ponds
WDS	Woods	Forested areas
CIT	City	All land uses within the City of Annapolis

Boundaries were changed for the following situations:

- They were more than 100' away from those that can be discerned from the orthophotography
- Two of the adjacent 1995 land use codes were combined into one code for this study. For example, townhouses and multi-family residential areas would be combined to high-density residential.

- A single 1995 code needed to be split to provide more detail. For example, vacant land might be split to woods and open space (turf).
- New development has changed the land use.
- Land use attributes were checked against existing conditions as shown on 2000 orthophotography and were revised as necessary.
- For residential areas, an extra step was taken to estimate residential density by counting the number of houses in 1 acre.
    - 6 houses + road = R18
    - 2-4 houses + road = R14
    - 1-2 houses + road = R12
    - 1 house + road = R11

Future Land Use

The County's 2001 zoning map was used as the basis for future (ultimate) land use conditions. The procedure was to recode the zoning map based on the relationships between the codes in Table 2.2.

Table 2.2 Future Land Use / Zoning Codes

Code	Land Use Type	Zoning Codes
COM	Commercial	C1, C2, C3, C4, MA1, MA2, MA3, MB, MCSB, TC
IND	Industrial	W1, W2, W3
OPS	Open Space	OS
R11	Residential 1 Acre lots	R2
R12	Residential 1/2 Acre lots	R5
R14	Residential 1/4 Acre lots	R10
R18	Residential 1/8 Acre lots	R15
R21	Residential 2 Acre lots	R1
RWD	Residential Woods	RLD
SRC	Single Row Crop	RA
TRN	Transportation	N/A Included in other zoning categories
WAT	Water	N/A
WDS	Woods	N/A All open space assumed to be turf
CIT	City	All land uses within the City of Annapolis

Imperviousness

Drainage area imperviousness is a key parameter for both the PLOAD and TR-20 modeling, and is an important consideration in characterizing watersheds and subwatersheds. Typically, literature values from the Natural Resources Conservation Service (NRCS) or other sources are used. For this study, these appeared appropriate for all but the residential categories.

Residential Total Imperviousness

Residential imperviousness was estimated by using GIS to measure areas of buildings, roadways, and parking lots in representative areas of each land use category. Sixteen sample areas were chosen. Buildings and roads in these sample areas were converted to polygons from the planimetric coverage. Driveway areas were estimated using a measured average driveway area multiplied by the number of houses. The areas of these three features were added to derive the impervious area. Table 2.3 shows the original estimate, with areas in square feet.

Table 2.3 Estimate with All Roof Area Included

Sample Area	LU Code	No. of Properties	Avg. Drive	Driveways	Roofs	Roads	Impervious Area	Total Area	Percent Impervious
H9	R18	103	100	10,300	486,545	871,053	1,367,898	3,194,569	42.8%
J10	R18	309	500	154,500	384,623	405,014	944,137	3,826,376	24.7%
G9	R18	1422	200	284,400	2,255,963	2,486,146	5,026,510	14,903,989	33.7%
T19	R18	103	200	20,600	362,211	756,170	1,138,981	3,078,499	37.0%
	R18 Total	1937	243	469,800	3,489,342	4,518,384	8,477,526	25,003,433	**33.9%**
L10	R14	125	500	62,500	172,750	189,652	424,902	2,154,940	19.7%
I9	R14	221	500	110,500	324,005	321,010	755,515	3,727,975	20.3%
G9	R14	353	700	247,100	570,059	691,251	1,508,410	9,915,942	15.2%
T19	R14	276	500	138,000	396,083	577,596	1,111,679	3,197,542	34.8%
	R14 Total	975	572	558,100	1,462,897	1,779,509	3,800,506	18,996,399	**20.0%**
G9	R12	198	500	99,000	292,089	426,091	817,180	3,958,287	20.6%
T19	R12	163	1000	163,000	289,187	289,859	742,046	4,639,484	16.0%
	R12 Total	361	726	262,000	581,276	715,950	1,559,226	8,597,772	**18.1%**
R15	R11	143	700	100,100	285,272	328,211	713,583	5,564,677	12.8%
G9	R11	60	700	42,000	98,889	112,965	253,854	1,842,020	13.8%
	R11 Total	203	700	142,100	384,161	441,176	967,436	7,406,697	**13.1%**
R15	R21	122	800	97,600	307,318	545,855	950,773	7,486,653	12.7%
G9	R21	10	80	800	12,303	90,222	97,173	626,994	15.5%
	R21 Total	132	745	97,600	307,318	545,855	950,773	7,486,653	**12.7%**
T18	RWD	16	600	9,600	22,611	60,715	92,926	1,951,375	4.8%
S18	RWD	36	100	3,600	54,224	104,871	162,695	2,436,889	6.7%
	RWD Total	52	254	13,200	76,835	165,586	255,621	4,388,264	**5.8%**

Residential Directly Connected Imperviousness

While total imperviousness of an area can be measured or estimated reasonably accurately using this approach, the amount of directly connected imperviousness (also known as effective imperviousness) may be lower. Driveways, sidewalks, or roofs that drain directly to lawns or other pervious surfaces do not contribute runoff in the same manner as impervious areas that drain to streets and storm drains, because there is an opportunity for infiltration to take place, reducing the amount of runoff.

Sidewalks were assumed to drain to lawn and utility strips on either side where the runoff would be intercepted as sheet flow. There was no GIS coverage of sidewalks that would allow an estimate of their extent in a particular type of land use.

For the modeling in this study, a consensus was reached that only the directly connected imperviousness should be used. The approach to be used was to consider half the roof area disconnected for residential land use of 1/2 acre and above, which are represented by land use codes R12 (1/2 acre lots), R11 (1 acre lots), R21 (2 acre lots) and RWD (2 acre lots, wooded). For these areas, the original measured value of the roof area was divided by two to represent half of the roof draining to lawn or forested surfaces, where the runoff would be infiltrated. Table 2.4 shows the changed values.

Table 2.4 Estimate with Roofs Partially Disconnected

Sample Area	LU Code	No. of Properties	Avg. Drive	Driveways	Roofs	Roads	Impervious Area	Total Area	Percent Impervious
G9	R12	198	500	99,000	146,045	426,091	817,180	3,958,287	17.0%
T19	R12	163	1000	163,000	144,594	289,859	742,046	4,639,484	12.9%
	R12 Total	361	726	262,000	290,638	715,950	1,268,588	8,597,772	**14.8%**
R15	R11	143	700	100,100	142,636	328,211	713,583	5,564,677	10.3%
G9	R11	60	700	42,000	49,445	112,965	253,854	1,842,020	11.1%
	R11 Total	203	700	142,100	192,080	441,176	775,356	7,406,697	**10.5%**
R15	R21	122	800	97,600	153,659	545,855	950,773	7,486,653	10.6%
G9	R21	10	80	800	6,152	90,222	97,173	626,994	15.5%
	R21 Total	132	745	97,600	159,811	636,077	894,287	8,113,647	**11.0%**
T18	RWD	16	600	9,600	11,306	60,715	92,926	1,951,375	4.2%
S18	RWD	36	100	3,600	27,112	104,871	162,695	2,436,889	5.6%
	RWD Total	52	254	13,200	38,417	165,586	217,204	4,388,264	**4.9%**

Partially disconnecting rooftop drainage results in somewhat lower imperviousness for these types of land cover, ranging from about 4% for 1/2 acre lots to 1% for wooded lots. The revised values will be applied in the lookup tables in the TR-20 and PLOAD models for use in further study efforts (Table 2.5). The impervious percentages for each land use to be used for modeling in the study are summarized below in Table 2.6.

Table 2.5 Average Residential Percent Impervious, Weighted by Area

	R11	R12	R14	R18	R21	RWD
Weighted Average	10.5	14.8	20.0	33.9	11.0	4.9
TR-55 Standard	20.0	25.0	38.0	65.0	12.0	n/a

Table 2.6 Land Use Percent Impervious

Code	Land Use Type	Percent Impervious	Source
COM	Commercial	85	TR-55 Commercial
IND	Industrial	72	TR-55 Industrial
OPS	Open Space	0	TR-55
R11	Residential 1 Acre lots	11	This study
R12	Residential 1/2 Acre lots	15	This study
R14	Residential 1/4 Acre lots	20	This study
R18	Residential 1/8 Acre lots	34	This study
R21	Residential 2 Acre lots	11	This study
RWD	Residential Woods	5	This study
SRC	Single Row Crop	0	TR-55
TRN	Transportation	85	TR-55 Highway, paved open ditch
WAT	Water	0	TR-55
WDS	Woods	0	TR-55
CIT	City	50	Assumed for mix of residential and commercial

Stormwater Management Facilities

The goal of this task was to compile a database of all publicly and privately owned Best Management Practices (BMPs) in the Severn River watershed, with their correct location indicated as a point in an ArcView shapefile. The database will provide information on BMP type, drainage area, and location, which are needed for PLOAD and TR-20 modeling.

The consultants met with the Anne Arundel County Department of Public Works (DPW) and Inspections and Permitting (I&P) staff to review all the County's databases and mapping. The inspection database maintained by I&P appeared to be the most complete list of facilities, and was chosen as the basis for the mapping. It also contained information on drainage area and BMP type.

Most of the effort for this task was finding the correct location for the BMPs in the database. Approximately 80% of the 5,500 records in the database had coordinates associated with them. There were several steps in the process of verifying locations:

- Identify zip codes and Alexandria Drafting Company (ADC) map pages that contain the Severn watershed. Delete records where the zip code in the address or the page number in the ADC field is not in the watershed vicinity. This step assumed the information in these fields was correct. After this step, approximately 2,900 records remained.
- Create a GIS point coverage of the database using the coordinates.
- Check coordinates of these records by comparing them to addresses. Using a point-in-polygon spatial join, the zip code for each BMP coordinate point was found and entered in a new field. This was compared to the zip code in the address. If they matched, it was assumed the coordinates were correct. About 1,600 BMPs met this classification.
- For the points that didn't match, ADC address-matching software was used to find the coordinates and create the correct location. Approximately 600 additional BMPs were matched this way.
- Of the remaining BMPs, about 390 had ADC map page and grid locations in the database. These were located to this level of detail.
- The remaining 200-400 BMPs were researched in the County's records, concentrating on the larger and more significant BMPs.
- Quality control and field checks were made to verify the existence and type of about 20 facilities with missing file information.

BMPs owned by the Maryland State Highway Administration (MSHA) were added to the database. These were obtained from the MSHA mapping project for storm drains and SWM facilities, which is currently underway in Anne Arundel County. The mapping project provided the location and BMP type, but not the drainage area for 118 facilities. For this study, drainage areas were delineated for 23 wet ponds, dry ponds, extended detention ponds, and shallow marsh facilities. It was assumed that drainage areas to infiltration facilities were small, so a value of 0.0 acres was entered for these BMPs.

Table 2.7 summarizes the information on the BMPs in the watershed. There are 1,442 BMPs in the watershed, which treat runoff from a combined drainage area of 5,772 acres (about 14% of the Severn River watershed). Of these, 72 had a drainage area of 20 acres or more, and another 84 had a drainage area between 10 and 20 acres. These 156 BMPs treat an area of 4,550 acres, 79% of the total treated area.

Table 2.7 BMP Summaries

BMP Code	Description	No.	Drainage Area (acres)
ASCD	Attenuation Swale/Check Dam	9	1.9
ATTENSWA	Attenuation Swale	1	0.5
ATTTRENCH	Attenuation Trench	2	7.9
DP	Detention Structure (Dry Pond)	72	1722.4
DW	Dry Well	36	52.1
DWIT	Dry Well - Infiltration Trench	2	6.4
DWITCE	Dry Well - Infiltration Trench with Complete Exfiltration	426	100.6
DWITPE	Dry Well - Infiltration Trench with Partial Exfiltration	47	27.3
DWITWQE	Dry Well - Infiltration Trench with Water Quality Exfiltration	7	4.2
ED	Extended Detention	2	25.3
EDSD	Extended Detention Structure Dry	98	1350.6
EDSDITCE	Extended Detention Structure Dry, Infiltration Trench with Complete Exfiltration	1	5.0
EDSW	Extended Detention Structure Wet	55	801.1
EXPOND	Wet Pond	1	9.4
IB	Infiltration Basin	63	343.0
INPOND	Infiltration Basin - No Outfall	1	0.6
IT	Infiltration Trench	133	119.2
ITCE	Infiltration Trench with Complete Exfiltration	305	282.6
ITCEMB	Infiltration Trench with Complete Exfiltration, Microbasin	1	0.6
ITPE	Infiltration Trench with Partial Exfiltration	90	138.5
ITVSW	Infiltration Trench, Extended Detention	1	0.0
ITWQE	Infiltration Trench with Water Quality Exfiltration	21	22.8
ITWQPE	Water Quality Infiltration Trench with Partial Exfiltration	2	3.4
LS	Level Spreader	1	0.4
NA	NOT APPLICABLE	1	0.0
OGS	Oil Grit Separator	2	11.3
OGSITCE	Oil Grit Separator Infiltration Trench with Complete Exfiltration	1	1.9
OTHER	Other	3	11.8
PNDTR		1	2.3
PP	Porous Pavement	1	0.0
SM	Shallow Marsh	6	75.6
SW	Wet Structure	1	0.6
UGS	Underground Storage	8	33.8
UGVAULT	Underground Storage	1	7.1
WP	Retention Structure (Wet Pond)	38	600.4
WQINLET	Water Quality Inlet	1	1.0
WQITPE	Water Quality Inlet with Partial Exfiltration	1	0.1
TOTAL		**1,442**	**5,771.6**

Ownership of the facilities is summarized as follows:

Table 2.8 Facilities Ownership

Owner Code	Owner	Number
BE	Unknown	1
PR	Private	1,020
PW	Anne Arundel DPW	223
SHA	MD State Highway Administration	118
STA	Unknown	1
NONE	No owner listed	19
TOTAL		**1,442**

2.2 Water Quality Monitoring

Baseflow Sampling

Dry weather grab samples were collected once at a single station in each of the subwatersheds in order to identify unusual pollutant loads and to characterize baseflow loadings for water quality modeling. Table 2.9 lists the tested parameters.

Table 2.9 Baseflow Sampling Parameters

Parameter	Reporting Limit	Units
Nitrogen		
Nitrate (NO_3)	0.050	mg/L
Nitrite (NO_2)	0.050	mg/L
Total Kjeldahl Nitrogen (TKN)	0.10	mg/L
Phosphorus		
Total P	0.010	mg/L
Fecal Coliform	2.0	org/100ml
Total Suspended Solids (TSS), non-filterable solids	1.0	mg/L
Copper	0.0020	mg/L
Lead	0.00011	mg/L
Zinc	0.020	mg/L

Sample sites were selected for each subwatershed based on location and access. Locations were selected nearest the stream outfall point for each subwatershed so that the entire subwatershed was represented with one grab sample, and where access to that location was fairly easy; such as a location near the bottom of the subwatershed where a stream intersects a road. Some of the smaller subwatersheds that drain directly to the Severn River are made up of several small creeks that do not connect. In the case where subwatersheds had multiple streams that did not merge together, for example Aisquith Creek, the largest stream with the most tributaries was selected to represent the subwatershed. Sample station locations are represented with a yellow point on the Dry Weather Sampling Location Map.

Pre-treated sample bottles were used to collect the samples. To ensure no acids or bases were lost from the pre-treated bottles, the Total Suspended Solids (TSS) bottle was dipped into the stream and used to fill the pretreated bottles. This was done since most of the streams that were sampled had little flow and the entire sample bottle could not be submerged upright. The TSS and the fecal coliform sample bottles were then filled as full as possible.

Whenever possible, samples were taken from flowing sections of the streams; otherwise the sample was taken from pooling areas within the stream channel. Sample sites that were dry were noted and another attempt was made to sample the same site. Sites that had little to no flow or where grabbed from pooling water were also sampled again in the hope of greater volumes of water in the channel. A summary of the water quality results is included in section 3.2 and the complete laboratory results for each subwatershed are included in the subwatershed conditions sections 4.1 through 4.4.

2.3 Water Quality Modeling Data

Event Mean Concentrations

An Event Mean Concentration (EMC) is the average concentration of a pollutant measured during a storm runoff event. Typically an EMC is a flow-weighted calculation for a given storm event. Flow weighting is usually achieved by taking a sample after a set volume has passed through the monitoring station. All of the samples for the storm event are combined (composited). The resulting composite sample is analyzed for the desired parameters, thus producing EMCs for the storm event. Due to the highly variable nature of stormwater pollutant concentrations, it is better to use the EMCs from multiple events to produce a final EMC for a given land use and parameter. Generally this is the result of taking the mean or the median of the data set of many storms. In addition to trying to reduce the variable nature of stormwater pollutant concentrations by averaging storms, it is also advantageous to try and reduce the highly variable nature of land parcels by averaging sites. Although the stormwater sampling is typically taken from a point that drains one single land use, there are still many variations site to site. Therefore, it is often useful to take the mean of several EMCs from the same land use. To determine the variability within sites in a data set, the coefficient of variation is used. EMC information is necessary to run the PLOAD model.

With little or no available monitoring data from the watershed, several different types of literature sources were reviewed for EMC data including broader or regional studies and local state studies of monitoring data. In addition, the South River Watershed Management Master Plan Study (PBS&J 2000) was used to determine, for consistency's sake, what EMCs had been used in that study. A list of almost a dozen sources and their respective values was compiled. No single source provided all of the EMCs corresponding to each of the land use categories required by the Severn River Watershed Management Master Plan project. It was therefore necessary to compile a list of EMCs from multiple sources.

Much of what is known about stormwater monitoring, pollutant concentrations, and characterizing those data were derived from the EPA's Nationwide Urban Runoff Program (NURP) results (1983). That text, in addition to *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs* (Scheuler, 1987), which focuses on the metropolitan Washington, DC and Baltimore areas, has become the standard that many stormwater projects and modeling efforts use as a starting point. In fact, EPA has recommended using NURP data as a default in the absence of local data. A major drawback to these data is that they are now more than two decades old and may not be indicative of present stormwater conditions. An example of this is the case of lead. Leaded gasoline was outlawed in 1991 and it is assumed that EMCs for lead calculated for today would be much lower than during the early 1980s.

The resources that the South River study drew upon included Scheuler (1987), The Terrene Institute (1996), and Zarbock et al. (1994). Unfortunately, this study only encompassed three of the seven parameters needed for the Severn River modeling effort.

Stormwater monitoring data were obtained from MDE that was collected and analyzed as part of the Maryland municipalities' NPDES Phase I permit application effort. MDE published a list of "Maryland

EMCs" calculated from this data (Bahr 1997). This study was updated in 2001 with additional data (Bahr 2001). Since these data are local, recent, and include all parameters of interest, it was used in its entirety – for all residential, commercial, and industrial land uses for all of the seven parameters of interest (Total Kjeldahl Nitrogen (TKN), nitrate and nitrite (NOx), total phosphorus (TP), total copper (Cu), total lead (Pb), total zinc (Zn), and fecal coliform). Overall average EMC values were calculated using both the 1997 and the 2001 MDE EMC values.

The Federal Highway Administration study (Young et al. 1996), based on data collected in the late 1980s and early 1990s, is still considered to be the best highway EMC data available. The Northern Virginia Planning District Commission (NVPDC 1979) published the only source researched that included EMCs for surface waters. The closest and most recent EMCs found for agricultural land uses were from a study using the City of Chesapeake, Virginia's Virginia Pollution Discharge Elimination System (CDM 1993) application monitoring data. It was somewhat difficult to find EMC data for a Woods/Open Space type land use from a single source. The final suggested EMCs include values from NURP, Scheuler, and the City of Chesapeake, VA.

Of all the parameters, EMCs for fecal coliform were found to be the least reported in the research. The MDE data were used for commercial, residential, and industrial land uses. The only other data found were from a Georgia study, which encompassed data from 1992 to 1996 (CDM 1996). To date, a fecal coliform EMC has not been found for the agricultural land use. This would be highly dependent on whether manure was applied to cropland for fertilization and/or disposal. If this were not the case for croplands in the Severn River watershed, then the forest/open space EMC for fecal coliforms would be applicable. The Anne Arundel County Soil Conservation District (AASCD) was contacted with some questions on agricultural practices in the County. Staff confirmed that the district was comfortable using the woods/open space EMC for fecal coliforms for the agricultural land use as well. They stated that there are only isolated cases of livestock farms in this portion of Anne Arundel County, and no real concentrations on a watershed or subwatershed scale. Therefore, this portion of the County is manure deficient and does not use manure application extensively on their crops.

It was agreed at a Project Team meeting that EMCs for the Residential Woods land use category would be created from a weighted average of 75% of the Woods category and 25% of the Residential category. These numbers were based on a check of the land use GIS layer and aerial photographs of the proportions of the Residential Woods lots that were Residential or Woods.

During the review of BMP efficiency rating literature values it was found that most information reported TN and Nitrate/Nitrite, but not TKN. The Project Team agreed that modeling should be performed for reported TN and Nitrate/Nitrite, but not TKN. Most literature studies report the opposite for EMCs – TKN and Nitrate/Nitrite, but not TN. In order to use TN EMC values, the values already decided upon for TKN and Nitrate/Nitrite based on the above literature review were added together. Table 2.10 shows EMCs developed for this project and includes TKN, NOx, and the addition of those items to obtain TN.

The level of statistical analysis performed on the EMC information varied from source to source. MDE provided the coefficient of variation for their data sets. Other sources performed similar analyses but did not necessarily include all of it in their texts. Therefore, statistical analyses of the EMCs are not provided here.

Table 2.10 EMCs by Land Use (mg/L except where noted)

Code	Land Use Type	TN	TKN	NOx	TP	Zn	Cu	Pb	Fecal Coliform (MPN/ 100mL)
COM	Commercial	2.24	1.49	0.75	0.30	0.1546	0.0199	0.0203	1262
IND	Industrial	2.22	1.71	0.51	0.19	0.1609	0.0222	0.0113	2614
OPS	Open Space	1.15	0.61	0.543	0.15	0.195	0.006	0.030	500
R11	Residential 1 Acre	2.74	1.83	0.91	0.32	0.0925	0.0230	0.0140	2309
R12	Residential 1/2 Acre	2.74	1.83	0.91	0.32	0.0925	0.0230	0.0140	2309
R14	Residential 1/4 Acre	2.74	1.83	0.91	0.32	0.0925	0.0230	0.0140	2309
R18	Residential 1/8 Acre	2.74	1.83	0.91	0.32	0.0925	0.0230	0.0140	2309
R21	Residential 2 Acre	2.74	1.83	0.91	0.32	0.0925	0.0230	0.0140	2309
RWD	Residential Woods	1.55	0.92	0.63	0.19	0.1694	0.0100	0.0260	952
SRC	Single Row Crop	1.71	1.47	0.24	1.00	0.000	0.000	0.000	500
TRN	Transportation	2.59	1.83	0.76	0.43	0.329	0.054	0.400	1400
WAT	Water	1.20	0.60	0.60	0.03	0.023	0.0053	0.0030	500
WDS	Woods	1.15	0.61	0.543	0.15	0.195	0.006	0.030	500
CIT	City of Annapolis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Pollutant Removal Efficiencies

The BMPs were grouped into 11 categories according to type as presented in Table 2.11. Literature sources were reviewed to select pollutant removal efficiency data for each BMP type. The most comprehensive information was found to come from the Center for Watershed Protection (CWP) *National Pollutant Removal Performance Database for Stormwater Treatment Practices*, (2000). This reference was used for all the information presented in Table 2.11, which summarizes the pollutant removal efficiencies assigned to each BMP type. Removal efficiencies for fecal coliform and lead were unavailable, due to paucity of data.

Anne Arundel County classifies and labels its BMPs according to the Maryland SWM Database. The *Glossary of Stormwater BMP structures in the Maryland SWM Database* was used to determine which BMP matched up with the descriptions given CWP 2000. The Anne Arundel County Office of Planning and Zoning was also consulted in areas with discrepancies, in order to obtain a better description of the particular BMP in question. In several cases the description seemed to indicate that the existing structure was made up of more than one functional BMP as described in the literature. In those cases, calculations were performed to route the runoff through more than one BMP and a final overall pollutant removal efficiency was obtained for the BMP system. That is, the first BMP had a particular efficiency (for example, 60%) associated with it. The second BMP's efficiency (70%) was applied to the remainder of the first BMP (40%) and the overall efficiency (88%) achieved was determined. These instances are designated as "in series" within Table 2.11.

Certain BMPs were found in studies to experience negative percent removal efficiencies. There are a variety of reasons why this could occur including resuspension of particles, inadequate residence in the detention pond, or biological activity, which would return pollutants to the system. In addition, often if the inflow concentration to a particular BMP is very low or at the irreducible level of the parameter, the BMP may experience no removal or negative removal.

Table 2.11 Percent Pollutant Removal Efficiencies of BMPs[1]

BMP Type (CWP)	AACo BMP	AACo BMP Code	TN	NOx	TP	Cu	Zn
Dry Extended Detention Pond [2]	Extended Detention	ED	31	-2	20	29	29
	Extended Detention Structure, Dry	EDSD	31	-2	20	29	29
	Microbasin	MB	31	-2	20	29	29
	Underground Storage	UGVAULT or UGS	31	-2	20	29	29
Quantity Control Pond	Detention Structure (Dry Pond)	DP	5	9	19	10	5
Wet Extended Detention Pond	Extended Detention Structure Wet	EDSW	35	63	55	44	69
Wet Pond	Wet Pond	EXPOND, SW	32	36	49	58	65
	Retention Structure (Wet Pond)	WP	32	36	49	58	65
Infiltration Trench	Dry Well	DW	42	82	100	0	0
	Dry Well – Infiltration Trench	DWIT	42	82	100	0	0
	Dry Well – Infiltration Trench with Complete Exfiltration	DWITCE, DWITCW	42	82	100	0	0
	Dry Well – Infiltration Trench with Partial Exfiltration	DWITPE	42	82	100	0	0
	Dry Well – Infiltration Trench with Water Quality Exfiltration	DWITWQE	42	82	100	0	0
	Infiltration Trench	IT	42	82	100	0	0
	Infiltration Trench with Complete Exfiltration	ITCE	42	82	100	0	0
	Infiltration Trench with Complete Exfiltration, Microbasin	ITCEMB	42	82	100	0	0
	Infiltration Trench with Partial Exfiltration	ITPE	0	0	0	0	0
	Infiltration Trench with Water Quality Exfiltration	ITWQE	42	82	100	0	0
	Water Quality Trench with Partial Exfiltration	WQITPE	42	82	100	0	0
	Water Quality Trench	WQP	42	82	100	0	0
	Level Spreader	LS	42	82	100	0	0
Oil Grit Separator[2]	Water Quality Inlet (OGS)	WQINLET	0	47	-41	-11	17
	Oil Grit Separator	OGS	0	47	-41	-11	17
Stormceptor	Stormceptor	STMCEPTOR	0	6	19	30	21
Shallow Marsh	Shallow Marsh	SM	26	73	43	33	42
Porous Pavement	Porous Pavement	PP	83	0	65	0	99
In Series / Combination	Extended Detention Structure Dry, Infiltration Trench with Complete Exfiltration	EDSDITCE	60	82	100	29	29
	Infiltration Basin	IB	42	83	100	30	21
	Infiltration Basin, No outfall	INPOND	42	83	100	30	21
	Infiltration Trench, Extended Detention	ITVSW	60	82	100	29	29
	Oil Grit Separator [2], Infiltration	OGSITCE	42	90	100	-11	17

BMP Type (CWP)	AACo BMP	AACo BMP Code	TN	NOx	TP	Cu	Zn
	Trench with Complete Exfiltration						
	Pond / Trench	PNDTR	42	83	100	30	21
Not Applicable	Other	OTHER, NA	0	0	0	0	0
	Attenuation Swale / Check Dam	AS/CD	0	0	0	0	0
	Attenuation Swale	ATTENSWA	0	0	0	0	0
	Attenuation Trench	ATTTRENCH	0	0	0	0	0

Notes: 1 National Pollutant Removal Performance Database for Stormwater Treatment Practices, June 2000, Center for Watershed Protection. 2 These BMPs were found in studies to experience negative percent removal efficiencies. There are a variety of reasons why this could occur including resuspension of particles, inadequate residence in the detention pond, or biological activity, which would return pollutants to the system. In addition, often if the inflow concentration to a particular BMP is very low or at the irreducible level of the parameter, the BMP may experience no removal or negative removal.

Point Sources

PLOAD has the ability to incorporate existing point sources in its runoff calculations. The EPA's Permit Compliance System (PCS), along with valuable insight from Anne Arundel County DPW, was the main source of information on the point sources within the Severn River watershed.

GIS Information

In the investigation of point sources, all active NPDES permits in the Severn River watershed were split into three main groups: those permits which have actual permitted limits (such as International Paper), others which are required to report discharges (primarily sand/gravel operations and ready-mix plants), and permitted marinas which are also required to report discharges. DPW staff transmitted an NPDES permit shape file of these point sources to the Project Team. The file was based on structure locations (building or cooling/runoff pond) from the Anne Arundel County 1995 planimetric maps. This procedure was followed for each point source, with the exception of NPDES Permit Number MD002184, the Annapolis Water Reclamation Facility (WRF). The point associated with this source is located on the last point along the outfall appearing on the Anne Arundel County DPW 40 scale maps. It is a mid-river discharge and therefore will not be considered in the modeling effort, as it is not assigned to any watershed's load.

Tabular Data

Information related to point source discharges was obtained from the PCS with DPW's guidance. Of the twenty point sources identified, only nine had limits or discharge data associated with them. Of those, only five had limits or discharge data that included the parameters of interest in this study. The discharge information was obtained from the limits listed in the PCS. Either the limit listed in pounds per day was translated into pounds per year, or the maximum concentration limit listed was converted to pounds per year using the flow limit. In two cases (NPDES Permit Number MD002184 Annapolis WRF – TN and NOx; NPDES Permit Number MD0023523 US Naval Academy – NOx) limits were not provided but discharge data from recent discharge monitoring reports were. These data were averaged and used as the point source discharge for the respective parameter.

Table 2.12 lists the point source discharges included in the PLOAD modeling. Note that the GIS layer contains all the point source discharges while the table only shows the applicable ones. Therefore, the GIS layer contains more points than this table includes.

Table 2.12 Point Source Discharges (lb/year except where noted)

Permit Number	Facility	TN	NOx	TP	Cu	Fecal Coliform (counts/ year)
MD0021814	Annapolis Water Reclamation FC	164969	124538	62050	0	1.934E+11
MD0068730	Analysis & Technology	0	0	0	0.019	0
MD0023523	U.S. Naval Academy	0	1774	6205	0	1.934E+10
MD0052868	Dreams Landing Condo WWTP	0	0	0	0	3.868E+8
MD0002003	International Paper-Odenton	0	0	0	58447	0

2.4 Modeling

Hydrologic Analysis

Introduction

A TR-20 model was prepared for assessing the current condition of the watershed and evaluating improvements. Input data for TR-20 were developed from the GIS data. No calibration has been done.

Modeling Environment

The TR-20 environment originally proposed for the project was a module of the Watershed Management System, (WMS) developed by Boss, Inc. WMS is a graphical decision support system for several hydrologic and hydraulic models, including TR-20. It offers an ArcView shell, which allows spatial data to be imported directly from ArcView shape files or DEMs (Digital Elevation Models).

After developing the first draft of the modeling using WMS, it became clear that it would be more difficult to use it with the ArcView data developed for this project than anticipated. The default method was an automated procedure that used a DEM to define catchments and flow paths from outlet points digitized by the modeler. This procedure did not work ideally in developed areas, and did not represent the Severn River watershed very well.

As an alternative, KCI staff custom programmed a new GIS front end for TR-20 modeling for this project. One of the factors that influenced the change of model processing from WMS to ArcView was the manual process involved in the creation of a WMS model and the impossibility of obtaining a comparison table to check the results and perform quality control. ArcView gave the possibility of checking results and keeping a record of the changes. In addition, slopes, lengths and geometric data in WMS were defined through an almost “black box” procedure which made it difficult to keep track of actual versus previous conditions. The version of TR-20 used in this project is the TR-20-92 version, which was downloaded from the NRCS USDA website.

TR-20 Model Interface

The ArcView interface uses the GIS coverages and data tables that were developed and updated for this project, including land use, future land use, soils, and BMPs. Contours were used to develop a DEM with a cell size resolution of 30 feet. These data are used to make several calculations that are used for TR-20 input. Once the input data are derived, the interface writes them out to a standard TR-20 text input file and executes the model for the desired rainfall event.

Curve Number (CN) CN calculation is done from the land use and soil type themes and the land use/soil group/CN lookup table. The first step is to intersect the watershed and clipped soil (hydrologic soil type) themes. The second step intersects the results of the first step with the clipped land use theme. The resulting theme has individual areas with a unique soil hydrologic type condition, land use, and watershed. The CN is assigned to each one of these sub-areas by comparison with the land use lookup table. For each catchment, a weighted average CN is calculated based on area. Finally each CN is rounded to the nearest whole number and the resulting value is assigned to each catchment.

Time of concentration (Tc) It was desirable to find a semi-automated method of estimating this parameter so the model could be updated more easily as GIS coverages were updated. The TR-55 sheet flow / shallow flow / channel flow method is widely used, but requires considerable manual input. After investigation, the Soil Conservation Service (SCS) lag time equation was chosen. This equation has been approved for use in GIS-HYDRO and has been in common use with this program in the state of Maryland.

The equation defines Tc as a function of longest flow path, watershed slope and CN. It is especially appropriate for an area undergoing development, because it uses CN, an indicator of land use, as one of the variables.

$$Tc = \frac{0.000526 * L^{0.8} * \left(\frac{1000}{CN} - 9\right)^{0.7}}{\sqrt{S}}$$

Where T_c = time of concentration in hours
L = longest flow path in ft
CN = Curve Number
S = slope of the watershed in percent

In order to obtain the longest flow path, the DEM is used with the procedure defined in Arc View. As a first step, the DEM is filled in a process of filling "sinks" or grid cells with no data values. Next, a flow direction matrix is generated. In this process each cell is checked in all of the eight possible directions (N, NE, E, SE, S, SW, W and NW) and the steepest slope direction is selected as the direction of flow for each cell. The total number of cells draining to each cell is counted based on the flow direction matrix and the flow accumulation matrix is generated. The DEM is clipped for each sub-area and two matrixes are calculated: one with the downstream length and one with the upstream length. The first one is related to the length that a drop of water must follow from each cell to reach the outlet and the second one is the longest length that a drop of water has already run when reaching a cell. By adding the two matrixes the longest flow path can be obtained by selecting the cells with the highest value, which corresponds to the longest flow path for each catchment. The watershed slope was derived based on the slope of the longest flow path, which can be easily determined from the above-mentioned matrixes.

Stage – Storage – Discharge (SSD) Curves The interface takes into account BMP and pond peak attenuation by reading the stage-storage-discharge tables located inside each sub-area and routing flows through them. A list of all identifiable BMPs was developed from the GIS mapping, then sorted by type and area served. All BMPs with ponds were selected and searched through the I&P and AASCD files to find previous TR-20 runs showing the Stage – Storage – Discharge tables. These tables were entered and saved as text files identified by the numeric part of the permit number. When creating the model the SSD for each BMP with a previous run of TR-20 was imported directly from these text files that can be easily identified. Drained area, Tc, and CN used in the historic TR-20 runs were not used because that

information was old, in some cases more than 10 years old, and there was no way to ascertain whether the scenario conditions had changed in the mean time. It was a reasonable assumption however that the structure itself and the SSD table had not.

Land Use – Soil look-up table As described in the imperviousness section, residential areas in the watershed were measured to estimate the local percent impervious rather than using literature values from the model documentation. Also as described, the total imperviousness was reduced for low-density residential land uses based on the assumption that half the roof area drained to lawns or woods. The CN was then calculated using a weighted average of impervious CN (98) and pervious CN (OS values for lawns). RWD CNs were calculated using the weighted average of impervious CN and pervious CNs of for woods.

Table 2.13 CN Values

Land Use	Percent Impervious	A	B	C	D	Source
Commercial	85	89	92	94	95	TR-55
Industrial	72	81	88	91	93	TR-55
Meadow	0	39	61	74	80	TR-55
Open Space	0	39	61	74	80	TR-55
Residential 1/8 Acre lots	34	59	74	82	86	Severn measurement
Residential 1/4 Acre lots	20	51	68	79	84	Severn measurement
Residential 1/2 Acre lots	15	48	67	78	83	Severn measurement
Residential 1 Acre lots	11	45	65	77	82	Severn measurement
Residential 2 Acre lots	11	45	65	77	82	Severn measurement
Residential, wooded lots	5	33	57	71	78	Severn measurement
Single Row Crop	0	67	78	85	89	TR-55
Transportation (paved open section)	75	83	89	92	94	TR-55 (% derived from CN values)
Water	0	100	100	100	100	TR-55
Woods	0	30	55	70	77	TR-55

Model Structure

The watershed was broken up into three smaller classifications: areas with no TR-20 simulation (primarily the Severn River Tidal catchments), Severn Run, and the areas with TR-20 simulation that were not included in Severn Run. Due to the necessity for connectivity Severn Run was considered to be a single area. Even so, it had to be subdivided into seven sub-areas in order to create the model.

The seven sub-areas were defined according to the capacity of the interface for generating the sequence of outputs to meet the eight-hydrograph ADDHYD limitation of TR-20. The final hydrograph of each one was inserted manually as an input hydrograph for the downstream catchment to the corresponding sub-area.

Verification of Tc Calculation

To compare different methods of calculating Tc, the Bear Branch (BRB) subwatershed was selected as a study area. BRB is composed of eight catchments and five outlets. Two of the areas are highly developed and three are relatively undeveloped. Two Tc methods were selected: sheet/shallow/channel flow and SCS lag time.

TR 55 was used to get the sheet-shallow-channel flow Tc. WMS was used to split the flow types in each sub-area using the tools for generating flow paths, and selecting the type of flow for each section. For ease of calculation, the average velocity in the channels was assumed to be 4.0 ft/sec. Tc was tested with a sensitivity analysis using channel velocities of 1.0 and 10.0 ft/sec. The SCS lag time was calculated using the procedure described above.

Results from both of the methods are shown in Table 2.14. The sheet-shallow-channel flow Tc was longer in most of the sub-areas mainly because sheet flow travel time was large. This is most likely due to the flat slopes, ranging around zero on the sub-areas on the higher elevations.

Tc values calculated using the lag equation were in general, shorter than the calculations using a channel velocity of 1 ft/sec and longer than the calculations with a velocity of 10 ft/sec. On average, they were somewhat longer than the calculations using a velocity of 4 ft/sec, ranging from 55% of the value for BRB050 to 176% of the value for BRB0010.

Table 2.14 Comparison of Tc calculations

CATCHMENT	Sheet-Shallow-Channel Flow			SCS Equation
	V = 1 ft/s	V = 4 ft/s	V = 10 ft/s	
BRB0010	0.98	0.53	0.44	0.88
BRB0020	0.37	0.37	0.37	0.33
BRB0030	1.56	1.15	1.07	1.45
BRB0040	0.87	0.57	0.51	0.64
BRB0050	0.43	0.32	0.30	0.18
BRB0060	0.49	0.32	0.29	0.40
BRB0070	0.64	0.38	0.33	0.67
BRB0080	0.67	0.45	0.40	0.54

Flows for the subwatershed were calculated using Tc estimated with the four methods above. Table 2.15 shows that flows using the lag time computation fell within the values calculated using the sheet-shallow-channel flow method for channel flow velocities of 1 ft/sec and 4 ft/sec.

Table 2.15 Comparison of Flows (cfs) with Different Tcs

Event	Sheet-Shallow-Channel Flow			Lag Time
	V = 1 ft/s	V = 4 ft/s	V = 10 ft/s	
1 year	156	196	205	172
2 year	233	300	316	258
100 year	1159	1570	1691	1237

Pollutant Load Analysis

Introduction

PLOAD, developed by CH2M HILL and integrated into the EPA BASINS program, is an ArcView extension tool that was used to calculate pollutant loads for watersheds and subwatersheds. The tool uses GIS coverages of land use, subwatershed boundaries, BMP locations, and point sources as well as look-up tables for EMCs, imperviousness, BMP pollutant removal efficiencies, and point source discharges.

The model was used to evaluate pollutant loads in stormwater runoff from the Severn River watershed to its receiving waters. Calculations were performed on each catchment and subwatershed using land use,

percent impervious, EMC, and BMP data within each of the watersheds. Seven parameters were analyzed based on input from Anne Arundel County staff and stakeholders:

- Total nitrogen (TN)
- Nitrate and nitrite as N (NOx-N)
- Total phosphorus (TP)
- Total Copper (Cu)
- Total Zinc (Zn)
- Total Lead (Pb)
- Fecal Coliform (FC)

PLOAD focuses on pollutant loads in stormwater runoff and as such does not explicitly model atmospheric deposition. However, because atmospheric deposition is part of the overall pollutant buildup on land surfaces, these loads from wet deposition and washoff are included in the EMC value. Atmospheric deposition to the tidal surface water is not included in the load analysis.

Data Description

The following GIS and tabular input data were used to build the PLOAD model. These data are further described in the following paragraphs.

- GIS watershed data
- GIS land use data
- GIS best management practice site data
- GIS point source facility locations
- Pollutant loading rate data tables (Event mean concentration data)
- Imperviousness rating by land use table
- BMP pollutant reduction tables
- Point source facility loads

Watersheds

The Project Team developed two GIS coverages of delineated watersheds for the Severn River watershed: delineated subwatersheds and delineated catchments. The development of these coverages is described in Section 2.1.

Land Use

The Project Team created a current conditions land use layer as part of this effort. The development of this layer is described in Section 2.1. In addition to the current conditions scenario, a forested conditions scenario was run. This involved changing the land use file to all WDS (with the exception of CIT which remained as is for the reasons described in later paragraphs.)

Best Management Practice Site Data

Anne Arundel County provided a database of BMP ponds and other onsite BMPs. The methodology used to generate a GIS layer from this information can be found in Section 2.1.

Event Mean Concentrations

EMCs were developed for each land use category in the Severn River watershed using a variety of literature values. The methodology and final values are described in detail in Section 2.3. Annual EMCs were developed for each of the parameters – TN, NOx, TP, Zn, Cu, Pb, fecal coliform. The City of Annapolis did not provide information regarding land use, best management practices, etc. CIT was assigned an EMC of zero for all parameters, which meant, for modeling purposes, that it would experience no pollutant load runoff whatsoever. The impact of this is explained in later paragraphs.

Impervious Land Cover

From the land use layer developed according to Section 2.1, imperviousness values were determined. Detailed information about the methodology and the values used can be found in Section 2.1. The City of Annapolis did not provide information regarding land use, best management practices, etc. CIT was assigned an imperviousness rating of zero which meant, for modeling purposes, that it would experience no runoff whatsoever. The impact of this is explained in later paragraphs

Best Management Practices –Tabular Data

A literature review was performed to assign pollutant removal efficiency values to each BMP type. More information about this review can be found in Section 2.1.

Point Source Facilities – GIS and Tabular Data

A GIS layer of point source facilities in the Severn River Watershed was used in the PLOAD model. The development of a GIS layer and tabular discharge data associated with each point is described in Section 2.3.

Pollutant Load Calculations

Annual pollutant loads are calculated for each watershed using the EPA Simple Method:

$$L = \Sigma_u (P * P_j * R_{vu} * C_u * A_u * 2.72 / 12)$$

Where:
- L = Pollutant load, lb
- P = Precipitation, in./yr
- P_j = Ratio of storms producing runoff (typically 0.9)
- R_{vu} = Runoff Coefficient for land use u, $in._{runoff}/in._{rain}$
- C_u = EMC for land use u, mg/L
- A_u = Area of land use u, ac

The runoff coefficient, R_v, can be calculated from the following equation:

$$R_v = 0.05 + 0.009 * I$$

Where: I = Percent Imperviousness

To calculate the appropriate reduction in pollutant loadings due to the BMPs, the model uses the pollutant removal efficiencies and area served by each BMP. This reduction is assigned to the watershed in which

each BMP resides. The model also incorporates point source discharges by adding them to the overall pollutant load running off the watershed in which that point source resides.

Application of Model

PLOAD uses the Simple Method, which uses several parameters that are based on much uncertainty, specifically the EMC values. As such, it is important to recognize that the PLOAD results, as with most model results, should be looked at in relative terms rather than absolute. The relative loads should be compared to each other, i.e. Picture Spring Branch (PSB) is higher in copper than Jabez Branch 1 (JZ1), rather than using the absolute value of the loads, i.e. Picture Spring Branch has 51,240 pounds of copper running off annually. While PLOAD model results should be analyzed in the proper context as described here, this is not meant to lessen the value of the model results. The Simple Method is a widely accepted method for analyzing pollutant load runoff. For instance, the Simple Method is a requirement of localities governed by the Chesapeake Bay Local Assistance Department in Virginia. The communities making up the Hampton Roads Region of Virginia use PLOAD and the Simple Method to report to the Virginia Department of Environmental Quality in association with their NPDES permits' annual reports.

2.5 Stream Assessment

Stream Walk

Introduction

Conducting a comprehensive stream walk and intensive data collection effort completed a major portion of the Current Conditions assessment. The task involved teams of environmental scientists and engineers conducting a full-scale stream survey to develop an accurate catalog of infrastructure, stream habitat and environmental features. Teams walked 152 miles of streams in the Severn River watershed and collected information that will allow planners to determine areas of high environmental quality that may need protection and areas of degradation that may be candidates for restoration.

Information on safety, training, office preparation, mapping requirements, collection of features' locations and attributes, and use of software and GPS equipment are described. In addition the procedures for database structure and cataloging of data points and photos are described.

Safety and Training

Safety was the major concern of all personnel responsible for conducting fieldwork. The nature of the task required working in all varieties of weather and conditions and involved long periods of walking in and near stream channels, in forests and along roadways. Personnel always traveled and conducted stream walks in teams of at least two people. When accessing the stream system, teams respected private property and crossed only when necessary. Teams attempted to gain access along utility rights of way when possible. A copy of the letter of authorization for private property access was in possession of the team members at all times and was given to homeowners upon request. All team members wore blaze orange vests and carried appropriate identification.

All field team members participated in the Pilot Stream Walk. The Pilot allowed team members the opportunity to become familiar with the procedures. Teams carried out the full protocol on two reaches within the Saltworks Creek subwatershed and compared results. The Pilot provided a practical training exercise that increased the level of accuracy and homogeneity within the various team members' results.

Methodologies

Data points were collected using the Trimble GPS Pathfinder Pocket Receiver along with the Trimble Beacon on a Belt Receiver, which provides real-time differential correction. The Beacon on a Belt receives and tracks differential beacon broadcasts from up to 8 satellites at a time. The data collection device used with the GPS receivers was the Tripod Data Systems, Inc. Ranger 200T Data Collector running Trimble's TerraSync Version 1.22 software. Positions were collected once every second for a minimum of 60 seconds for each data point.

Field crews were equipped with digital mapping on the Ranger Data Collector. Digital maps were created in ArcView using the Xtools extension, which allowed the user to clip various point and line layers to a polygon. The digital layers consisted of topography, planimetrics, hydrography and known outfalls and culverts. These ArcView shapefile layers were imported into GPS Pathfinder Office v2.80 software using the data import wizard and converted into a background file. The resulting background file was then transferred to the Ranger so teams could view the map and track the collection of GPS points within TerraSync. The digital map allowed teams to locate their position and surroundings in each subwatershed, digitize points on screen in areas where satellites were not sufficient for data collection, and identify the potential for unidentified stream networks not previously mapped.

Paper field maps were created using 2000 Anne Arundel County 200 scale orthophotography overlaid with 5-foot interval topography, hydrography and known outfalls and culverts. Areas where scientists presumed that streams might exist even though they were not indicated on the mapping were drawn on the field mapping by hand before the area was assessed. All data points were collected digitally and recorded on the field mapping for quality control.

Field Procedure

Teams worked in subwatersheds individually to avoid confusion with naming conventions and duplication of effort. Teams and equipment were denoted as either 'A' or 'B.' Two data dictionaries were built and used with the GPS equipment. They were identical except that one tagged points with an 'A,' and the other with a 'B.' The filename for each days work included the subwatershed, the date of collection, and either 'A' or 'B' depending on team. This allowed for better tracking of what areas were completed when, and by whom.

The original strategy for the stream walk was to only walk, inventory and assess perennial streams. For the purposes of this study, this was defined as only those streams with observed flow during the stream study period. Confluences with intermittent/ephemeral channels, swales and ditches were to be mapped and briefly characterized, but these channels were not to be walked or have a full inventory conducted. However, due to drier than normal conditions in the spring of 2002 and the increased frequency of ephemeral/intermittent channels in the watershed, some of these channels were walked.

All ephemeral and intermittent channels were given a cursory inspection to ensure that they were not perennial. Habitat assessments were not conducted on ephemeral or intermittent channels. The MPHI assessment requires measures of velocity/depth diversity, pool/glide eddy quality, and maximum depth measurements. These parameters would preclude ephemeral and intermittent channels. Certain ephemeral and intermittent channels had infrastructure features recorded where either the channel was of significant size and/or the features' impact was substantial.

Teams began in upstream portions of the subwatersheds from a point they determined to be an achievable distance for the day. As the teams traveled downstream they took notice of aquatic habitat, valley topography, channel geometry and features with possible impacts. Observations made on the walk

downstream were integral in later determinations of habitat and Rosgen changes. As teams traveled upstream from the downstream tidal limit information was collected. Data was collected with the Ranger data collection device and marked on the field map. The field mapping was used for verification of points and in the quality assurance/quality control process. The following data was collected:

- Photographs,
- Rosgen Level I verification,
- county stream layer verification,
- habitat assessment,
- environmental and infrastructure features,

The following sections describe in more detail how these types of information were collected and cataloged. While they are described separately, the information was collected simultaneously.

Naming Convention

Every point located was given a unique name that identified it by subwatershed, reach ID and feature ID. Each subwatershed was given a three-digit code, which became the first three digits of each point within that subwatershed. The reach ID corresponds to the habitat reach where that point was taken. The reach ID's for each subwatershed began with 01, and were sequential for that subwatershed and made up the fourth and fifth digits of the name. The feature codes were made up by a letter, which identified the type of feature, and a number, which began with 01 and was sequential for that type of feature in that reach.

The Segment ID was also recorded for each point. It was recorded on the mapping prior to fieldwork and was used to divide the subwatersheds physically by mainstem and tributaries. Reaches were assigned a four-digit code and were broken up at each confluence. The segment ID was not included in the unique naming of each point. For example, the first buffer in the fifth reach of Picture Spring Branch was be, PSB05B01. The codes listed in Table 2.15 were used to identify the features:

Table 2.16 Features' Codes

Features	Code
Rosgen Change	R
Rosgen Section	X
Habitat Start	A
Habitat Assessment	Z
Stream	S
Confluence with ephemeral or intermittent channel	F
Buffer	B
Erosion	E
Obstruction	T
Crossing	C
Utilities	U
Dump Sites	M
Head Cut	H
Pipe	P
Ditch	D

Photographs

Photograph identification (Photo ID) numbers are generated by the digital cameras and consist of the date, without year, and the sequential three-digit number of each photo for that date. Because two (2) cameras were used, one was labeled Camera 'A' and the other 'B' so that each picture would have a unique ID. For example, the fifteenth photo taken on January 22nd with camera A was entered into the GPS unit as, 122015A.

Photographs, in general, were linked to the features that they represented. Photographs were indicated on the mapping both when they were associated with features and when recorded individually as a photograph independent of features. These photos had the same naming convention described above but will have their own attributes. Table 2.16 indicates the attributes collected for these independent photos.

Table 2.17 Photographs (Independent of Features)

Subwatershed	Reach ID	Photo ID	Segment ID	Photo Direction	Photo Description
ST1	01	1220001A	0100	north	text
ST2	02	1220002A	0200	south	
SM1	03	1220003A	0300	east	
				west	
				northeast	
				southeast	
				northwest	
				southwest	
				upstream	
				downstream	
				left bank	
				right bank	

Rosgen Level I Verification

Change points between different geomorphic reaches should be located and mapped. Two points will be taken when a Rosgen change is identified, one representing the end of the former reach and one representing the start of the new reach. The complexities of tracking confluences, true beginning and end points and areas where the Rosgen system does not apply, such as in wetland areas, will require teams to take points signifying the end of one reach, and the beginning of the next. The attributes in the following table will be collected for each change point.

Table 2.18 Rosgen Change

Subwatershed	Reach ID	Rosgen Change ID	Segment ID	Comments
ST1	01	R01	0100	Text (start/end)
ST2	02	R02	0200	
SM1	03	R03	0300	

At a representative portion within each Rosgen reach, channel measurements were taken for verification. This location was flagged, photographed and a GPS point recorded. The attributes in Table 2.19 were collected for each Rosgen section.

Table 2.19 Rosgen Section

Team Members	Subwatershed	Reach ID	Rosgen Section ID	Photo ID	Segment ID
MJPLEN	ST1	01	X01	1220001A	0100
MJPMRM	SM1	02	X02	1220002A	1100
MRMLEN	PSB	03	X03	1220003A	3100
Bankfull Height (dec. ft)	**Thalweg Depth**	**Wetted Width (dec. ft)**	**Bankfull Width (dec. ft)**	**Top of Bank (dec. ft)**	**Width of Flood Prone Area**
3.2	21.	7.8	6.6	9.0	50
2.1	1.2	8.6	5.6	10.4	70
4.5	3.1	5.7	3.4	11.2	30
Dominant Substrate	**Stream Character**	**Rosgen Classification**	**Flow Present**	**Depth 1**	**Depth 2**
clay	meandering	A	yes	0.1	0.1
silt	braided	B	no	0.2	0.2
sand	channelized	C		0.3	0.3
gravel	straight	D			
cobble		DA			
boulder		E			
bedrock		F			
muddy		G			
Depth 3	**Depth 4**	**Depth 5**	**Depth 6**	**Depth 7**	**Comments**
0.1	0.1	0.1	0.1	0.1	text
0.2	0.2	0.2	0.2	0.2	
0.3	0.3	0.3	0.3	0.3	

The representative section was typically located on a riffle segment and all measurements were collected in decimal feet. Bankfull Height was measured from the channel thalweg to the field determined bankfull stage elevation. Because bankfull is crucial to many of the measurements its identification had to be consistent and accurate. Bankfull elevation determination was obtained by identifying the top of the floodplain where incipient flooding occurs. For most channels with a well-developed floodplain the bankfull stage was easily identified as the elevation of the floodplain. Where a floodplain was not developed the following indicators were used (Rosgen 1996) to determine bankfull:

- Elevation of the top of the *highest* depositional features
- A break in the slope of the banks and/or a change in the particle size distribution
- Evidence of an inundation feature such as small benches
- Staining of rocks
- Exposed root hairs below an intact soil layer
- Riparian vegetation species.

Table 2.20 presents a summary description of the Level I channel types. The types are dependent on a combination of factors including level of entrenchment, planform, slope and shape. The soil types, basin relief, valley morphology and position relative to development also contribute to the channel type.

Table 2.20 Rosgen Level I Channel Type Description

Channel Type	General Description
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.
A	Steep, entrenched, confined, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.
B	Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Moderate width/depth ratio. Narrow, gently sloping valleys. Very stable plan and profile. Stable banks.
C	Low gradient, meandering, slightly entrenched, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks. Active lateral adjustment, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well-vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.
E	Low gradient, Highly sinuous, riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander/width ratio.
F	Entrenched, meandering riffle/pool channel on low gradients with high width/depth ratio and high bank erosion rates.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients. Narrow valleys. Unstable, with grade control problems and high bank erosion rates.

from Rosgen 1996

Habitat Assessment

Habitat Assessments were conducted throughout the watershed. As teams began they located, flagged and mapped a Habitat Assessment Start point. A photo, facing upstream, was taken and recorded. Teams then moved upstream until there was a discernable change in habitat where the scores differed enough to break out a new habitat reach. These possible changes included differences in habitat availability, changes in riparian buffer or land use or changes in the riffle/glide/pool sequence. When a change occurred, the team flagged, located and mapped an end point for that reach. This point became the Habitat Assessment for the reach that was just walked. A photo, facing downstream, was taken, mapped and recorded.

The Habitat Assessment was conducted following the MDNR MPHI. The structure and examples of the various parameters in the MPHI are located in the section titled Habitat Assessment – Maryland Physical Habitat Index (Maryland Biological Stream Survey (MBSS) Guidelines). Additional attributes were collected to provide more information on water quality, odors and general appearance. The following attributes were collected for the Habitat Start point and for the Habitat Assessment.

Table 2.21 Habitat Start

Subwatershed	Reach ID	Habitat Start ID	Photo ID	Segment ID	Comments
ST1	01	A01	1220004A	0100	Text
ST2	02	A02	1220005A	0200	
SM1	03	A03	1220006A	0300	

Table 2.22 Habitat Assessment

Team Members	Sub-watershed	Reach ID	Habitat Assessment ID	Photo ID (facing downstream)	Weather Past 24	Current Weather
MJPLEN	ST1	01	Z01	1220007A	clear	clear
MJPMRM	ST2	02	Z02	1220008A	overcast	overcast
MJPMRM	SM1	03	Z03	1220009A	trace	trace
MRMLEN	SM2	04	Z04	1220010A	rain	rain
MJPNSD	PSB	05	Z05	1220011A	t-storm	t-storm
LENSMS	WEC	06	Z06	1220012A	snow	snow
Flow present	**Habitat Assessment Conducted**	**If no Hab Assessment., why?**	**Infra-structure Inventory**	**If no Infra. Inventory, why?**	**Water Quality**	**Water Odor**
yes	yes	Wetland	yes	wetland	clear	none
no	no	no access	no	no access	milky	sewage
		dangerous conditions		dangerous conditions	foamy	chlorine
		pond/lake		pond/lake	turbid	fishy
		Other		other	light brown (not tannin)	rotten eggs
		intermittent/ ephemeral channel		intermittent/ ephemeral channel	dark brown (not tannin)	other: text
					oily sheen	
					reddish	
					greenish	
					other: text	
Sediment Odor	**Fish Presence**	**Fish Size**	**Aquatic plants area**	**Aquatic Plants Attachment**	**Aquatic Plants location**	**Algae Cover (slime)**
none	none	small (1-2 in)	0%	attached	stream margin	none
sewage	few	medium(3-6 in)	1-10%	free floating	pool	light
chlorine	many	large (7 and up)	10-30%		near riffles	heavy
petroleum			30-50%			
rotten eggs			>50%			
other: text						
Algae Color (slime)	**Algae Cover (filamentous)**	**Algae Color (filamentous)**	**Algae Cover (floating)**	**Algae Color (floating)**	**Dominant Land Use**	**Riparian Veg. Dominant**
green	none	green	none	green	forest	trees
brown	light	brown	light	brown	field pasture	shrubs
orange	heavy	orange	heavy	orange	agricultural	grasses
red		red		red	residential	herbaceous
yellow		yellow		yellow	commercial	
other: text		other: text		other: text	industrial	
					other: text	

Riparian Veg. Avg. Width	Bank Stability	Instream Habitat (MPHI)	Epifaunal Substrate (MPHI)	Velocity/ Depth Diversity (MPHI)	Pool/ Glide/ Eddy Quality (MPHI)	Riffle/ Run Quality (MPHI)
none	stable	1-20	1-20	1-20	1-20	1-20
0-20	mod. stable					
20-35	mod. unstable					
35-50	unstable					
>50						
Embedded-ness (MPHI)	**Shading (MPHI)**	**Trash Rating (MPHI)**	**Maximum Depth (cm) (MPHI)**	**Segment ID**	**Other Water Quality**	**Other Water Odor**
1-20	1-20	1-20	25	0100	text	text
				0200		
				0300		
Other Sediment Odor	**Other Algae**	**Bacteria Presence**	**Bacteria Character**	**Other Land Use**	**Comments**	
text	text	none	sheen	text	text	
		light	iron flocculent			
		heavy				

Stream Layer Update

The county's stream coverage was displayed on the field mapping. This coverage was verified and updated in the field. Field mapping was preliminarily marked to denote potential ditches versus potential perennial streams based on the planimetric layer. Man made channels with no flow were recorded as ditches at their confluences but were not be walked and assessed. Likewise, natural channels with no flow were recorded at their confluence as intermittent or ephemeral channels and were not walked or assessed. Exceptions were made where the channel was of significant size. Confluences of channels already on the stream layer were located but not recorded unless significant variation existed between the stream layer and the actual location of the confluence.

Perennial streams and channels of significant size that were not originally on the county's stream coverage were walked and the data collected as a line feature. Once the line feature was complete, teams went back and continued collecting Rosgen, habitat and features data for that stream. A segment ID for that stream reach was added to the field map.

Table 2.23 Stream Segment

Subwatershed	Reach ID	Stream ID	Segment ID	Stream Character	Comments
ST1	01	S01	0100	single channel	text
SRT2	02	S02	0200	braided	
SRM1	03	S03	0300	wetland	

Table 2.24 Confluence with Intermittent or Ephemeral Channels

Subwatershed	Reach ID	Confluence ID	Photo ID	Segment ID	Bank	Width (dec ft)	Channel Type	Comments
ST1	01	F01	1220014B	0100	left	2.0	Inter-mittent	text
ST2	02	F02	1220015B	0200	right	5.5	ephemeral	
SM1	03	F03	1220016B	0300	in line	4.5		

Inventory of Infrastructure/Environmental Features

As teams walked the streams, a detailed inventory of infrastructure and environmental features, such as utilities and buffers was collected. All points were indicated on the field maps and their positions located and mapped via GPS as a point feature with the appropriate attributes collected. Each data point, in order to be unique, but also be linked to subwatershed and reach, had its subwatershed and reach ID collected, and was given its own unique inventory/feature ID. The following indicate the features and attributes that were collected.

Buffer

Buffer widths or disturbances within 50 feet of the stream bank were considered deficient and a point was recorded on the mapping and GPS. The stream banks were denoted as left or right with the team facing downstream. The estimated linear footage of the deficient buffer was recorded along with the buffer type, impact score and restoration potential. Only buffers with scores of 5 or higher were recorded and photographed.

Table 2.25 Buffers

Subwatershed	Reach ID	Buffer ID	Photo ID	Segment ID	Bank
ST1	01	B01	1220007B	0100	left
ST2	02	B02	1220008B	0200	right
SM1	03	B03	1220009B	0300	both
Linear Feet of <50 ft buffer	**Encroachment Type**	**Impact Rank**	**Restoration Potential**	**Other Type of Encroachment**	**Impact Score**
60	forbs	extreme	high	text	10
70	lawn	severe	moderate		7
80	pavement	moderate	low		5
	cultivated crop	minor			
	other: text				
Comments					
text					

Impact Scoring:

- Extreme (10) – Impervious/commercial area in close proximity to stream; banks may be modified or engineered. Stream character such as (bank/bed stability, sediment deposition, and/or shading) is obviously degraded by adjacent use.
- Severe (7) – Some impervious and/or just turf up to bank, very little vegetation aside from turf within 25 foot zone; stream character probably degraded by adjacent use.
- Moderate (5) – Encroachment mostly from residential uses and yard; some vegetation within 25 foot zone; but very little aside from turf within remainder of 100 foot zone; stream character may be changed slightly by adjacent use.
- Minor (is not recorded, scored or photographed) – Vegetated buffer primarily intact within 100 feet of stream.

Restoration Potential:

- High – Potential project is of good size (more than a couple of residential yards), would not involve easements in residential yards, involves one or a few properties, appears to have good access, and would provide good benefit to stream.
- Moderate – Potential project is of good or fair size, involves just a few properties, may include but is not confined to small residential yards, appears to have good access, and would benefit stream.

- Low – Potential project is small OR is confined to small residential yards, appears to have access issues OR is not critical for character of stream.

Erosion

Erosion problems were noted on field maps and recorded using GPS. The stream banks were denoted as left or right with the team facing downstream. The estimated linear footage of the erosion problem was recorded along with the impact score and restoration potential. Only erosion problems with scores of 5 or higher were recorded and photographed.

Table 2.26 Erosion

Subwatershed	Reach ID	Erosion ID	Photo ID	Segment ID	Bank
ST1	01	E01	1220010A	0100	left
ST2	02	E02	1220011A	0200	right
SM1	03	E03	1220012A	0300	both
Linear Feet of Erosion (dec ft)	**Impact Rank**	**Impact Score**	**Restoration Potential**	**Comments**	
15	extreme	10	high	text	
30	severe	7	moderate		
20	moderate	5	low		

Impact Scoring:

- Extreme (10) – Impending threat to structures or infrastructure
- Severe (7) – Large area of erosion that is damaging property and causing obvious instream degradation. Eroding bank is generally 5 feet or greater in height.
- Moderate (5) – Moderate area of erosion that may be damaging property and causing some instream degradation. Eroding bank is generally 2-3 feet or greater in height.
- Minor (is not recorded, scored or photographed) – Minor area of erosion, low threat to property, and no noticeable instream degradation.

Restoration Potential:

- High – Potential project is of good size (more than a couple of residential yards), would not involve easements in residential yards, involves one or a few properties, appears to have good access, and would provide good benefit to stream.
- Moderate – Potential project is of good or fair size, involves just a few properties, may include but is not confined to small residential yards, appears to have good access, and would benefit stream.
- Low – Potential project is small OR is confined to small residential yards, appears to have access issues OR is not critical for character of stream.

Obstruction

Instream obstructions such as concrete and riprap that were causing backwater conditions and were impediments to fish passage were recorded on field mapping and GPS. All recorded obstructions were photographed. Obstructions that only partially blocked the stream but were not causing erosion problems were not identified or photographed. The following attributes were recorded for each obstruction.

Impact Scoring:

- Severe (10) – Blockage causing significant erosion problem and/or potential for flooding. Stream usually almost totally blocked (>75%).

- Moderate (5) – Blockage is causing moderate erosion and could cause flooding. Stream partially blocked, but obstruction should probably be removed, because problem could worsen.
- Minor (2) – Blockage is causing some erosion problems but does have potential to worsen and probably should be looked at/or monitored.

Table 2.27 Obstruction

Subwatershed	Reach ID	Obstruction ID	Photo ID	Segment ID	Type	Impact Rank
ST1	01	T01	1220010B	0100	trees	severe
ST2	02	T02	1220011B	0200	debris	moderate
SM1	03	T03	1220012B	0300	sediment	minor
					concrete	
					rip-rap	
					beaver dam	
					utility line	
					other: text	
Impact Score	**Other Type**	**Comments**				
10	text	text				
5						
2						

Crossing

All stream crossings including footbridges, roadways, and driveways were recorded on field mapping and with GPS. All crossings were photographed. The attributes in Table 2.28 were collected for each crossing.

Table 2.28 Crossing

Subwatershed	Reach ID	Crossing ID	Photo ID	Segment ID	Crossing Type
ST1	01	C01	1220013A	0100	box
ST2	02	C02	1220014A	0200	elliptical
SM1	03	C03	1220015A	0300	circular
					bridge
					foot bridge
Conveyance Material	**Other Type**	**Number of Barrels**	**Diameter of Barrel (dec. ft)**	**Conveyance Length (dec. ft)**	**Upstream Debris**
concrete	text	2	3.2	10.0	yes
corrugated metal		1	4.5	15.0	no
plastic					
wood					
other					
Upstream Sediment	**Upstream Bank Erosion**	**Upstream Bed Erosion**	**Upstream Bed Erosion Height (feet)**	**Downstream Debris**	**Downstream Sediment**
yes	yes	yes	2.0	yes	yes
no	no	no	1.0	no	no

Downstream Bank Erosion	Downstream Bed Erosion	Downstream Bed Erosion Height (feet)	Impact Rank	Impact Score	Comments
yes	yes	2.0	extreme	10	text
no	no	1.0	severe	7	
			moderate	5	
			minor	2	

Impact Scoring:

- Extreme (10) – Condition of debris, sediment, or erosion poses immediate threat to structural stability of road or other structure. Major repair will be needed if problem is not addressed.
- Severe (7) – Condition probably poses threat to road or other structure. Problem should be addressed to avoid bigger problem in the future.
- Moderate (5) – Condition does not appear to pose threat to road or other structure, but should be addressed to enhance stream integrity and future stability of structure.
- Minor (2) – Condition is noticeable but may not warrant repair.

Utilities

Utilities that occurred within the stream channel or within the buffer were recorded on field maps and by GPS. Due to the high frequency of manholes, only those within 25 feet of the streambank were recorded. The location and impact on the stream system was recorded for all utilities, however only those with an Impact score of 5 or higher were photographed. Banks were noted left or right facing downstream.

Table 2.29 Utilities

Subwatershed	Reach ID	Utility ID	Photo ID	Segment ID	Bank
ST1	01	U01	1220013B	0100	left bank
ST2	02	U02	1220014B	0200	right bank
SM1	03	U03	1220015B	0300	across
Size (inches)	**Size Unknown**	**Manhole**	**Impact Rank**	**Type**	**Location**
5.0	yes	yes	extreme	sanitary	within stream banks
6.0		no	severe	water	within buffer
5.5			moderate	gas	crossing stream, partially buried
			minor	cable	crossing stream, above base flow
				unknown	crossing stream, above high water
				other: text	other
Other Type	**Impact Score**	**Other Location**	**Comments**		
text	20	text	text		
	10				
	5				
	2				
	0				

Impact Scoring:

- Extreme (20) – Line is leaking.
- Severe (10) – Exposed line causing a significant erosion and/or obstruction (blockage) OR sanitary line potential to burst/leak appears high.
- Moderate (5) – Half exposed line causing moderate erosion problem.
- Minor (2) – Line is partially visible however mostly buried in stream bed, little if any erosion.

Dump Sites

All dump sites encountered were recorded on field maps and GPS. Sites were given location, an impact score and type of materials. All dump sites recorded were photographed. Banks were noted as left or right when facing downstream.

Table 2.30 Dump Site

Subwatershed	Reach ID	Dump ID	Photo ID	Segment ID	Bank
ST1	01	M01	122016A	0100	left
ST2	02	M02	122017A	0200	right
SM1	03	M03	122018A	0300	
Location	**Impact Rank**	**Description of Materials**	**Other Location**	**Impact Score**	**Comments**
instream	severe	appliances	text	10	text
bank	moderate	trash		5	
floodplain	minor	petroleum		1	
other: text		tires			
		55-gal drums (closed)			
		55-gal drums (leaking)			
		55-gal drums (empty)			
		other: text			

Impact Scoring:

- Severe (10) – Active and/or threatening. Material may be considered toxic or threatening to environment (concrete, petroleum, empty 55 gal drums etc.) or site is large (>2,500 ft^2) and appears active
- Moderate (5) – Dump site (<2,500 ft^2) non-toxic material, does not appear to be used often, however clean-up would definitely be a benefit.
- Minor (1) – Dump site appears small (<100 ft^2) and material stable (will not likely be transported downstream by high water). Not high priority.

Head Cuts

Areas of streambed erosion and downcutting were mapped on field maps and with GPS. All head cut areas were recorded and photographed. The height of the head cut was measured from the elevation of the original invert to the resultant invert. Areas considered headcuts were limited to areas with finite and abrupt elevation changes induced by manmade structures, such as outfalls or dams or obvious changes in runoff patterns. Natural areas with changes in thalweg elevation associated with riffle pool sequences or step pools were not considered headcuts.

Table 2.31 Head Cuts

Subwatershed	Reach ID	Headcut ID	Photo ID	Segment ID	Height (dec ft)	Comments
ST1	01	H01	1220016B	0100	1.0	text
ST2	02	H02	1220017B	0200	1.5	
SM1	03	H03	1220018B	0300	3.2	

Pipes and Drainage Ditches

Piped outfalls and drainage ditches were mapped on field maps and with GPS. Field mapping was preliminarily marked to denote potential ditches versus potential perennial streams based on the planimetric layer. Teams only located and recorded the confluences of ditches with the stream system. Ditches were defined as channels that were man made or are the result of outfall placement. Ditches were not be walked or assessed. Only those pipes or ditches with impact scores of 5 or greater were photographed. The types and quality of discharge were recorded for both pipes and ditches. The quality included clear, oil and two types of bacterially influenced characteristics, iron flocculent and a bacterial byproduct that appears as a sheen.

Pipe diameter was measured in inches and the material type indicated along with an impact score. Pipe materials included polyvinyl chloride (PVC), reinforced concrete pipe (RCP), corrugated metal pipe (CMP), high-density polyethylene (HDPE), iron or clay. The approximate distance from the stream channel was recorded.

Table 2.32 Pipes

Subwatershed	Reach ID	Pipe ID	Photo ID	Segment ID	Location
ST1	01	P01	122019A	0100	left
ST2	02	P02	122020A	0200	right
SM1	03	P03	122021A	0300	in line
Diameter (inches)	**Distance from Channel (dec ft)**	**Type of Pipe**	**Flow**	**Discharge Clarity**	**Discharge Odor**
12	50	PVC	none	clear	none
24	75	RCP	trickle	opaque	sewage
6	25	CMP	strong	cloudy	sulfurous
		HDPE			organic
		iron			other: text
		clay			
		other: text			
Discharge Quality	**Erosion**	**Impact Rank**	**Impact Score**	**Other Type**	**Other Clarity**
good	none	severe	10	text	text
oil	minor	moderate	5		
iron flocculent	moderate	minor	0		
bacterial sheen	major				
Other Odor	**Other Quality**	**Comments**			
text	text	text			

The outfall pipe was investigated only on ditches where the pipe was visible from the stream channel. The width of all ditches was recorded along with characteristics concerning discharge flow and quality.

Table 2.33 Ditches

Subwatershed	Reach ID	Ditch ID	Photo ID	Segment ID	Bank	Width (dec ft)
ST1	01	D01	122019B	0100	left	3.0
ST2	02	D02	122020B	0200	right	4.5
SM1	03	D03	122021B	0300	in line	6.0
Flow	**Discharge Clarity**	**Discharge Odor**	**Discharge Quality**	**Erosion**	**Impact Rank**	**Impact Score**
none	clear	none	good	none	severe	10
trickle	opaque	sewage	oil	minor	moderate	5
strong	cloudy	sulfurous	iron flocculent	moderate	minor	0
		organic	bacterial sheen	major		
		other: text				
Other Clarity	**Other Odor**	**Other Quality**	**Comments**			
text	text	text	text			

Impact Scoring:

- Severe (10) – Pipe or Ditch causing a significant erosion problem to stream bank or stream and/or discharge is coming from pipe that may not be stormwater.
- Moderate (5) – Pipe or Ditch is causing moderate erosion problem and should be fixed, it may get worse if left unattended.
- Minor (0) – Pipe or ditch is not causing erosion problem and no discharge is occurring.

Stormwater Management Facilities

Stormwater Management facilities adjacent to the stream channel were marked on field maps with approximate locations. They were not located with GPS or given attributes collected with the handheld device. The locations were used as ancillary data for the Stormwater Management Facility task and were reconciled based on review of County records. By identifying approximate locations in the field, the teams indicated ponds or other facilities that required further investigation.

Quality Control

Each field team was assigned a Team Leader that ensured all equipment was functioning properly and that data was collected accurately and consistently. The field Team Coordinator was responsible for checking data points, impact scores and overall consistency. These checks were done on a daily basis as data was downloaded. If any points or scores were felt to be inaccurate they were either reconciled in the office or the reach was walked and the data collected again.

Habitat Assessment – Maryland Physical Habitat Index (MBSS Guidelines)

The MPHI was completed for each reach and incorporated the results of a series of eight Habitat Parameters and the measurement of the maximum depth in the reach. Parameters 1-5 and 8 were given a score between 0 and 20, and a narrative rating of Poor (0-5), Marginal (6-10), Sub-Optimal (11-15) or Optimal (16-20). Parameters 6 and 7 were based on actual percentages rather than a score. The maximum depth for the reach was measured and recorded in centimeters. The MPHI was later calculated for each reach. The following offers descriptions of each parameter and their respective ratings.

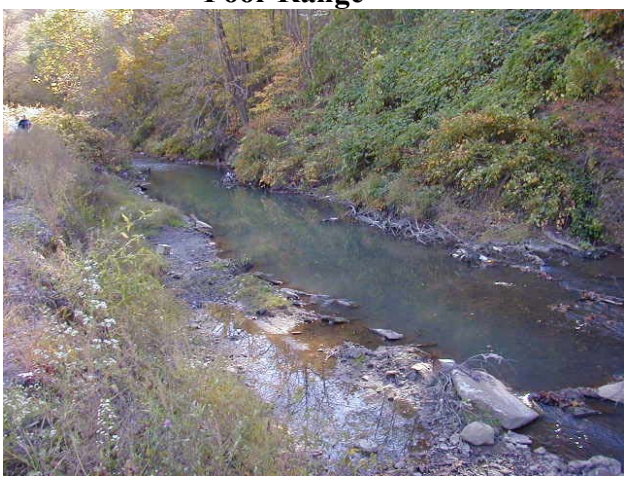
Instream Habitat

Rated based on perceived value of habitat to the fish community. Within each category, higher scores should be assigned to sites with a variety of habitat types and particle sizes. In addition, higher scores should be assigned to sites with a high degree of hypsographic complexity (complex bottom). In streams where ferric hydroxide is present, instream habitat scores are not lowered unless the precipitate has changed the gross physical nature of the substrate. In streams where substrate types are favorable but flows are so low that fish are essentially precluded from using the habitat, low scores are assigned. If none of the habitat within a segment is useable by fish, a score of zero is assigned.

Optimal - Greater than 50% of a variety of cobble, boulder, submerged logs, undercut banks, snags, rootwads, aquatic plants or other stable habitat
Sub-Optimal - 30-50% of stable habitat. Adequate habitat
Marginal - 10-30% mix of stable habitat. Habitat availability less than desirable
Poor - Less than 10% stable habitat. Lack of habitat is obvious

Optimal Range

Poor Range



Epifaunal Substrate

Rated based on the amount and variety of hard, stable substrates usable by benthic macroinvertebrates. Because they inhibit colonization, flocculent materials or fine sediments surrounding otherwise good substrates are assigned low scores. Scores are also reduced when substrates are less stable.

Optimal - Preferred substrate abundant, stable, and at full colonization potential (riffles well developed and dominated by cobble; and/or woody debris prevalent, not new, and not transient
Sub-Optimal – Abundance of cobble with gravel and/or boulders common; or woody debris, aquatic vegetation, undercut banks, or other productive surfaces common but not prevalent/suited for full colonization
Marginal - Large boulders and/or bedrock prevalent; cobble, woody debris, or other preferred surfaces uncommon
Poor - Stable substrate lacking; or particles are over 75% surrounded by fine sediment or flocculent material

Optimal Range

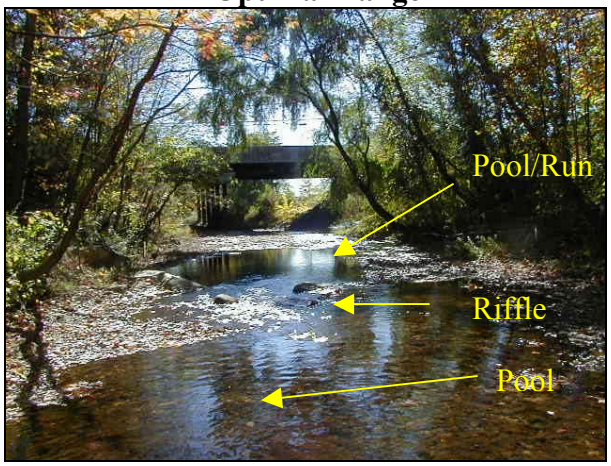
Poor Range

Velocity/Depth Diversity

Rated based on the variety of velocity/depth regimes present at a site (slow-shallow, slow-deep, fast-shallow, and fast deep). As with embeddedness, this metric may result in lower scores in low-gradient streams but will provide statewide information on the physical habitat found in Maryland streams.

Optimal - Slow (<0.3m/s), deep (>0.5m); slow, shallow (<0.5m); fast (>0.3m/s), deep; fast, shallow habitats all present
Sub-Optimal - Only 3 of the 4 habitat categories present
Marginal - Only 2 of the 4 habitat categories present
Poor - Dominated by 1 velocity/depth category (usually pools)

Optimal Range



Poor Range

Pool/Glide/Eddy Quality

Rated based on the variety and spatial complexity of slow- or still-water habitat within the sample segment. It should be noted that even in high-gradient segments, functionally important slow-water habitat may exist in the form of larger eddies. Within a category, higher scores are assigned to segments, which have undercut banks, woody debris or other types of cover for fish.

Optimal - Complex cover/&/or depth >1.5m; both deep (>0.5m)/shallows (<0.2m) present
Sub-Optimal - Deep (>0.5m) areas present; but only moderate cover
Marginal - Shallows (<0.2m) prevalent in pool/glide/eddy habitat; little cover
Poor - Max depth <0.2m in pool/glide/eddy habitat; or absent completely

Optimal Range

Poor Range

Riffle/Run Quality

Rated based on the depth, complexity, and functional importance of riffle/run habitat in the segment, with the highest scores assigned to segments dominated by deeper riffle/run areas, stable substrates, and a variety of current velocities.

Optimal - Riffle/run depth generally >10cm, with maximum depth greater than 50 cm (maximum score); substrate stable (e.g. cobble, boulder) & variety of current velocities
Sub-Optimal - Riffle/run depth generally 5-10cm, variety of current velocities
Marginal - Riffle/run depth generally 1-5cm; primarily a single current velocity
Poor - Riffle/run depth <1cm; or riffle/run substrates concreted

Optimal Range

Poor Range

Embeddedness

Rated as percentage based on the fraction of surface area of larger particles that is surrounded by fine sediments on the stream bottom. In low gradient streams with substantial natural deposition, the correlation between embeddedness and fishability or ecological health may be weak or non-existent, but this metric is rated in all streams to provide similar information from all sites statewide.

> Percentage that gravel, cobble, and boulder particles are surrounded by fine sediment or flocculent material

Optimal Range

Poor Range

Shading

Rated based on estimates of the degree and duration of shading at a site during summer, including any effects of shading caused by landforms. If assessment carried out during leaf off, consider shading that would be present during leaf on.

> Percentage of segment that is shaded (duration is considered in scoring), 0% = fully exposed to sunlight all day in summer; 100% = fully and densely shaded all day in summer

Optimal Range

Poor Range

Trash Rating

The scoring of this metric is based on the amount of human refuse in the stream and along the banks of the sample segment.

Optimal - Little or no human refuse visible from stream channel or riparian zone
Sub-Optimal - Refuse present in minor amounts
Marginal - Refuse present in moderate amounts
Poor - Refuse abundant and unsightly

Optimal Range

Poor Range

Tabulation of Scores and Stream Rankings

MPHI – Maryland Physical Habitat Index

During the stream assessment portion of the watershed study, habitat assessments were conducted for 352 reaches throughout the watershed. The assessment used was the MPHI, which was developed by MDNR for use in assessing freshwater streams in conjunction with the MBSS. The MPHI is based on a series of nine parameters. MDNR uses all nine parameters for assessment and comparison of streams across physiographic regions. For the purposes of the Severn River Watershed the Coastal Plain MPHI was used that incorporates six of the nine parameters. These six parameters were found to have the most discriminatory power for Coastal Plain streams.

- Instream habitat
- Velocity/Depth Diversity
- Pool/Glide/Eddy Quality
- Embeddedness
- Maximum depth
- Trash Rating

Each Habitat Assessment reach was given a Raw Score and a scaled MPHI score (0-100) and ranking according to the following ranges. This allows for a score that can be compared to the habitat assessments done statewide and within the Severn by MDNR or other agencies.

Very Poor 0-11.9 Poor 12-41.9 Fair 42-71.9 Good 72-100

Infrastructure and Environmental Features

In addition to the MPHI assessment, data points were also collected to create an inventory of infrastructure, such as crossings and utilities, and environmental features such as buffer encroachments and erosion points. Data was collected to describe each feature. For example data collected for erosion points included height, length, right or left bank, restoration potential and an Impact Score. The following features were collected during the assessment and are listed with their possible impact scores. Higher scores indicate more impact or impairment.

Table 2.34 Summary Infrastructure and Environmental Features Impact Scores

Buffer	Erosion	Obstruction	Crossing	Utilities	Dump site	Pipes	Ditches
10	10	10	10	20	10	10	10
7	7	5	7	10	5	5	5
5	5	2	5	5	1		
			2	2			

Final Habitat Score

A relative score incorporating the MPHI and the feature's Impact Scores was developed for each Habitat Assessment reach. A Total Impact Score was then tabulated by summation of all the impact scores for each reach. A fraction of the Total Impact Score was subtracted from the MPHI score to give a Final Habitat Score, which will indicate habitat quality for each Habitat Assessment Reach relative to each other.

In order to calculate the MPHI it is necessary to first derive a raw score using the following equation:

> Raw Score = (Instream Habitat + Velocity/Depth Diversity + Pool/Glide/Eddy Quality – Embededdedness/10 + Maximum Depth/10 + Trash Rating/2)/6.

MPHI is then calculated by transforming the Raw Score to a scaled score using the following equation:

> MPHI = 100*(1/(1+EXP((-(Raw Score-6.0051249))/1.5126126))).

To include the impact scores of the infrastructure and environmental features in the Final Habitat Score, the Infrastructure Reduction was established. A 0.5 multiplier was applied to the Total Impact Score in order to best utilize the inventory point scores. The Infrastructure Reduction value and Final Habitat Score are calculated using the following equations:

> Infrastructure Reduction = the sum of the (Total Impact Score*0.5)

> Final Habitat Score = MPHI – Infrastructure Reduction

The Final Habitat Score is then placed in the Final Habitat Category using the existing established MPHI range.

> Very Poor 0-11.9 Poor 12-41.9 Fair 42-71.9 Good 72-100

3.0 Results – Current Watershed Condition

3.1 GIS Data

Land Use and Development

Land use in the watershed is diverse. Portions are highly developed, containing the City of Annapolis, shopping centers, subdivisions, and industrial parks. The free-flowing section of Severn Run, however, is a Natural Resource Area managed by MDNR. Many of the south shore watersheds remain forested.

The single most dominant land use is single family residential, at all densities, at 38%. Forest is next, at 32%. When the 6% of open space maintained in turf is added to the forested areas, there is an equal amount of residential and vegetated land use.

Fifteen percent of the watershed is taken up with commercial and industrial property and the City of Annapolis. It should be noted that much of the city is residential, at similar densities to the County portion of the watershed, so this number is somewhat high.

Without good land use coverage of Annapolis, the exact imperviousness of the watershed cannot be calculated. However, if it is assumed to be 50%, which would represent a mix of commercial and residential properties, the watershed would be 18% impervious overall. Setting the 2,980 acres of Annapolis at 0% or 100% gives a range for the watershed of 15% to 22% impervious.

Sewered/Unsewered Areas

Twenty-six percent of the watershed is currently served by sanitary sewer systems. An additional 21% is planned to receive sewer service at some time in the future. This leaves over half of the watershed remaining with on-site sewage systems. Most of these areas are on the south shore, which is currently undeveloped or zoned for low-density residential development.

3.2 Water Quality Monitoring

The sampling indicated generally good water quality in the free-flowing tributaries. Many of the samples with the highest measurements were taken from standing water. Samples from Evergreen Creek (EVC) which had the worst overall readings, were taken from shallow standing water in a wetland area and included organic material from the bottom and the surface of the water. The same effect was noted to some extent for any sample taken from pooled areas. The most significant water quality problems are summarized in Table 3.1 below.

Table 3.1 Dry Weather Sampling Results

Code	Subwatershed Name	Comments
BWP	Brewer Pond	Nitrate was high, at 5.3 mg/L. No other nutrients were found in significant concentrations.
ICB	Indian Creek Branch	Copper was found at 0.011 mg/L, just below the COMAR chronic limit of 0.012 mg/L.
SSB	Sewell Spring Branch	Copper was found at 0.029 mg/L, over twice the COMAR chronic limit of 0.012 mg/L.

Code	Subwatershed Name	Comments
JZ1 PSB ST2 ST3	Jabez Branch 1 Picture Spring Branch Severn Run Tributary 2 Severn Run Tributary 3	All 3 nutrients (nitrate, TKN, TP) were found in detectable quantities.
ST4	Severn Run Tributary 4	All 3 nutrients (nitrate, TKN, TP) were found in detectable quantities. FC was over the COMAR limit of 400 org/100mL.
ST9	Severn Run Tributary 9	All 3 nutrients (nitrate, TKN, TP) were found in detectable quantities. FC was very high, at >2,400 org/100mL.

3.3 Modeling

Hydrologic Analysis Results

The TR-20 results are presented by subwatershed in Table 3.2 for the 1, 2 and 100 year storms. Results are also presented in section 4.0, Subwatershed Conditions.

Table 3.2 TR-20 Results

Code	Subwatershed Name	1 Year	2 Year	100 Year
AQC	Aisquith Creek	201	377	2368
ARP	Arden Pond	102	207	1422
BRB	Bear Branch	834	1285	6096
BRC	Browns Cove	222	374	1886
BWC	Brewer Creek	522	1046	5180
BWP	Brewer Pond	411	750	4239
BWS	Brewer Shore	202	305	1140
CHC	Chase Creek	365	682	3986
CLC	Clements Creek	391	639	4123
COC	Cove of Cork	192	310	1350
CPO	Chase Pond	119	194	839
CRC	Carr Creek	1059	1442	4446
CSB	Cool Spring Branch	7	33	1032
CSC	Cool Spring Creek	27	76	809
CWB	Chartwell Branch	101	247	2650
CYB	Cypress Branch	28	61	501
EVC	Evergreen Creek	12	50	394
FRC	Forked Creek	139	274	1769
FXC	Fox Creek	81	167	1132
GB1	Gumbottom Branch 1	276	572	4405
GB2	Gumbottom Branch 2	361	825	7373
HLA	Heron Lake	217	314	1055
HOC	Hopkins Creek	478	853	4288
HSP	Hacketts Point to Sandy Point	1146	1634	5332
ICB	Indian Creek Branch	515	1045	7338
JGP	Jonas Green Pond	59	114	690
JZ1	Jabez Branch 1	492	859	4077
JZ2	Jabez Branch 2	1605	2865	16552
JZ3	Jabez Branch 3	1600	2852	16407
JZ4	Jabez Branch 4	448	747	3657

Code	Subwatershed Name	1 Year	2 Year	100 Year
LKO	Lake Ogleton	573	936	4146
LRB	Little Round Bay	346	620	3483
LUC	Luce Creek	232	470	3187
MAC	Maynadier Creek	668	1269	7812
MC1	Mill Creek 1	1606	2800	13626
MC2	Mill Creek 2	2957	5112	24650
MEC	Meredith Creek	970	1442	5272
MRP	Martins Pond	16	48	516
PFB	Pointfield Branch	197	290	1073
PMP	Pendennis Mount Pond	198	319	1366
PSB	Picture Spring Branch	1208	1962	9415
RAP	Ray's Pond	285	497	2409
RBS	Round Bay Shore	117	244	1657
RGC	Ringgold Cove	16	60	929
SHP	Sharps Point	366	573	1984
SM1	Severn Mainstem 1	291	581	4364
SM2	Severn Mainstem 2	770	1500	10405
SM3	Severn Mainstem 3	226	655	9035
SM4	Severn Mainstem 4	287	345	2973
SSB	Sewell Spring Branch	145	292	2163
ST1	Severn Run Tributary 1	115	221	1443
ST2	Severn Run Tributary 2	122	272	2326
ST3	Severn Run Tributary 3	122	269	3894
ST4	Severn Run Tributary 4	147	438	6539
ST5	Severn Run Tributary 5	168	399	4378
ST6	Severn Run Tributary 6	210	263	1037
ST7	Severn Run Tributary 7	653	1002	5609
ST8	Severn Run Tributary 8	208	375	2446
ST9	Severn Run Tributary 9	287	489	2445
STC	Stevens Creek	6	22	469
SVC	Sullivan Cove	100	190	1127
SWC	Saltworks Creek	1295	2108	9581
VTC	Valentine Creek	172	371	2712
WCC	Woolchurch Cove	1186	1657	5137
WCP	Winchester Pond	131	253	1502
WH1	Whitehall Creek 1	806	1354	6422
WH2	Whitehall Creek 2	1442	2231	8864
WH3	Whitehall Creek 3	467	717	2778
YZC	Yantz Creek	71	152	1133

Pollutant Load Analysis Results

The total pollutant loads discharged from the Severn River Watershed are presented by subwatershed in Table 3.3 and Table 3.4. Total pollutant loads of each parameter are presented graphically in the included Pollutant Loading Maps.

Table 3.3 Severn River Current Conditions 2002 PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ acre/yr)
AQC	Aisquith Creek	816	275	94	3.07E+12					2.93	0.99	0.34	1.10E+10
ARP	Arden Pond	931	312	109	3.48E+12					4.18	1.40	0.49	1.56E+10
BKC	Back Creek[1]	373	126	48	1.10E+12					0.44	0.15	0.06	1.29E+09
BRB	Bear Branch	3977	1251	519	1.35E+13					6.07	1.91	0.79	2.06E+10
BRC	Browns Cove	775	186	107	2.32E+12					4.16	1.00	0.57	1.25E+10
BWC	Brewer Creek	1045	362	125	3.68E+12					2.38	0.82	0.29	8.38E+09
BWP	Brewer Pond	282	118	44	6.57E+11					0.70	0.29	0.11	1.64E+09
BWS	Brewer Shore	169	56	20	6.44E+11					3.91	1.30	0.46	1.49E+10
CGC	College Creek	0	0	0	0.00E+00					0.00	0.00	0.00	0.00E+00
CHC	Chase Creek	932	330	110	3.25E+12					2.09	0.74	0.25	7.29E+09
CLC	Clements Creek	1654	587	194	5.81E+12					2.18	0.77	0.26	7.67E+09
COC	Cove of Cork	538	176	65	1.91E+12					4.95	1.62	0.60	1.75E+10
CPO	Chase Pond[1]	455	162	48	1.62E+12					5.30	1.88	0.55	1.88E+10
CRC	Carr Creek	2191	752	293	5.52E+12	0	1773.9	6205	1.93E+10	5.49	1.88	0.73	1.38E+10
CSB	Cool Spring Branch	1639	549	193	6.03E+12					4.71	1.58	0.56	1.73E+10
CSC	Cool Spring Creek	237	86	32	6.62E+11					2.07	0.75	0.28	5.79E+09
CWB	Chartwell Branch	3049	1034	351	1.09E+13					3.74	1.27	0.43	1.33E+10
CYB	Cypress Branch	546	191	77	1.51E+12					2.01	0.70	0.28	5.54E+09
EVC	Evergreen Creek	290	113	37	1.13E+12					3.59	1.39	0.46	1.40E+10
FRC	Forked Creek	1071	355	119	3.91E+12					4.31	1.43	0.48	1.57E+10
FXC	Fox Creek	446	147	51	1.68E+12					3.82	1.26	0.44	1.44E+10
GB1	Gumbottom Branch 1	1580	552	216	5.40E+12					1.95	0.68	0.27	6.67E+09
GB2	Gumbottom Branch 2	813	309	105	2.30E+12					1.33	0.51	0.17	3.77E+09
HLA	Heron Lake	340	121	37	1.05E+12					5.65	2.02	0.62	1.74E+10
HOC	Hopkins Creek	607	228	78	1.92E+12					1.26	0.47	0.16	3.97E+09
HSP	Hacketts to Sandy Pt.	2748	922	409	6.56E+12					5.01	1.68	0.74	1.20E+10
ICB	Indian Creek Branch	3386	1117	497	1.03E+13					2.34	0.77	0.34	7.10E+09
JGP	Jonas Green Pond	245	79	31	8.43E+11					4.19	1.35	0.53	1.44E+10
JZ1	Jabez Branch 1	2316	767	316	7.81E+12					2.76	0.91	0.38	9.30E+09

Table 3.3 Severn River Current Conditions 2002 PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ acre/yr)
JZ2	Jabez Branch 2	3007	983	440	8.87E+12					2.55	0.83	0.37	7.52E+09
JZ3	Jabez Branch 3	4269	1313	625	1.23E+13					5.46	1.68	0.80	1.57E+10
JZ4	Jabez Branch 4	1350	428	225	4.15E+12					2.26	0.72	0.38	6.95E+09
LKO	Lake Ogleton[1]	1663	552	191	6.22E+12					3.42	1.14	0.39	1.28E+10
LRB	Little Round Bay	1052	356	122	3.79E+12					2.53	0.86	0.29	9.12E+09
LUC	Luce Creek	1148	386	137	3.76E+12					2.98	1.00	0.36	9.78E+09
MAC	Maynadier Creek	1589	588	204	4.76E+12					1.49	0.55	0.19	4.45E+09
MC1	Mill Creek 1	4877	1669	614	1.59E+13					3.41	1.17	0.43	1.11E+10
MC2	Mill Creek 2	3987	1391	522	1.35E+13					2.52	0.88	0.33	8.56E+09
MEC	Meredith Creek	2061	667	354	6.11E+12					2.12	0.69	0.36	6.29E+09
MRP	Martins Pond	41	18	5	9.95E+10					0.70	0.30	0.09	1.71E+09
PFB	Pointfield Branch	651	190	88	2.29E+12					6.23	1.82	0.85	2.19E+10
PMP	Pendennis Mount Pond	498	161	65	1.70E+12					5.39	1.75	0.70	1.84E+10
PSB	Picture Spring Branch	9498	2893	1081	3.91E+13					6.06	1.85	0.69	2.49E+10
RAP	Ray's Pond	318	116	37	1.07E+12					1.64	0.59	0.19	5.51E+09
RBS	Round Bay Shore	495	166	58	1.87E+12					3.97	1.33	0.46	1.50E+10
RGC	Ringgold Cove	403	135	47	1.53E+12					3.33	1.11	0.39	1.26E+10
SHP	Sharps Point	255	78	43	9.44E+11					1.91	0.58	0.32	7.07E+09
SM1	Severn Run Mainstem 1	4799	1561	531	1.92E+13					5.43	1.77	0.60	2.18E+10
SM2	Severn Run Mainstem 2	2261	700	262	8.86E+12					4.26	1.32	0.49	1.67E+10
SM3	Severn Run Mainstem 3	3131	1105	451	9.72E+12					2.13	0.75	0.31	6.60E+09
SM4	Severn Run Mainstem 4	1944	591	234	7.20E+12					2.30	0.70	0.28	8.52E+09
SPC	Spa Creek[1]	375	125	50	1.19E+12					0.24	0.08	0.03	7.71E+08

Table 3.3 Severn River Current Conditions 2002 PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ yr)	TN	NOx	TP	Fecal Coliform (counts/ acre/yr)
SRT	Severn River Tidal[1]	4368	1475	506	1.58E+13	0.02	0		3.87E+10	3.72	1.26	0.43	1.35E+10
SSB	Sewell Spring Branch	621	221	95	1.93E+12					1.31	0.46	0.20	4.05E+09
ST1	Severn Run Trib. 1	744	254	99	2.32E+12					2.43	0.83	0.32	7.59E+09
ST2	Severn Run Trib. 2	3658	1145	379	1.38E+13					5.21	1.63	0.54	1.96E+10
ST3	Severn Run Trib. 3	6320	2061	731	2.61E+13					4.05	1.32	0.47	1.67E+10
ST4	Severn Run Trib. 4	1477	514	179	5.25E+12					2.27	0.79	0.28	8.08E+09
ST5	Severn Run Trib. 5	6311	2079	801	2.23E+13					3.61	1.19	0.46	1.28E+10
ST6	Severn Run Trib. 6	1353	434	159	4.14E+12					3.94	1.26	0.46	1.20E+10
ST7	Severn Run Trib. 7	4678	1576	590	1.43E+13					5.40	1.82	0.68	1.65E+10
ST8	Severn Run Trib. 8	1567	491	199	5.42E+12					4.19	1.31	0.53	1.45E+10
ST9	Severn Run Trib. 9	1194	415	162	3.15E+12					3.47	1.21	0.47	9.17E+09
STC	Stevens Creek	540	183	59	2.11E+12					3.61	1.22	0.39	1.41E+10
SVC	Sullivan Cove	760	256	89	2.78E+12					4.63	1.56	0.55	1.69E+10
SWC	Saltworks Creek	3106	1018	355	1.20E+13					3.27	1.07	0.37	1.27E+10
VTC	Valentine Creek	833	284	97	3.09E+12					3.05	1.04	0.35	1.13E+10
WCC	Woolchurch Cove	2648	902	344	6.90E+12					9.82	3.34	1.28	2.56E+10
WCP	Winchester Pond	286	94	43	7.70E+11					2.66	0.88	0.39	7.15E+09
WEC	Weems Creek[1]	7683	2400	998	2.32E+13					5.00	1.56	0.65	1.51E+10
WH1	Whitehall Creek 1	3371	1112	465	1.06E+13					4.56	1.50	0.63	1.43E+10
WH2	Whitehall Creek 2	1664	543	292	5.37E+12					1.82	0.60	0.32	5.89E+09
WH3	Whitehall Creek 3	1099	360	174	3.13E+12					2.64	0.86	0.42	7.51E+09
YZC	Yantz Creek	1181	394	143	4.15E+12					5.79	1.93	0.70	2.04E+10
	Severn River					164969	124538	62050	1.93E+11				
TOTAL		**138585**	**45645**	**17666**	**4.71E+14**	**164969**	**126312**	**68255**	**2.13E+11**	**252.29**	**83.65**	**31.82**	**8.51E+11**

Notes:
[1]These subwatersheds lie in both Anne Arundel County and the City of Annapolis. The pollutant loads shown are the loads that runs off from the Anne Arundel County lands only.

Table 3.4 Severn River Current Conditions 2002 PLOAD Results – Metals Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb
AQC	Aisquith Creek	34	6.7	5.2				0.12	0.02	0.02
ARP	Arden Pond	36	7.8	5.5				0.16	0.03	0.02
BKC	Back Creek[1]	23	3.2	3.1				0.03	0.00	0.00
BRB	Bear Branch	279	47.2	205.1				0.43	0.07	0.31
BRC	Browns Cove	86	13.7	107.8				0.46	0.07	0.58
BWC	Brewer Creek	55	8.4	8.3				0.13	0.02	0.02
BWP	Brewer Pond	36	1.6	5.5				0.09	0.00	0.01
BWS	Brewer Shore	6	1.4	0.9				0.13	0.03	0.02
CGC	College Creek	0	0.0	0.0				0.00	0.00	0.00
CHC	Chase Creek	54	7.3	8.3				0.12	0.02	0.02
CLC	Clements Creek	94	12.9	14.3				0.12	0.02	0.02
COC	Cove of Cork	27	5.0	10.4				0.25	0.05	0.10
CPO	Chase Pond[1]	16	3.6	2.3				0.18	0.04	0.03
CRC	Carr Creek	164	19.0	22.1				0.41	0.05	0.06
CSB	Cool Spring Branch	67	13.7	9.9				0.19	0.04	0.03
CSC	Cool Spring Creek	25	2.6	13.6				0.22	0.02	0.12
CWB	Chartwell Branch	137	25.1	20.6				0.17	0.03	0.03
CYB	Cypress Branch	42	4.3	6.0				0.16	0.02	0.02
EVC	Evergreen Creek	14	2.5	2.3				0.17	0.03	0.03
FRC	Forked Creek	44	9.1	6.5				0.18	0.04	0.03
FXC	Fox Creek	18	3.8	2.8				0.16	0.03	0.02
GB1	Gumbottom Branch	87	12.1	13.3				0.11	0.01	0.02
GB2	Gumbottom Branch	76	6.4	18.2				0.12	0.01	0.03
HLA	Heron Lake	16	2.7	2.3				0.27	0.05	0.04
HOC	Hopkins Creek	47	4.3	7.3				0.10	0.01	0.02
HSP	Hacketts Pt to Sandy Pt.	254	37.2	212.4				0.46	0.07	0.39
ICB	Indian Creek Branch	266	37.4	160.9				0.18	0.03	0.11
JGP	Jonas Green Pond	16	2.8	11.1				0.28	0.05	0.19
JZ1	Jabez Branch 1	146	21.9	56.3				0.17	0.03	0.07
JZ2	Jabez Branch 2	279	37.7	197.5				0.24	0.03	0.17
JZ3	Jabez Branch 3	407	65.4	397.5				0.52	0.08	0.51
JZ4	Jabez Branch 4	100	12.9	43.8				0.17	0.02	0.07

Table 3.4 Severn River Current Conditions 2002 PLOAD Results – Metals Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb
LKO	Lake Ogleton[1]	72	14.0	10.8				0.15	0.03	0.02
LRB	Little Round Bay	55	8.5	8.6				0.13	0.02	0.02
LUC	Luce Creek	71	9.2	11.7				0.18	0.02	0.03
MAC	Maynadier Creek	128	12.0	19.0				0.12	0.01	0.02
MC1	Mill Creek 1	349	49.1	152.9				0.24	0.03	0.11
MC2	Mill Creek 2	243	35.1	79.4				0.15	0.02	0.05
MEC	Meredith Creek	149	21.5	91.4				0.15	0.02	0.09
MRP	Martins Pond	5	0.2	0.8				0.09	0.00	0.01
PFB	Pointfield Branch	57	9.3	63.5				0.54	0.09	0.61
PMP	Pendennis Mount Pond	30	5.7	21.2				0.32	0.06	0.23
PSB	Picture Spring Branch	681	104.5	359.1	0	58.	0	0.43	0.07	0.23
RAP	Ray's Pond	23	2.4	3.5				0.12	0.01	0.02
RBS	Round Bay Shore	19	4.1	2.9				0.15	0.03	0.02
RGC	Ringgold Cove	15	3.4	2.3				0.12	0.03	0.02
SHP	Sharps Point	8	1.7	1.4				0.06	0.01	0.01
SM1	Severn Run Mainstem 1	182	40.6	28.9				0.21	0.05	0.03
SM2	Severn Run Mainstem 2	130	21.1	40.2				0.24	0.04	0.08
SM3	Severn Run Mainstem 3	199	24.5	29.4				0.14	0.02	0.02
SM4	Severn Run Mainstem 4	200	23.4	99.7				0.24	0.03	0.12
SPC	Spa Creek[1]	20	3.1	2.8				0.01	0.00	0.00
SRT	Severn River Tidal[1]	196	36.9	36.4	0	0.019178	0	0.17	0.03	0.03
SSB	Sewell Spring Branch	44	4.5	8.0				0.09	0.01	0.02
ST1	Severn Run Trib. 1	47	6.0	7.3				0.15	0.02	0.02
ST2	Severn Run Trib. 2	214	36.4	119.2				0.30	0.05	0.17
ST3	Severn Run Trib. 3	291	53.5	42.1				0.19	0.03	0.03
ST4	Severn Run Trib. 4	78	11.6	12.1				0.12	0.02	0.02
ST5	Severn Run Trib. 5	317	54.1	75.8				0.18	0.03	0.04
ST6	Severn Run Trib. 6	81	10.8	14.2				0.23	0.03	0.04
ST7	Severn Run Trib. 7	293	39.9	41.3				0.34	0.05	0.05
ST8	Severn Run Trib. 8	128	18.7	82.9				0.34	0.05	0.22
ST9	Severn Run Trib. 9	87	9.9	12.0				0.25	0.03	0.03
STC	Stevens Creek	19	4.2	3.3				0.13	0.03	0.02

Table 3.4 Severn River Current Conditions 2002 PLOAD Results – Metals Annual Loads (Non-point and Point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb
SVC	Sullivan Cove	30	6.3	4.5				0.18	0.04	0.03
SWC	Saltworks Creek	203	26.9	27.1				0.21	0.03	0.03
VTC	Valentine Creek	38	6.8	5.7				0.14	0.03	0.02
WCC	Woolchurch Cove	179	23.0	23.7				0.66	0.09	0.09
WCP	Winchester Pond	32	4.4	28.7				0.30	0.04	0.27
WEC	Weems Creek[1]	551	86.1	341.4				0.36	0.06	0.22
WH1	Whitehall Creek 1	263	41.3	198.3				0.36	0.06	0.27
WH2	Whitehall Creek 2	83	11.5	12.6				0.09	0.01	0.01
WH3	Whitehall Creek 3	82	11.3	42.7				0.20	0.03	0.10
YZC	Yantz Creek	51	10.0	7.3				0.25	0.05	0.04
	Severn River									
TOTAL		**8891**	**1347**	**3757**	**0**	**58.4**	**0**	**15.56**	**2.43**	**6.60**

Notes:

[1] These subwatersheds lie in both Anne Arundel County and the City of Annapolis. The pollutant loads shown are the loads that run off from the Anne Arundel County lands only.

The City of Annapolis was not included in this study – land use information, imperviousness ratings, and BMP information were not obtained. An imperviousness rate of 0% was applied to the land use category "CIT" that represents the City of Annapolis. In addition, the EMCs CIT was zero for all parameters. Therefore, the City of Annapolis was not modeled and no pollutant runoff was calculated for the area. College Creek is contained wholly within the City, therefore, the pollutant loads from College Creek are zero. Spa Creek, Weems Creek, and Back Creek are contained mainly in the City with a small portion in Anne Arundel County. Lake Ogleton, Chase Pond, and Severn River Tidal are contained mainly in Anne Arundel County with small portions located within the city limits. In all of these 6 subwatersheds, the pollutant loads shown are the loads that run off from Anne Arundel County lands only. Although the following figures show the load over the whole subwatershed, it is really only being delivered by the areas within the County.

The subwatershed titled Severn River Tidal (SRT) is actually composed of 31 non-contiguous subwatersheds bordering the Severn River. Unlike Jabez Branch, which was divided into four subwatersheds with unique names (JZ1, JZ2, etc), all of these 31 subwatersheds were given the subwatershed code of SRT. Many of these are very small, and lumping them together creates an overall SRT subwatershed of approximately 1500 acres. PLOAD calculates the total load for the aggregated SRT and displays it across all the pieces.

In order to determine the overall effectiveness of the over 1400 BMPs in the Severn River watershed, a PLOAD model scenario was run assuming that no BMPs existed. It was found that BMPs treat runoff from approximately 14 percent of the land, producing the overall pollutant reductions presented in Table 3.5.

Table 3.5 Annual Percent Reduction of Non-point Source Pollutant Load Due to Existing BMPs (lb/yr except where noted)

	TN	NOx	TP	Zn	Cu	Pb	Fecal Coliform (Counts/yr)
Without BMPS	145,097	48,191	19,030	9,383	1,416	3,758	4.71E+14
With BMPS	138,585	45,645	17,666	8,891	1,347	3,757	4.71E+14
Total Load Reduced	6,512	2,546	1,364	491	69	1	1.25E+11
Percent Reduction	4.5%	5.3%	7.2%	5.2%	4.8%	0.0%	0.0%

A forested condition model run scenario was performed to provide a baseline for activities in the County. While this could be construed as a baseline condition, it is important to keep in mind that this assumes that the whole watershed is entirely composed of forest (with the exception of the City of Annapolis) to which it will never return. The results are included in the following two tables – nutrients and fecal coliform data are shown in Table 3.6 and metals data are shown in Table 3.7.

Table 3.6 Severn River Forested Condition PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/yr)	TN	NOx	TP	Fecal Coliform (counts/acre/yr)
AQC	Aisquith Creek	137	65	18	2.70E+11	0.49	0.23	0.06	9.69E+08
ARP	Arden Pond	109	52	14	2.16E+11	0.49	0.23	0.06	9.69E+08
BKC	Back Creek[1]	27	13	4	5.33E+10	0.03	0.01	0.00	6.24E+07
BRB	Bear Branch	322	152	42	6.35E+11	0.49	0.23	0.06	9.69E+08
BRC	Browns Cove	92	43	12	1.80E+11	0.49	0.23	0.06	9.69E+08
BWC	Brewer Creek	216	102	28	4.26E+11	0.49	0.23	0.06	9.69E+08
BWP	Brewer Pond	197	93	26	3.88E+11	0.49	0.23	0.06	9.69E+08
BWS	Brewer Shore	21	10	3	4.18E+10	0.49	0.23	0.06	9.69E+08
CGC	College Creek	0	0	0	0.00E+00	0.00	0.00	0.00	0.00E+00
CHC	Chase Creek	219	104	29	4.32E+11	0.49	0.23	0.06	9.69E+08
CLC	Clements Creek	372	176	49	7.34E+11	0.49	0.23	0.06	9.69E+08
COC	Cove of Cork	53	25	7	1.05E+11	0.49	0.23	0.06	9.69E+08
CPO	Chase Pond[1]	39	18	5	7.61E+10	0.45	0.21	0.06	8.85E+08
CRC	Carr Creek	196	93	26	3.86E+11	0.49	0.23	0.06	9.69E+08
CSB	Cool Spring Branch	171	81	22	3.37E+11	0.49	0.23	0.06	9.69E+08
CSC	Cool Spring Creek	56	27	7	1.11E+11	0.49	0.23	0.06	9.69E+08
CWB	Chartwell Branch	401	189	52	7.91E+11	0.49	0.23	0.06	9.69E+08
CYB	Cypress Branch	134	63	17	2.64E+11	0.49	0.23	0.06	9.69E+08
EVC	Evergreen Creek	40	19	5	7.83E+10	0.49	0.23	0.06	9.69E+08
FRC	Forked Creek	122	58	16	2.41E+11	0.49	0.23	0.06	9.69E+08
FXC	Fox Creek	57	27	7	1.13E+11	0.49	0.23	0.06	9.69E+08
GB1	Gumbottom Branch 1	398	188	52	7.85E+11	0.49	0.23	0.06	9.69E+08
GB2	Gumbottom Branch 2	300	142	39	5.92E+11	0.49	0.23	0.06	9.69E+08
HLA	Heron Lake	30	14	4	5.83E+10	0.49	0.23	0.06	9.69E+08
HOC	Hopkins Creek	237	112	31	4.67E+11	0.49	0.23	0.06	9.69E+08
HSP	Hacketts Pt to Sandy Pt	270	127	35	5.32E+11	0.49	0.23	0.06	9.69E+08
ICB	Indian Creek Branch	711	336	93	1.40E+12	0.49	0.23	0.06	9.69E+08
JGP	Jonas Green Pond	29	14	4	5.66E+10	0.49	0.23	0.06	9.69E+08
JZ1	Jabez Branch 1	413	195	54	8.14E+11	0.49	0.23	0.06	9.69E+08
JZ2	Jabez Branch 2	580	274	76	1.14E+12	0.49	0.23	0.06	9.69E+08
JZ3	Jabez Branch 3	384	181	50	7.58E+11	0.49	0.23	0.06	9.69E+08
JZ4	Jabez Branch 4	294	139	38	5.79E+11	0.49	0.23	0.06	9.69E+08
LKO	Lake Ogleton[1]	235	111	31	4.63E+11	0.48	0.23	0.06	9.52E+08

Table 3.6 Severn River Forested Condition PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/yr)	TN	NOx	TP	Fecal Coliform (counts/acre/yr)
LRB	Little Round Bay	204	96	27	4.03E+11	0.49	0.23	0.06	9.69E+08
LUC	Luce Creek	189	89	25	3.73E+11	0.49	0.23	0.06	9.69E+08
MAC	Maynadier Creek	526	248	69	1.04E+12	0.49	0.23	0.06	9.69E+08
MC1	Mill Creek 1	703	332	92	1.39E+12	0.49	0.23	0.06	9.69E+08
MC2	Mill Creek 2	777	367	101	1.53E+12	0.49	0.23	0.06	9.69E+08
MEC	Meredith Creek	478	225	62	9.42E+11	0.49	0.23	0.06	9.69E+08
MRP	Martins Pond	29	13	4	5.63E+10	0.49	0.23	0.06	9.69E+08
PFB	Pointfield Branch	51	24	7	1.01E+11	0.49	0.23	0.06	9.69E+08
PMP	Pendennis Mount Pond	45	21	6	8.95E+10	0.49	0.23	0.06	9.69E+08
PSB	Picture Spring Branch	770	364	100	1.52E+12	0.49	0.23	0.06	9.69E+08
RAP	Ray's Pond	96	45	12	1.88E+11	0.49	0.23	0.06	9.69E+08
RBS	Round Bay Shore	61	29	8	1.21E+11	0.49	0.23	0.06	9.69E+08
RGC	Ringgold Cove	59	28	8	1.17E+11	0.49	0.23	0.06	9.69E+08
SHP	Sharps Point	66	31	9	1.29E+11	0.49	0.23	0.06	9.69E+08
SM1	Severn Mainstem 1	435	205	57	8.57E+11	0.49	0.23	0.06	9.69E+08
SM2	Severn Mainstem 2	261	123	34	5.15E+11	0.49	0.23	0.06	9.69E+08
SM3	Severn Mainstem 3	724	342	94	1.43E+12	0.49	0.23	0.06	9.69E+08
SM4	Severn Mainstem 4	415	196	54	8.19E+11	0.49	0.23	0.06	9.69E+08
SPC	Spa Creek[1]	38	18	5	7.51E+10	0.02	0.01	0.00	4.85E+07
SRT	Severn River Tidal[1]	572	270	75	1.13E+12	0.49	0.23	0.06	9.61E+08
SSB	Sewell Spring Branch	234	110	30	4.61E+11	0.49	0.23	0.06	9.69E+08
ST1	Severn Run Trib. 1	151	71	20	2.97E+11	0.49	0.23	0.06	9.69E+08
ST2	Severn Run Trib. 2	345	163	45	6.81E+11	0.49	0.23	0.06	9.69E+08
ST3	Severn Run Trib. 3	768	363	100	1.51E+12	0.49	0.23	0.06	9.69E+08
ST4	Severn Run Trib. 4	319	151	42	6.30E+11	0.49	0.23	0.06	9.69E+08
ST5	Severn Run Trib. 5	858	405	112	1.69E+12	0.49	0.23	0.06	9.69E+08
ST6	Severn Run Trib. 6	169	80	22	3.33E+11	0.49	0.23	0.06	9.69E+08
ST7	Severn Run Trib. 7	425	201	55	8.39E+11	0.49	0.23	0.06	9.69E+08
ST8	Severn Run Trib. 8	184	87	24	3.62E+11	0.49	0.23	0.06	9.69E+08
ST9	Severn Run Trib. 9	169	80	22	3.33E+11	0.49	0.23	0.06	9.69E+08
STC	Stevens Creek	74	35	10	1.45E+11	0.49	0.23	0.06	9.69E+08
SVC	Sullivan Cove	81	38	11	1.59E+11	0.49	0.23	0.06	9.69E+08
SWC	Saltworks Creek	467	220	61	9.20E+11	0.49	0.23	0.06	9.69E+08

Table 3.6 Severn River Forested Condition PLOAD Results – Nutrients and Fecal Coliform Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)				Non-point Source Loads (lbs/acre/yr)			
		TN	NOx	TP	Fecal Coliform (counts/yr)	TN	NOx	TP	Fecal Coliform (counts/acre/yr)
VTC	Valentine Creek	134	63	17	2.64E+11	0.49	0.23	0.06	9.69E+08
WCC	Woolchurch Cove	133	63	17	2.61E+11	0.49	0.23	0.06	9.69E+08
WCP	Winchester Pond	53	25	7	1.04E+11	0.49	0.23	0.06	9.69E+08
WEC	Weems Creek[1]	417	197	54	8.21E+11	0.27	0.13	0.04	5.34E+08
WH1	Whitehall Creek 1	363	172	47	7.16E+11	0.49	0.23	0.06	9.69E+08
WH2	Whitehall Creek 2	449	212	59	8.84E+11	0.49	0.23	0.06	9.69E+08
WH3	Whitehall Creek 3	205	97	27	4.04E+11	0.49	0.23	0.06	9.69E+08
YZC	Yantz Creek	100	47	13	1.98E+11	0.49	0.23	0.06	9.69E+08
TOTAL		**19,456**	**9,187**	**2,538**	**3.84E+13**	**34.18**	**16.14**	**4.52**	**6.84E+10**

Notes:
[1]These subwatersheds lie in both Anne Arundel County and the City of Annapolis. The pollutant loads shown are the loads that run off from the Anne Arundel County lands only.

Table 3.7 Severn River Forested Condition PLOAD Results – Metals Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb
AQC	Aisquith Creek	23	0.7	3.6	0.08	0.00	0.01
ARP	Arden Pond	19	0.6	2.9	0.08	0.00	0.01
BKC	Back Creek[1]	5	0.1	0.7	0.01	0.00	0.00
BRB	Bear Branch	55	1.7	8.4	0.08	0.00	0.01
BRC	Browns Cove	16	0.5	2.4	0.08	0.00	0.01
BWC	Brewer Creek	37	1.1	5.6	0.08	0.00	0.01
BWP	Brewer Pond	33	1.0	5.1	0.08	0.00	0.01
BWS	Brewer Shore	4	0.1	0.6	0.08	0.00	0.01
CGC	College Creek	0	0.0	0.0	0.00	0.00	0.00
CHC	Chase Creek	37	1.1	5.7	0.08	0.00	0.01
CLC	Clements Creek	63	1.9	9.7	0.08	0.00	0.01
COC	Cove of Cork	9	0.3	1.4	0.08	0.00	0.01
CPO	Chase Pond[1]	7	0.2	1.0	0.08	0.00	0.01
CRC	Carr Creek	33	1.0	5.1	0.08	0.00	0.01
CSB	Cool Spring Branch	29	0.9	4.5	0.08	0.00	0.01
CSC	Cool Spring Creek	10	0.3	1.5	0.08	0.00	0.01
CWB	Chartwell Branch	68	2.1	10.5	0.08	0.00	0.01
CYB	Cypress Branch	23	0.7	3.5	0.08	0.00	0.01
EVC	Evergreen Creek	7	0.2	1.0	0.08	0.00	0.01
FRC	Forked Creek	21	0.6	3.2	0.08	0.00	0.01
FXC	Fox Creek	10	0.3	1.5	0.08	0.00	0.01
GB1	Gumbottom Branch 1	68	2.1	10.4	0.08	0.00	0.01
GB2	Gumbottom Branch 2	51	1.6	7.8	0.08	0.00	0.01
HLA	Heron Lake	5	0.2	0.8	0.08	0.00	0.01
HOC	Hopkins Creek	40	1.2	6.2	0.08	0.00	0.01
HSP	Hacketts Pt to Sandy Pt	46	1.4	7.0	0.08	0.00	0.01
ICB	Indian Creek Branch	121	3.7	18.6	0.08	0.00	0.01
JGP	Jonas Green Pond	5	0.1	0.7	0.08	0.00	0.01
JZ1	Jabez Branch 1	70	2.2	10.8	0.08	0.00	0.01
JZ2	Jabez Branch 2	98	3.0	15.1	0.08	0.00	0.01
JZ3	Jabez Branch 3	65	2.0	10.0	0.08	0.00	0.01
JZ4	Jabez Branch 4	50	1.5	7.7	0.08	0.00	0.01
LKO	Lake Ogleton[1]	40	1.2	6.1	0.08	0.00	0.01

Table 3.7 Severn River Forested Condition PLOAD Results – Metals Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb
LRB	Little Round Bay	35	1.1	5.3	0.08	0.00	0.01
LUC	Luce Creek	32	1.0	4.9	0.08	0.00	0.01
MAC	Maynadier Creek	89	2.7	13.7	0.08	0.00	0.01
MC1	Mill Creek 1	119	3.7	18.3	0.08	0.00	0.01
MC2	Mill Creek 2	132	4.1	20.3	0.08	0.00	0.01
MEC	Meredith Creek	81	2.5	12.5	0.08	0.00	0.01
MRP	Martins Pond	5	0.1	0.7	0.08	0.00	0.01
PFB	Pointfield Branch	9	0.3	1.3	0.08	0.00	0.01
PMP	Pendennis Mount Pond	8	0.2	1.2	0.08	0.00	0.01
PSB	Picture Spring Branch	131	4.0	20.1	0.08	0.00	0.01
RAP	Ray's Pond	16	0.5	2.5	0.08	0.00	0.01
RBS	Round Bay Shore	10	0.3	1.6	0.08	0.00	0.01
RGC	Ringgold Cove	10	0.3	1.6	0.08	0.00	0.01
SHP	Sharps Point	11	0.3	1.7	0.08	0.00	0.01
SM1	Severn Mainstem 1	74	2.3	11.3	0.08	0.00	0.01
SM2	Severn Mainstem 2	44	1.4	6.8	0.08	0.00	0.01
SM3	Severn Mainstem 3	123	3.8	18.9	0.08	0.00	0.01
SM4	Severn Mainstem 4	70	2.2	10.8	0.08	0.00	0.01
SPC	Spa Creek[1]	6	0.2	1.0	0.00	0.00	0.00
SRT	Severn River Tidal[1]	97	3.0	14.9	0.08	0.00	0.01
SSB	Sewell Spring Branch	40	1.2	6.1	0.08	0.00	0.01
ST1	Severn Run Trib 1	26	0.8	3.9	0.08	0.00	0.01
ST2	Severn Run Trib 2	59	1.8	9.0	0.08	0.00	0.01
ST3	Severn Run Trib 3	130	4.0	20.0	0.08	0.00	0.01
ST4	Severn Run Trib 4	54	1.7	8.3	0.08	0.00	0.01
ST5	Severn Run Trib 5	146	4.5	22.4	0.08	0.00	0.01
ST6	Severn Run Trib 6	29	0.9	4.4	0.08	0.00	0.01
ST7	Severn Run Trib 7	72	2.2	11.1	0.08	0.00	0.01
ST8	Severn Run Trib 8	31	1.0	4.8	0.08	0.00	0.01
ST9	Severn Run Trib 9	29	0.9	4.4	0.08	0.00	0.01
STC	Stevens Creek	12	0.4	1.9	0.08	0.00	0.01
SVC	Sullivan Cove	14	0.4	2.1	0.08	0.00	0.01
SWC	Saltworks Creek	79	2.4	12.2	0.08	0.00	0.01

Table 3.7 Severn River Forested Condition PLOAD Results – Metals Annual Loads (Non-point Sources)

Code	Subwatershed Name	Non-point Source Loads (lbs/yr)			Non-point Source Loads (lbs/acre/yr)		
		Zn	Cu	Pb	Zn	Cu	Pb
VTC	Valentine Creek	23	0.7	3.5	0.08	0.00	0.01
WCC	Woolchurch Cove	22	0.7	3.5	0.08	0.00	0.01
WCP	Winchester Pond	9	0.3	1.4	0.08	0.00	0.01
WEC	Weems Creek[1]	71	2.2	10.9	0.05	0.00	0.01
WH1	Whitehall Creek 1	62	1.9	9.5	0.08	0.00	0.01
WH2	Whitehall Creek 2	76	2.3	11.7	0.08	0.00	0.01
WH3	Whitehall Creek 3	35	1.1	5.3	0.08	0.00	0.01
YZC	Yantz Creek	17	0.5	2.6	0.08	0.00	0.01
TOTAL		**3,299**	**101.5**	**507.6**	**5.88**	**0.18**	**0.90**

Notes:
[1]These subwatersheds lie in both Anne Arundel County and the City of Annapolis. The pollutant loads shown are the loads that runs off from the Anne Arundel County lands only.

3.4 Stream Assessment

Stream Type

There were a total of 152 miles of stream assessed during the stream walk portion of the Watershed Study. Figure 3.1 and Table 3.8 present the stream miles per type and the percent of stream miles per type for the entire Watershed. Figure 3.2 displays the percent of each stream type in each subwatershed. It should be noted that Figure 3.2 shows the percent within each subwatershed and not the total number of stream miles.

Perennial streams are most abundant with 89.37 miles making up 58.8% of the total for the entire Watershed. Ephemeral streams comprise 19.5% of the channels with the remaining types making up the final 21%.

Figure 3.1 Stream Miles per Type

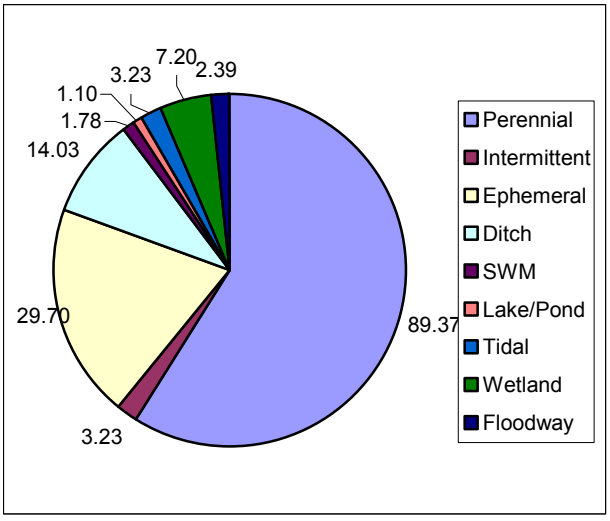
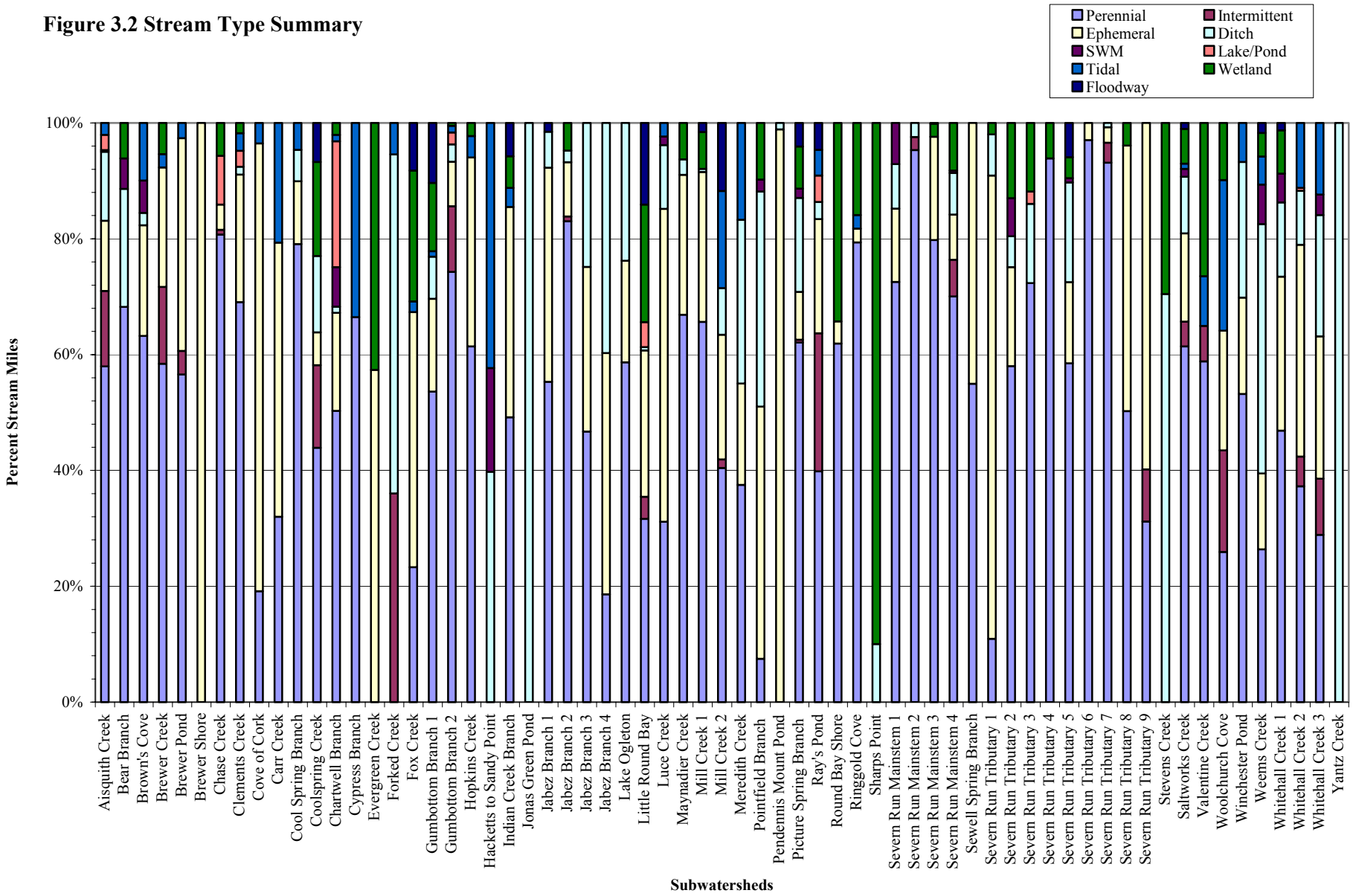


Table 3.8 Percent Stream Miles per Type

Type	Percent of Total
Perennial	58.8
Intermittent	2.1
Ephemeral	19.5
Ditch	9.2
SWM	1.2
Lake/Pond	0.7
Tidal	2.1
Wetland	4.7
Floodway	1.6

Figure 3.2 Stream Type Summary



Rosgen Classification

Rosgen classification was conducted on 92.63 miles of streams with 381 separate reaches and cross-sections conducted throughout the Watershed. Figure 3.3 presents the number of stream miles per Rosgen classification for the entire Watershed. Table 3.9 shows the percent of each classification as a percent of the Watershed total. Figure 3.4 displays the percent of each stream classification in each subwatershed. It should be noted that Figure 3.4 shows the percent within each subwatershed and not the total number of stream miles.

E type channels make up the majority of the stream miles throughout the Watershed, comprising 34.6% of the total. E channels are most prevalent in the downstream reaches of tributaries as they enter the floodplain of the subwatershed's main channel. G channels are also common and make up 27.9% of the total. Entrenched G type channels are typical of both mainstem channels and the upstream portions of tributaries as they flow out of steep, narrow headwater valleys with erodable materials. C type channels are most prevalent in the downstream mainstem reaches of Severn Run Mainstems 2 and throughout Severn Run Mainstem, 3 and 4.

Figure 3.3 Stream Miles per Rosgen Classification

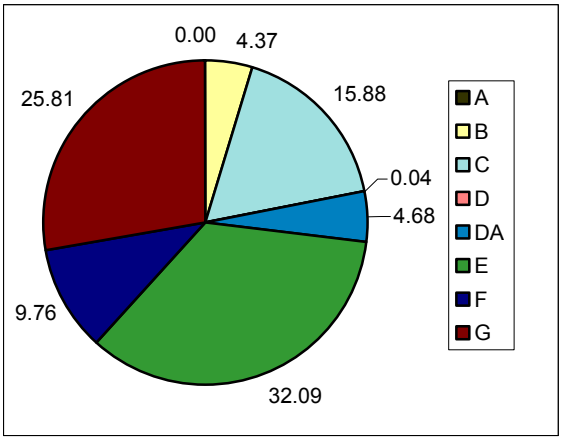
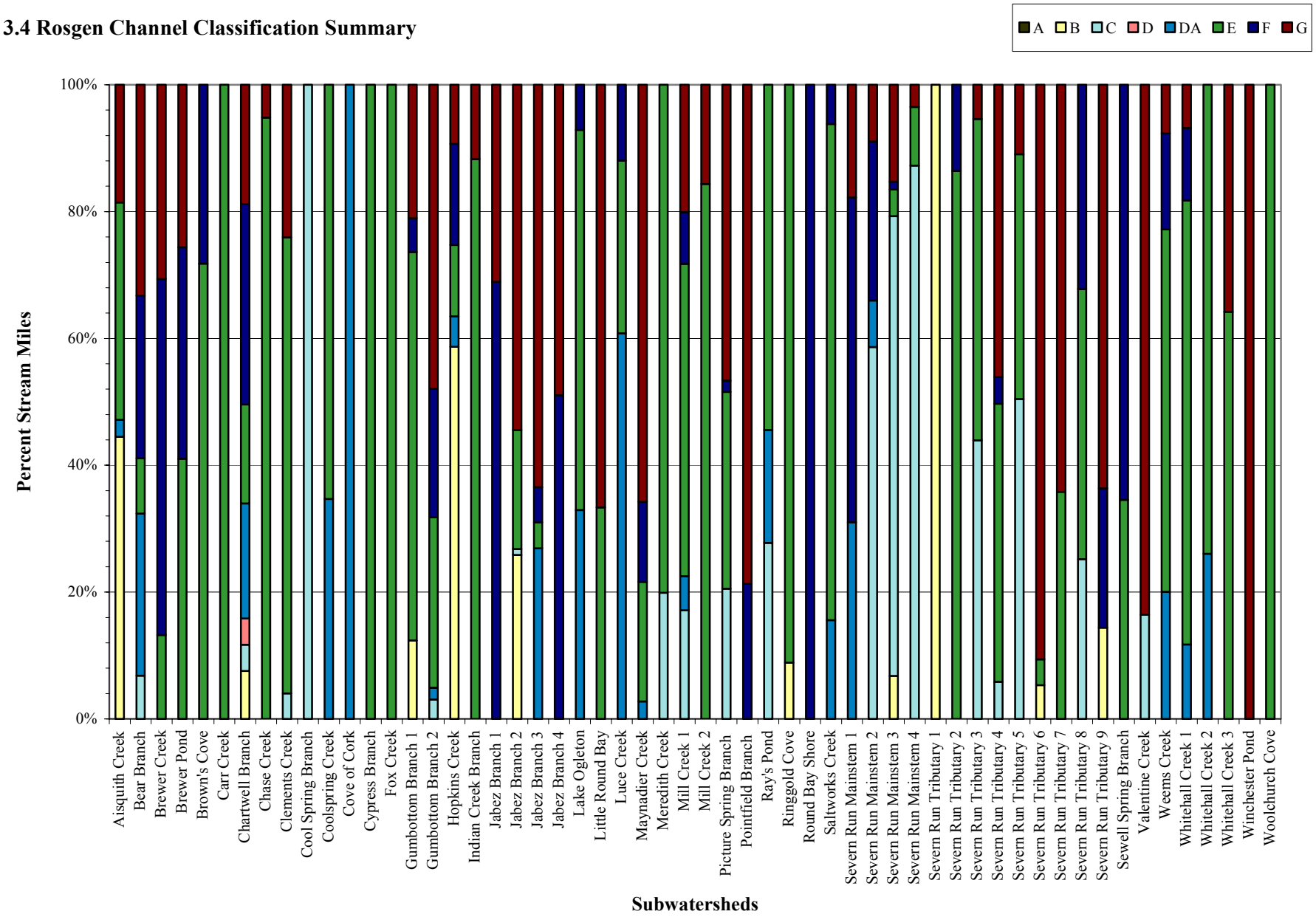


Table 3.9 Percent of Stream Miles per Rosgen Classification

Classification	Percent of Total
A	0.0
B	4.7
C	17.1
D	0.05
DA	5.1
E	34.6
F	10.5
G	27.9

3.4 Rosgen Channel Classification Summary



MPHI and Final Habitat Scores

MPHI

Habitat Assessments were conducted for a total of 89 miles of perennial streams in the Watershed for 352 distinct reaches. The mean MPHI score for the entire Watershed is 44.05, Fair, while the median is 39.10, in the upper part of the Poor range. The stream length weighted MPHI score for the Watershed is in the Fair range with a score of 58.13.

Figure 3.5 presents the number of stream miles in each MPHI category. The higher quality streams are generally the longest reaches assessed and therefore tend to skew the results toward the Good range with 39.6% of the stream miles versus 39.1% in the Poor range. Figure 3.6 is also presented to show the number of reaches that were assessed with scores in each of the categories. Forty-five percent of the reaches are in the Poor range while 20.5% are in the Good range. The high number of small tributary channels assessed skews this distribution toward the Poor range.

Figure 3.9 shows the percentage of stream miles in each MPHI category for each subwatershed. It should be noted that Figure 3.9 shows the percent within each subwatershed and not the total number of stream miles.

Figure 3.5 Number of Stream Miles per MPHI Category

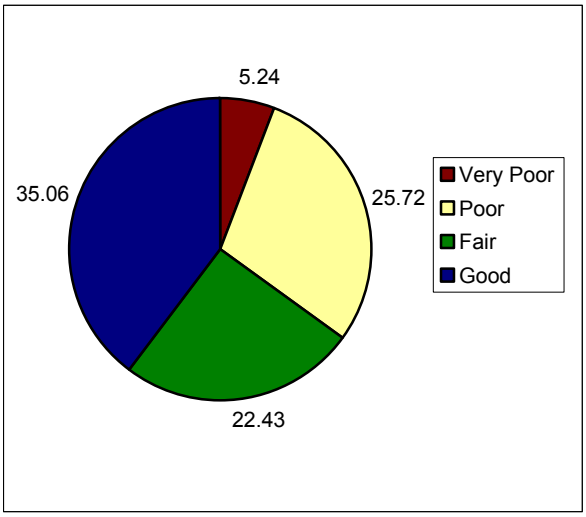
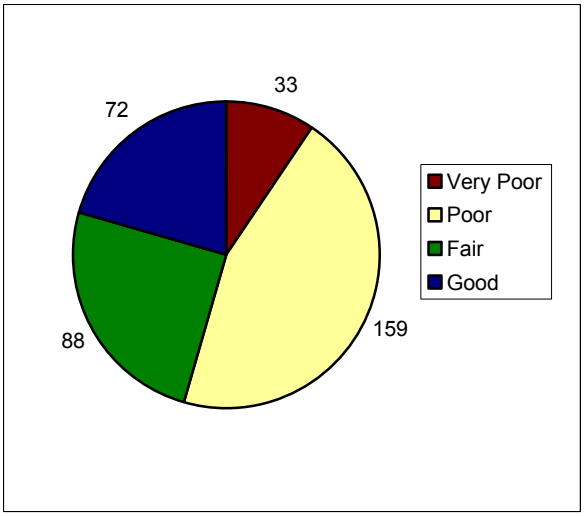


Figure 3.6 Number of Habitat Assessment Reaches per MPHI Category



Final Habitat Score

The mean FHS score for the entire Watershed was 40.1, Poor, while the median was 35.55, also in the Poor range. The stream length weighted FHS score for the Watershed was in the Fair range with a score of 53.98.

Table 3.10 MPHI and Final Habitat Summary

Category	Percent Stream Miles MPHI	Percent Reaches MPHI	Percent Stream Miles FHS	Percent Reaches FHS
Good	39.6	20.5	30.6	16.8
Fair	24.5	25.0	29.7	24.7
Poor	29.1	45.2	27.4	44.3
Very Poor	5.9	9.4	12.4	14.2

Figure 3.7 presents the number of stream miles in each FHS category. Like the MPHI results, the higher quality streams are generally the longest reaches and skew the results toward the Good range with 30.6% of the stream miles versus 27.4% in the Poor range. Figure 3.8 is shows the number of reaches that were assessed with scores in each of the categories. Forty-four percent of the reaches are in the Poor range while 16.8% are in the Good range. The high number of small tributary channels assessed skews this distribution toward the Poor range.

Figure 3.9 shows the percentage of stream miles in each MPHI category for each subwatershed. It should be noted that Figure 3.9 shows the percent within each subwatershed and not the total number of stream miles. Table 3.10 includes a summary of the MPHI and FHS percentages of each category.

Figure 3.7 Number of Stream Miles per FHS Category

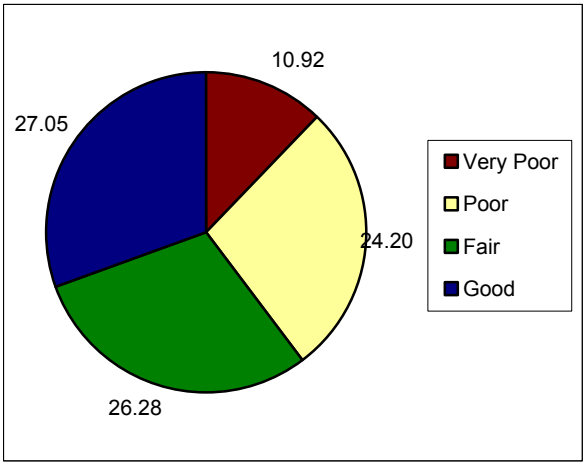


Figure 3.8 Number of Habitat Assessment Reaches per FHS Category

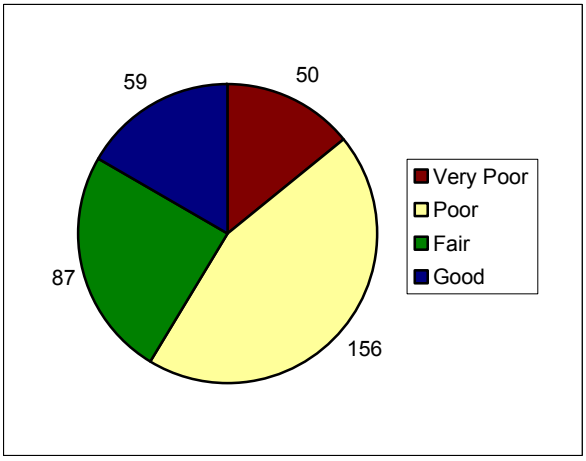


Figure 3.9 MPHI Summary

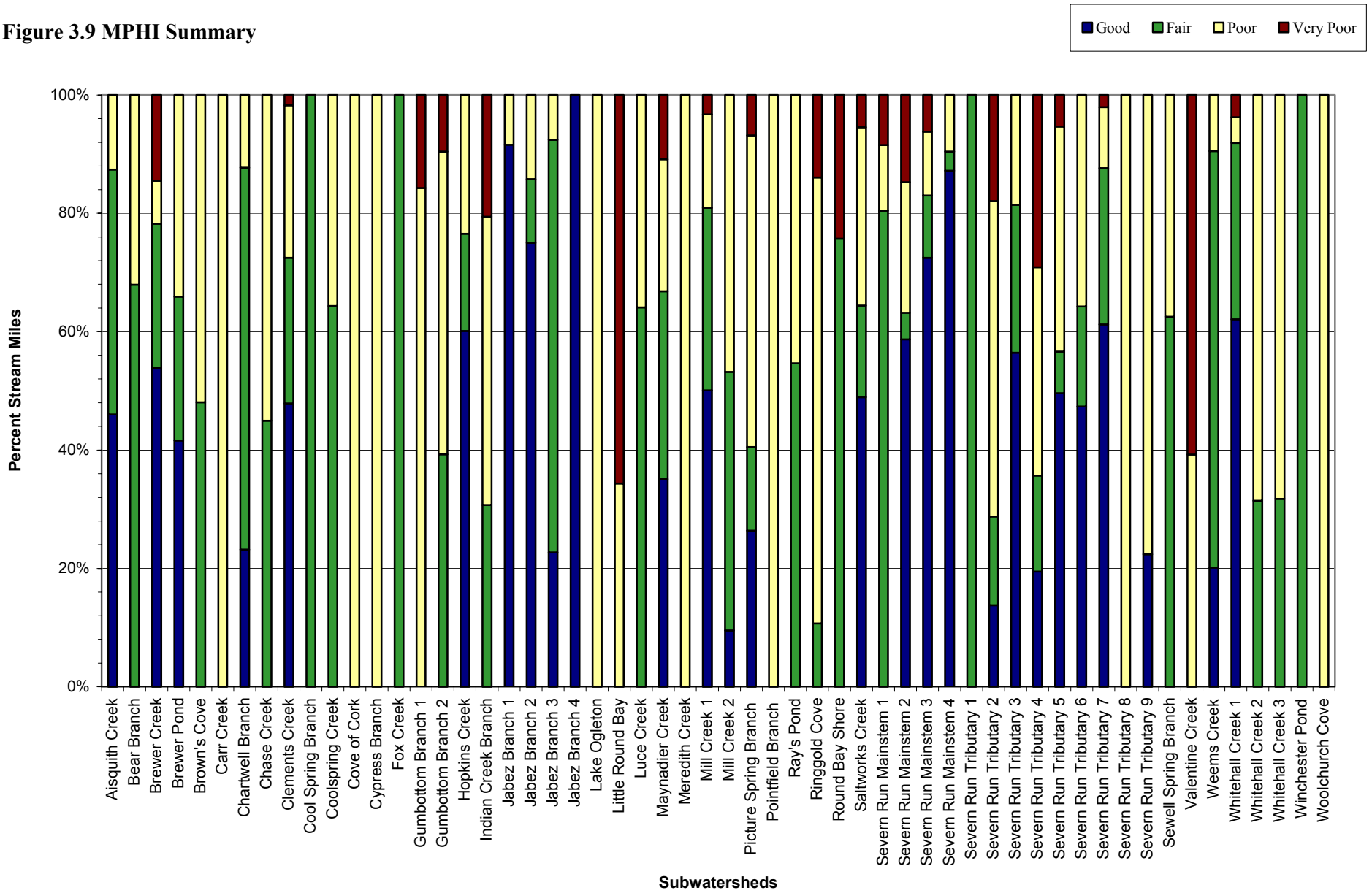
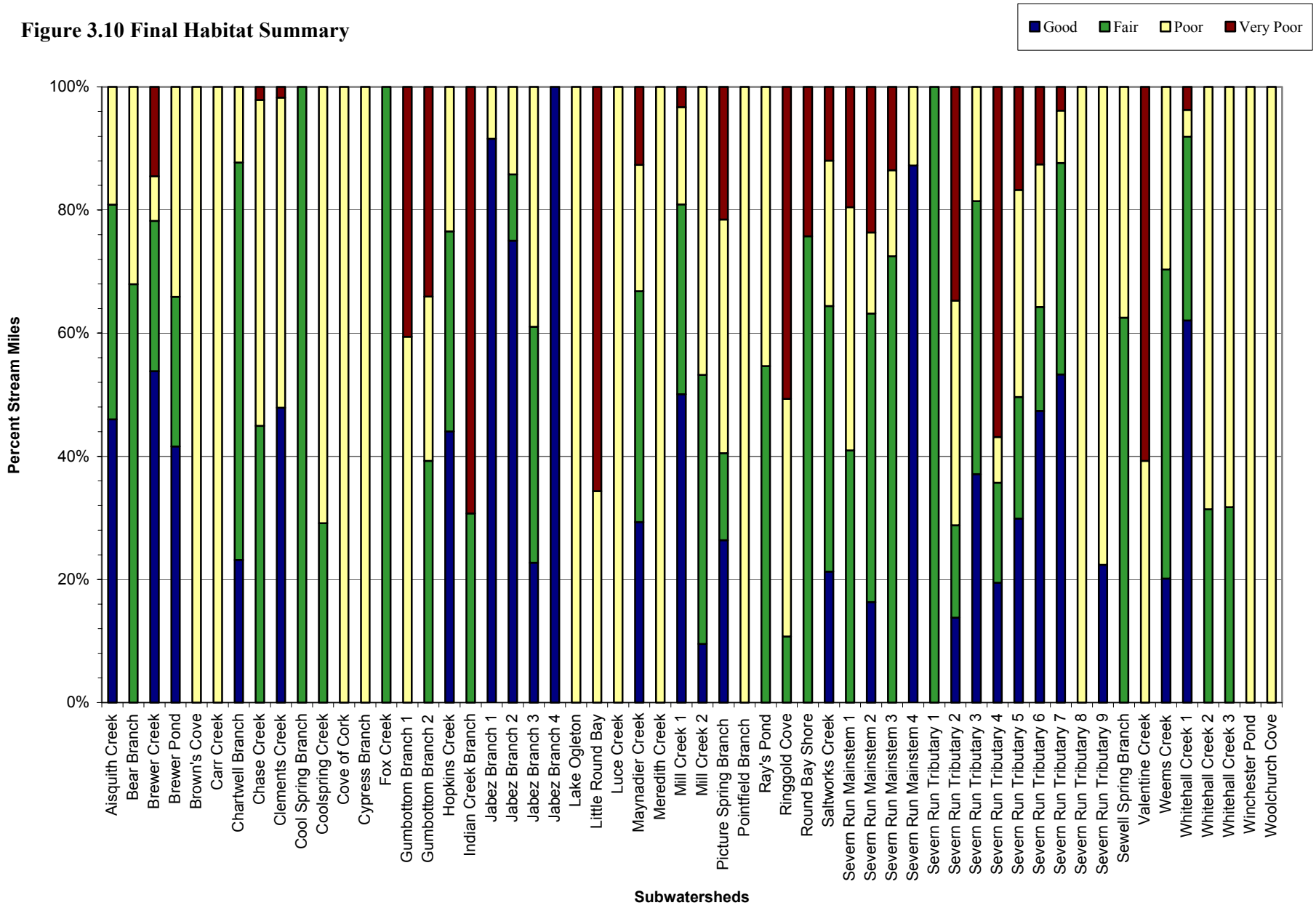


Figure 3.10 Final Habitat Summary



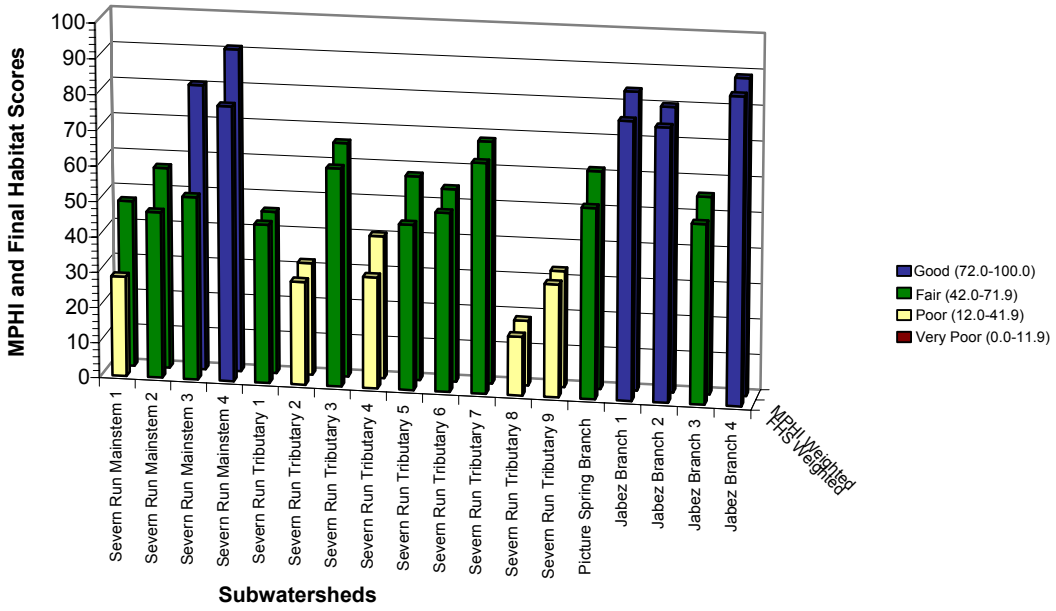
4.0 Subwatershed Conditions

4.1 Severn Run and Tributaries

Severn Run and its tributaries, 18 drainage areas in all, make up 63.95 miles or 42 percent of the stream miles in the Severn River Watershed. Severn Run drains the northwest portion of the Watershed and is generally bounded by MD 175 to the west. The upper reaches of the Severn Run drainage area is moderately to heavily developed with major roadways and residential development present. This development has created high levels of imperviousness in the upper reaches of the drainage area. Impervious values in this area are: 22% in Severn Run Mainstem 1, 18% in Mainstem 2, 25% in Tributary 2, 15% in Tributary 9 and 32% in Picture Spring Branch.

All of the subwatersheds in this area have perennial streams with habitat assessments conducted. The overall stream length weighted subwatershed Maryland Physical Habitat Index (MPHI) and Final Habitat Scores (FHS) are presented in Figure 4.1 to highlight the difference between the MPHI and the FHS. The average difference between the MPHI and FHS for Severn Run and its tributaries was 7.4, with Severn Run Mainstem 3, Mainstem 1 and Mainstem 4 having the biggest influences from infrastructure and environmental features. Mainstem 3 was the only subwatershed to drop from one category to another.

Figure 4.1 Stream length Weighted Subwatershed Scores (MPHI Scores are displayed in the back row)



The following sections summarize the results of the stream assessment and modeling. The S*ubwatershed Description* section describes pertinent land use data, subwatershed features and the types and classifications of the stream channels. *Subwatershed Characteristics* are then presented including land use data and PLOAD and TR-20 modeling results. The *Streams* section presents water quality data, stream type results, habitat information including MPHI and FHS and channel classification results. Refer to Section 2.5 for information on the derivation and categories used for the MPHI and FHS. The final *Summary* briefly interprets the habitat scores and gives the primary and probable influences on the score.

Severn Run Mainstem 1 (SM1)

Subwatershed Description

Severn Run Mainstem 1 is 884.1 acres in size and drains the headwaters of the Severn River in a southeasterly direction. Lake Marion outfalls over a concrete spillway in the uppermost reaches of the subwatershed. Land use is heavily dominated by high-density residential development in the northern portion of the subwatershed comprising 55.3% of the total area. Newer development on the southern side has more stormwater controls. The stream corridor is buffered by forest along 87% of its 2.29 miles. The subwatershed is linear in configuration, drained primarily by a single stream valley. The channel classifications vary considerably. The most upstream portion of the subwatershed is an entrenched and unstable G type channel, while the middle portions have more floodplain connectivity and are dominated by braided sections.

Subwatershed Characteristics

SM1 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	9.2	1.0
IND – Industrial	0.0	0.0
OPS – Open space	65.5	7.4
R11 – Residential 1 Acre lots	0.7	0.1
R12 – Residential ½ acre lots	91.3	10.3
R14 – Residential ¼ acre lots	61.5	7.0
R18 – Residential 1/8 acre lots	488.7	55.3
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	22.3	2.5
TRN – Transportation	0.0	0.0
WAT – Water	3.9	0.4
WDS – Woods	141.1	16.0
Total Area	884.1	100.0
Impervious Area	200.1	22.6
Area served by BMPs	169.5	19.2

SM1 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	4799	1561	531	182	40.6	28.9	1.92E+13

*Fecal coliform bacteria reported in org/year

SM1 - TR-20 Results

	Peak flows (cfs)
2-yr	581
100-yr	4364

Streams

SM1 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.7	1.4	0.02	<0.01	0.007	<0.005	93	1

*Fecal coliform bacteria reported in org/100ml

SM1 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8753	0	1529	925	860	0	0	0	0	12067
Miles	1.66	0.00	0.29	0.18	0.16	0.00	0.00	0.00	0.00	2.29
Percent of Total	73	0	13	8	7	0	0	0	0	

SM1 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	7,044	1.33	80.5
Poor (MPHI)	969	0.18	11.1
Very Poor (MPHI)	741	0.14	8.5
Good (FHS)	0	0.00	0.0
Fair (FHS)	3,587	0.68	41.0
Poor (FHS)	3,457	0.65	39.5
Very Poor (FHS)	1,710	0.32	19.5
Forested Stream Length	10,558	2.00	87.0
Total Stream Length with Habitat Assessment	8,754	1.66	Na

SM1 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	2,715	0	4,482	1,557	8,754
Miles	0.00	0.00	0.00	0.00	0.51	0.00	0.85	0.29	1.66
Percent of Total	0	0	0	0	31	0	51	18	

Summary

Severn Run Mainstem 1 has degraded conditions in the channel downstream of Lake Marion in the Severn Run headwaters. The channel appears unstable both laterally and vertically. Midstream and downstream portions of the subwatershed are more stable, well vegetated and provide complex cover.

Severn Run Mainstem 1 received an overall stream length weighted MPHI score of 46.96 and an FHS of 28.22, ratings of Fair and Poor, respectively. The variation in scores is due to many buffer, erosion, obstruction, utility, pipe and ditch infrastructure points. Medium- to high-density residential areas border the entire stream corridor. Localized areas of degradation occurred at many points throughout the system near stormwater outfalls.

Severn Run Mainstem 2 (SM2)

Subwatershed Description

Severn Run Mainstem 2 is located in the northwestern portion of the watershed, and is 531.4 acres of total area. Severn Run Mainstem 2 includes Severn Run and its tributaries located downstream of Severn Run Mainstem 1 and upstream of Severn Run Mainstem 3. The SM2 subwatershed is comprised of 21.8% high-density residential, 12.8% medium-density residential, and 9% commercial and industrial land uses. The development is concentrated in the northern portion of the subwatershed providing only a relatively narrow vegetated corridor adjacent to the Severn Run mainstem. Forty-six percent of the subwatershed is wooded, including 96% of the stream miles having forested buffers. Perennial channels accounted for 2.25 (95%) of the stream miles within Severn Run Mainstem 2. Of the 2.25 miles of classifiable streams, 59% are C type, low gradient, meandering channels with well defined floodplains, 25% are F type, low gradient, entrenched meandering channels, 9% are G type channels, deeply entrenched on moderate gradients, and 7% are DA type channels, multiple channels with well vegetated floodplains.

Subwatershed Characteristics

SM2 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	13.5	2.5
IND – Industrial	34.7	6.5
OPS – Open space	12.2	2.3
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	53.7	10.1
R14 – Residential ¼ acre lots	14.5	2.7
R18 – Residential 1/8 acre lots	116.0	21.8
R21 – Residential 2 acre lots	12.1	2.3
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	20.0	3.8
TRN – Transportation	10.4	2.0
WAT – Water	0.0	0.0
WDS – Woods	244.2	46.0
Total Area	531.4	100.0
Impervious Area	97.1	18.3
Area served by BMPs	40.9	7.7

SM2 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	2261	700	262	130	21.1	40.2	8.86E+12

*Fecal coliform bacteria reported in org/year

SM2 - TR-20 Results

	Peak flows (cfs)
2-yr	1500
100-yr	10405

Streams

SM2 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.2	0.9	0.06	<0.01	0.006	<0.005	4	2

*Fecal coliform bacteria reported in org/100ml

SM2 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	11856	281	0	301	0	0	0	0	0	12438
Miles	2.25	0.05	0.00	0.06	0.00	0.00	0.00	0.00	0.00	2.36
Percent of Total	95	2	0	2	0	0	0	0	0	

SM2 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	6,959	1.32	58.7
Fair (MPHI)	535	0.10	4.5
Poor (MPHI)	2,616	0.50	22.1
Very Poor (MPHI)	1,746	0.33	14.7
Good (FHS)	1,936	0.37	16.3
Fair (FHS)	5,558	1.05	46.9
Poor (FHS)	1,556	0.29	13.1
Very Poor (FHS)	2,806	0.53	23.7
Forested Stream Length	11,978	2.27	96.0
Total Stream Length with Habitat Assessment	11,856	2.25	na

SM2 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	6,954	0	871	0	2,971	1,060	11,856
Miles	0.00	0.00	1.32	0.00	0.16	0.00	0.56	0.20	2.25
Percent of Total	0	0	59	0	7	0	25	9	

Summary

Severn Run Mainstem 2 has an overall average MPHI score of 56.79, a rating of Fair. When considering the impact of infrastructure on the stream system, the average FHS score is 46.88, also a Fair rating. Overall, 63.2 % of the streams are rated as Good and Fair when considering the weighted MPHI and FHS. The percent of stream miles that have an MPHI rating of Good was reduced from 58.7% to 16.3% when considering infrastructure. In general, the score reduction is due to the number of erosion, obstruction, crossing, and pipe and ditch points present within Severn Mainstem 2. Trash densities were high in the northern half of the subwatershed.

Severn Run Mainstem 3 (SM3)

Subwatershed Description

Severn Run Mainstem 3 is located in the northwestern portion of the watershed and drains in an east to southeasterly direction. The topography is characterized by flat and wide floodplains along the mainstem of Severn Run and steep slopes at the headwaters of the tributaries. The majority of the land use consists of forestland, due to the presence of the Severn Run Natural Environment Area. Commercial land use consists of 4.9% of the subwatershed and is confined mostly to the southern fringe of the subwatershed, which makes up the majority of the impervious area (7.4%). Forested buffers cover 93% of the stream miles. Perennial streams make up 80% of the stream miles and are generally characterized as C type channels, sinuous with broad, well-developed floodplains, and G type channels, highly entrenched, dominate the tributaries.

The wetland and upland areas within the floodplain provide a variety of habitats for the local species, while the large size and flow diversity of the stream provides quality fish and benthic macroinvertebrate habitat. The Severn Run Natural Environment Area provides refuge for the flora and fauna that utilize the floodplain habitat.

Subwatershed Characteristics

SM3 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	71.9	4.9
IND – Industrial	0.0	0.0
OPS – Open space	3.4	0.2
R11 – Residential 1 Acre lots	102.6	7.0
R12 – Residential ½ acre lots	83.4	5.7
R14 – Residential ¼ acre lots	69.4	4.7
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	84.6	5.7
RWD – Residential woods	7.4	0.5
SRC – Single Row Crops	172.9	11.7
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	877.2	59.6
Total Area	1472.6	100.0
Impervious Area	108.4	7.4
Area served by BMPs	136.5	9.3

SM3 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3131	1105	451	199	24.5	29.4	9.72E+12

*Fecal coliform bacteria reported in org/year

SM3 - TR-20 Results

	Peak flows (cfs)
2-yr	655
100-yr	9035

Streams

SM3 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.1	0.8	0.14	<0.01	0.006	<0.005	21	2

*Fecal coliform bacteria reported in org/100ml

SM3 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	31866	0	7112	0	0	0	0	901	56	39934
Miles	6.04	0.00	1.35	0.00	0.00	0.00	0.00	0.17	0.01	7.56
Percent of Total	80	0	18	0	0	0	0	2	0	

SM3 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	22,843	4.33	75.2
Fair (MPHI)	3,319	0.63	10.5
Poor (MPHI)	3,406	0.65	10.8
Very Poor (MPHI)	1,949	0.37	6.2
Good (FHS)	0	0.00	0.0
Fair (FHS)	22,843	4.33	72.5
Poor (FHS)	4,405	0.83	14.0
Very Poor (FHS)	4,269	0.81	13.5
Forested Stream Length	37,004	7.01	93.0
Total Stream Length with Habitat Assessment	31,517	5.97	na

SM3 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	2,136	22,843	0	0	1,322	393	4,813	31,507
Miles	0.00	0.40	4.33	0.00	0.00	0.25	0.07	0.91	5.97
Percent of Total	0	7	73	0	0	4	1	15	

Summary

All of the streams with Good MPHI scores, 75.2%, are rated as Fair with the consideration of the infrastructure scores. This is due to the high frequency of bank erosion and channel obstructions within the subwatershed. The obstructions include of a mixture of trees and debris and beaver dams. Areas of erosion are located mostly on the outer bend of meanders. The aquatic habitat along Severn Run is good, consisting of deep water with old logs and fallen trees present, while the habitat of the side tributaries is less desirable, mostly due to low flows.

Severn Run Mainstem 3 received an overall stream length weighted MPHI score of 80.60, classified as Good. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system dropped to 51.62, rated as Fair.

Severn Run Mainstem 4 (SM4)

Subwatershed Description

Severn Run Mainstem 4 is located in the northern portion of the watershed, and drains in a southerly direction directly into the Severn River. The topography of the subwatershed consists of wide floodplains, expansive toward the mouth of Severn Run, and steep slopes adjacent to the floodplains and around the headwaters of the tributaries. The subwatershed is generally characterized by 78.6% forest, with 7.1% industrial, 4% transportation, and 4.8% low-density residential land use. Of the 6.91 miles of stream in the subwatershed, 83% have a forested buffer. Perennial streams make up 70% of the stream miles in Severn Run Mainstrem 4. These streams are generally characterized as C type channels, slightly entrenched with broad well developed floodplains, and E type channels, low gradient, highly sinuous with broad well developed floodplains, were present among the tributaries near their confluence with the mainstem.

The mainstem of Severn Run Mainstem 4 is completely within the Severn Run Natural Environment Area. The floodplain adjacent to the mainstem of Severn Run Mainstem 4 contains a diversity of wetlands, especially toward the mouth of the mainstem where tidal and freshwater meet. This area provides quality habitat for diverse of wildlife.

Subwatershed Characteristics

SM4 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	11.9	1.4
IND – Industrial	59.8	7.1
OPS – Open space	22.3	2.6
R11 – Residential 1 Acre lots	5.5	0.7
R12 – Residential ½ acre lots	3.4	0.4
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	16.7	2.0
RWD – Residential woods	23.3	2.8
SRC – Single Row Crops	3.9	0.5
TRN – Transportation	33.9	4.0
WAT – Water	0.0	0.0
WDS – Woods	664.3	78.6
Total Area	845.0	100.0
Impervious Area	86.1	10.2
Area served by BMPs	67.3	8.0

SM4 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1944	591	234	200	23.4	99.7	7.20E+12

*Fecal coliform bacteria reported in org/year

SM4 - TR-20 Results

	Peak flows (cfs)
2-yr	345
100-yr	2973

Streams

SM4 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.0	1.4	0.06	<0.01	0.007	<0.005	43	3

*Fecal coliform bacteria reported in org/100ml

SM4 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	25568	2297	2855	2615	163	0	0	2992	0	36490
Miles	4.84	0.44	0.54	0.50	0.03	0.00	0.00	0.57	0.00	6.91
Percent of Total	70	6	8	7	0	0	0	8	0	

SM4 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	22,301	4.22	87.2
Fair (MPHI)	822	0.16	3.2
Poor (MPHI)	2,445	0.46	9.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	22,301	4.22	87.2
Fair (FHS)	0	0.00	0.0
Poor (FHS)	3,267	0.62	12.8
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	30,445	5.77	83.0
Total Stream Length with Habitat Assessment	25,568	4.84	Na

SM4 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	22,301	0	0	2,370	0	891	25,562
Miles	0.00	0.00	4.22	0.00	0.00	0.45	0.00	0.17	4.84
Percent of Total	0	0	87	0	0	9	0	3	

Summary

The percent of Good stream miles remained the same, 87.2%, with the consideration of the infrastructure scores. Although present, there were not many infrastructure points that would indicate degrading stream characteristics. Overall, the aquatic habitat in the mainstem consisted of deep pools, with old logs and fallen trees providing cover, while the tributaries consisted mainly of small streams with low flow.

Overall, Severn Run Mainstem 4 received a stream length weighted MPHI of 91.08 and is classified as Good. The overall stream length weighted FHS, which accounts for infrastructure, was 77.55, also Good. Overall, Severn Run Mainstem 4 has over 85% of its streams in the Good range.

Severn Run Tributary 1 (ST1)

Subwatershed Description

Severn Run Tributary 1 is located in the northwest portion of the watershed and drains 306.4 acres in an easterly direction to a confluence with Severn Run. Land use in the subwatershed is dominated by forest, making up 44.4% of the total, and occurring in the middle and downstream portions of the watershed. Commercial areas are situated along the fringe of the headwaters. Almost 10% of the subwatershed consists of impervious area and 78% of the stream has a forested buffer.

During site visits, the majority of the channels were dry. Consequently, 80% of the 1.82 miles are ephemeral while only 11% are perennial. The most downstream reaches are essentially characterized by agricultural ditches that were dry during site visits. Only 0.2 miles of the channels were classifiable. They are moderately entrenched with high width depth ratios and are classified as B type channels.

Subwatershed Characteristics

ST1 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	23.7	7.7
IND – Industrial	0.0	0.0
OPS – Open space	52.8	17.2
R11 – Residential 1 Acre lots	42.1	13.7
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	11.6	3.8
R18 – Residential 1/8 acre lots	1.6	0.5
R21 – Residential 2 acre lots	17.1	5.6
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	21.5	7.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	136.0	44.4
Total Area	306.4	100.0
Impervious Area	29.5	9.6
Area served by BMPs	48.5	15.8

ST1 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	744	254	99	47	6	7.3	2.32E+12

*Fecal coliform bacteria reported in org/year

ST1 - TR-20 Results

	Peak flows (cfs)
2-yr	221
100-yr	1443

Streams

ST1 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.58	0.58	0.07	<0.01	0.005	<0.005	30	17

*Fecal coliform bacteria reported in org/100ml

ST1 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	1053	0	7694	685	0	0	0	190	0	9622
Miles	0.20	0.00	1.46	0.13	0.00	0.00	0.00	0.04	0.00	1.82
Percent of Total	11	0	80	7	0	0	0	2	0	

ST1 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	1,053	0.20	100.0
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	1,053	0.20	100.0
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	7,505	1.42	78.0
Total Stream Length with Habitat Assessment	1,053	0.20	na

ST1 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	1,053	0	0	0	0	0	0	1,053
Miles	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Percent of Total	0	100	0	0	0	0	0	0	

Summary

Severn Run Tributary 1 received an overall stream length weighted MPHI score of 45.80 and an FHS of 44.80 for assessable streams. The stream system is in the Fair category for its entire length. Much of the ephemeral reaches that did not receive a habitat assessment score, were entrenched and showed signs of excessive bank erosion. These were especially prevalent in the stream reach that parallels Disney Road.

Severn Run Tributary 2 (ST2)

Subwatershed Description

Severn Run Tributary 2 is located in the northwestern portion of the watershed and drains 702.5 acres in an easterly direction to a confluence with Severn Run. Land use is dominated by 45.9% high-density residential land use and 33.1% forest. The forestland is primarily along the stream corridor and buffers 62 percent of the 2.65 miles of stream. Commercial property exists at the western fringe of the subwatershed along MD 175.

Perennial streams make up 58% of the subwatershed. Ephemeral channels are prevalent in the headwaters and beaver created wetlands intersperse the perennial segments. Many of the wetland areas, especially in the downstream reaches, appear to be of good quality and provide wildlife habitat. Channel classification resulted in 86% E type channels, stable, high entrenchment ratios and good access to the floodplain. Fourteen percent of the channels are F type channels, entrenched, meandering, and a high width to depth ratio.

The area served by BMPs is calculated as 122.2%. This is due to areas in the subwatershed being treated by more than one BMP. This value is artificially high.

Subwatershed Characteristics

ST2 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	38.8	5.5
IND – Industrial	0.0	0.0
OPS – Open space	61.8	8.8
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	5.1	0.7
R18 – Residential 1/8 acre lots	322.3	45.9
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	38.7	5.5
WAT – Water	3.3	0.5
WDS – Woods	232.4	33.1
Total Area	702.5	100.0
Impervious Area	176.5	25.1
Area served by BMPs	858.5	122.2

ST2 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3658	1145	379	214	36.4	119.2	1.38E+13

*Fecal coliform bacteria reported in org/year

ST2 - TR-20 Results

	Peak flows (cfs)
2-yr	272
100-yr	2326

Streams

ST2 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.5	0.0	0.05	<0.01	0.005	<0.01	<3	43

*Fecal coliform bacteria reported in org/100ml

ST2 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8125	0	2392	751	920	0	0	1817	0	14005
Miles	1.54	0.00	0.45	0.14	0.17	0.00	0.00	0.34	0.00	2.65
Percent of Total	58	0	17	5	7	0	0	13	0	

ST2 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	880	0.17	13.8
Fair (MPHI)	958	0.18	15.0
Poor (MPHI)	3,400	0.64	53.3
Very Poor (MPHI)	1,145	0.22	17.9
Good (FHS)	880	0.17	13.8
Fair (FHS)	958	0.18	15.0
Poor (FHS)	2,327	0.44	36.5
Very Poor (FHS)	2,218	0.42	34.7
Forested Stream Length	8,706	1.65	62.0
Total Stream Length with Habitat Assessment	6,383	1.21	na

ST2 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	5,515	867	0	6,382
Miles	0.00	0.00	0.00	0.00	0.00	1.04	0.16	0.00	1.21
Percent of Total	0	0	0	0	0	86	14	0	

Summary

Severn Run Tributary 2 received an overall stream length weighted MPHI score of 31.76 and an FHS of 29.14, Poor ratings. Many of the stream reaches appear to be stormwater driven channels. Excessive sediment and degraded conditions were often present immediately downstream of stormwater outfalls. Ephemeral channels that were over widened and unstable dominated the headwater portions. Much of the stream system is fragmented by blockages such as beaver dams, man-made weir structures and road crossings. Dry weather sampling for the subwatershed resulted in detectable quantities for nitrate, TKN and TP.

Severn Run Tributary 3 (ST3)

Subwatershed Description

Severn Run Tributary 3 is located in the northwestern portion of the watershed, near the headwaters. The topography of the subwatershed consists of a moderately wide floodplain in the southern portion of the subwatershed, with steep slopes adjacent to the floodplain. The floodplain expands as the topography flattens out in the northern portion of the subwatershed toward the headwaters. High-density residential dominates the landscape east of the mainstem of Severn Run Tributary 3, comprising 24% of the total land use, while forests dominate the western portion of the subwatershed, totaling 34% of the total land use. There is 17.0% impervious area in the subwatershed. Seventy-two percent of the 3.6 stream miles, 72% are perennial and 91% is forested. Wetlands comprise 12% of stream miles located mostly in the northern half of the subwatershed. The perennial streams were mostly categorized as C type, slightly entrenched, and E type, low gradient.

Subwatershed Characteristics

ST3 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	24.7	1.6
IND – Industrial	65.2	4.2
OPS – Open space	60.5	3.9
R11 – Residential 1 Acre lots	59.9	3.8
R12 – Residential ½ acre lots	105.1	6.7
R14 – Residential ¼ acre lots	230.1	14.7
R18 – Residential 1/8 acre lots	375.1	24.0
R21 – Residential 2 acre lots	22.3	1.4
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	88.8	5.7
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	530.5	34.0
Total Area	1562.2	100.0
Impervious Area	266.3	17.0
Area served by BMPs	369.6	23.7

ST3 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	6320	2061	731	291	53.5	42.1	2.61E+13

*Fecal coliform bacteria reported in org/year

ST3 - TR-20 Results

	Peak flows (cfs)
2-yr	269
100-yr	3894

Streams

ST3 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.3	1.8	0.09	0.04	<0.005	<0.005	<2	3

*Fecal coliform bacteria reported in org/100ml

ST3 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	12820	0	0	2425	0	379	0	2095	0	17719
Miles	2.43	0.00	0.00	0.46	0.00	0.07	0.00	0.40	0.00	3.36
Percent of Total	72	0	0	14	0	2	0	12	0	

ST3 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	7,239	1.37	56.5
Fair (MPHI)	3,205	0.61	25.0
Poor (MPHI)	2,379	0.45	18.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	4,761	0.90	37.1
Fair (FHS)	5,683	1.08	44.3
Poor (FHS)	2,379	0.45	18.6
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	16,142	3.06	91.0
Total Stream Length with Habitat Assessment	12,823	2.43	na

ST3 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	5,608	0	0	6,472	0	691	12,771
Miles	0.00	0.00	1.06	0.00	0.00	1.23	0.00	0.13	2.42
Percent of Total	0	0	44	0	0	51	0	5	

Summary

The percent of good streams in Severn Tributary 3 dropped from 56.5% to 37.1% with the addition of the infrastructure scores. This is mostly due to the number of crossings present and extensive pipe and ditch systems connected to the streams. The overall stream length weighted MPHI score is 66.03, Fair classification. When considering the infrastructure, the overall FHS dropped to 19.81, Poor classification. Dry samples collected at Severn Tributary 3 had detectable quantities of nitrate, TKN, and TP present.

Severn Run Tributary 4 (ST4)

Subwatershed Description

The Severn Run Tributary 4 subwatershed is located in the northwestern portion of the watershed. The topography consists of a moderately wide floodplain with steep slopes adjacent to the floodplain throughout most of the subwatershed. Forestland is the dominant land use in the subwatershed and covers 88% of the total stream length. Low- and medium-density residential development is concentrated around the headwaters. Perennial streams make up 94% of the 2.93 stream miles in the Sever Run Tributary 4 subwatershed, and are generally characterized as G type and E type streams. The G type streams are located along the lower portion of the main stem, characterized as entrenched with generally unstable banks. The E type streams are located throughout the middle and upper portions of the subwatershed, characterized as low gradient and stable streams. The mainstem of the Severn Run Tributary 4 is located within the Severn Run Natural Environmental Area.

Subwatershed Characteristics

ST4 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	9.5	1.5
IND – Industrial	0.0	0.0
OPS – Open space	8.5	1.3
R11 – Residential 1 Acre lots	85.1	13.1
R12 – Residential ½ acre lots	52.3	8.0
R14 – Residential ¼ acre lots	29.1	4.5
R18 – Residential 1/8 acre lots	26.8	4.1
R21 – Residential 2 acre lots	49.8	7.7
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	27.3	4.2
TRN – Transportation	0.0	0.0
WAT – Water	1.5	0.2
WDS – Woods	360.1	55.4
Total Area	649.9	100.0
Impervious Area	45.7	7.0
Area served by BMPs	176.5	27.1

ST4 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1477	514	179	78	11.6	12.1	5.25E+12

*Fecal coliform bacteria reported in org/year

ST4 - TR-20 Results

	Peak flows (cfs)
2-yr	438
100-yr	6539

Streams

ST4 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.74	0.32	0.09	0.07	<0.005	<0.005	500	24

*Fecal coliform bacteria reported in org/100ml

ST4 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	14543	0	0	0	0	0	0	945	0	15488
Miles	2.75	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	2.93
Percent of Total	94	0	0	0	0	0	0	6	0	

ST4 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	2,792	0.53	19.5
Fair (MPHI)	2,332	0.44	16.2
Poor (MPHI)	5,053	0.96	35.2
Very Poor (MPHI)	4,176	0.79	29.1
Good (FHS)	2,792	0.53	19.5
Fair (FHS)	2,332	0.44	16.2
Poor (FHS)	1,065	0.20	7.4
Very Poor (FHS)	8,164	1.55	56.9
Forested Stream Length	13,587	2.57	88.0
Total Stream Length with Habitat Assessment	14,353	2.72	na

ST4 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	837	0	0	6,297	604	6,612	14,350
Miles	0.00	0.00	0.16	0.00	0.00	1.19	0.11	1.25	2.72
Percent of Total	0	0	7	0	0	53	5	56	

Summary

When considering infrastructure the percent of Good and Fair habitat reaches remained stable. Severn Run Tributary 4 received an overall stream length weighted MPHI score of 40.31 and is classified as Poor. The overall stream length weighted FHS, which considers the impact infrastructure was 31.39, also Poor. Overall, the habitat quality within Severn Run Tributary 4 is less than desirable, mostly due to low stream flow, eroding bank conditions, and fine particles lining the channel bed. During dry samples, nitrate, TKN, and TP were found in detectable amounts, and Fecal Coliform exceeded the COMAR limit of 400 org/100mL.

Severn Run Tributary 5 (ST5)

Subwatershed Description

The Severn Run Tributary 5 subwatershed is located in the northwestern portion of the watershed. The general topography of ST5 consists of a moderate to wide floodplain along the main stem and steep slopes present along most of the tributaries. The land use in Severn Run Tributary 5 consists mainly of medium-density residential and forestland. Buffers exist along 82% of the linear stream miles in the subwatershed. Fifty-nine percent of the stream miles are perennial, while 31% are comprised of ephemeral channels and ditches. The dominant stream classifications are C type (50%) and E type (39%). C type streams are generally characterized as slightly entrenched, sinuous, and having an active floodplain, and E type streams are generally described as low gradient, stable, with and active floodplain. Impervious area comprises 14.3% of the subwatershed area.

Subwatershed Characteristics

ST5 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	85.7	4.9
IND – Industrial	8.2	0.5
OPS – Open space	109.9	6.3
R11 – Residential 1 Acre lots	70.0	4.0
R12 – Residential ½ acre lots	144.6	8.3
R14 – Residential ¼ acre lots	404.1	23.1
R18 – Residential 1/8 acre lots	128.5	7.4
R21 – Residential 2 acre lots	48.1	2.8
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	189.3	10.8
TRN – Transportation	12.9	0.7
WAT – Water	3.9	0.2
WDS – Woods	541.4	31.0
Total Area	1746.7	100.0
Impervious Area	248.9	14.3
Area served by BMPs	296.3	17.0

ST5 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	6311	2079	801	317	54.1	75.8	2.23E+13

*Fecal coliform bacteria reported in org/year

ST5 - TR-20 Results

	Peak flows (cfs)
2-yr	399
100-yr	4378

Streams

ST5 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	9.9	9.9	<0.01	0.06	<0.005	<0.005	23	4

*Fecal coliform bacteria reported in org/100ml

ST5 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	16515	0	3958	4860	205	0	0	1016	1674	28228
Miles	3.13	0.00	0.75	0.92	0.04	0.00	0.00	0.19	0.32	5.35
Percent of Total	59	0	14	17	1	0	0	4	6	

ST5 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	8,196	1.55	49.6
Fair (MPHI)	1,155	0.22	7.0
Poor (MPHI)	6,282	1.19	38.0
Very Poor (MPHI)	833	0.17	5.3
Good (FHS)	4,937	0.94	29.9
Fair (FHS)	3,259	0.62	19.7
Poor (FHS)	5,557	1.05	33.6
Very Poor (FHS)	2,763	0.52	16.7
Forested Stream Length	23,125	4.38	82.0
Total Stream Length with Habitat Assessment	16,516	3.13	na

ST5 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	8,790	0	0	6,718	0	1,911	17,419
Miles	0.00	0.00	1.66	0.00	0.00	1.27	0.00	0.36	3.30
Percent of Total	0	0	50	0	0	39	0	11	

Summary

The percent of Good stream miles in Severn Run Tributary 5 dropped from 49.6% to 29.9% when considering infrastructure. This is due in large part to the number of obstructions in the stream and erosion along the banks. The overall stream length weighted MPHI score is 57.65 and is classified as Fair. The overall stream length weighted FHS, which reflects the impact due to infrastructure, is 46.71 and is also Fair.

Severn Run Tributary 6 (ST6)

Subwatershed Description

The Severn Run Tributary 6 subwatershed drains 343.5 acres in the northwestern portion of the watershed. The topography is characterized by wide floodplains in the downstream portions, decreasing in width and increasing in gradient upstream towards the headwaters. The valley slopes rise steeply from the floodplain region and flatten out in the outer portions of the subwatershed. The most dominant land use within the subwatershed is forest, covering 52.1% of the area and including part of the Severn Run Natural Environment Area. The forested areas provide a 92% forested stream corridor. The Millersville Landfill is located within the Severn Run Tributary 6 subwatershed and accounts for the 20.5% commercial land use. Medium-density residential occupies 15.3% of the land use mostly along the southern fringe of the subwatershed. Impervious areas comprise of 19.8% of the subwatershed.

The composition of stream miles within Severn Run Tributary 6 consists of 97% perennial and 3% ephemeral. Of the 1.45 miles of perennial stream, 91% are classified as entrenched and unstable G type channels. The remaining 9% of the channel length is split between low gradient, highly sinuous and stable E type channels, and moderately entrenched, moderate gradient B type channels.

Subwatershed Characteristics

ST6 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	70.6	20.5
IND – Industrial	0.0	0.0
OPS – Open space	27.0	7.9
R11 – Residential 1 Acre lots	6.0	1.8
R12 – Residential ½ acre lots	46.4	13.5
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	1.5	0.4
RWD – Residential woods	6.5	1.9
SRC – Single Row Crops	0.8	0.2
TRN – Transportation	0.0	0.0
WAT – Water	5.7	1.7
WDS – Woods	179.1	52.1
Total Area	343.5	100.0
Impervious Area	68.1	19.8
Area served by BMPs	114.1	33.2

ST6 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1353	434	159	81	10.8	14.2	4.14E+12

*Fecal coliform bacteria reported in org/year

ST6 - TR-20 Results

	Peak flows (cfs)
2-yr	263
100-yr	1037

Streams

ST6 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.0	1.0	<0.01	0.02	<0.005	<0.005	<3	6

*Fecal coliform bacteria reported in org/100ml

ST6 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	7667	0	235	0	0	0	0	0	0	7902
Miles	1.45	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	1.50
Percent of Total	97	0	3	0	0	0	0	0	0	

ST6 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	3,630	0.69	47.3
Fair (MPHI)	1,296	0.25	16.9
Poor (MPHI)	2,742	0.52	35.8
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	3,630	0.69	47.3
Fair (FHS)	1,296	0.25	16.9
Poor (FHS)	1,777	0.34	23.2
Very Poor (FHS)	965	0.18	12.6
Forested Stream Length	7,243	1.37	92.0
Total Stream Length with Habitat Assessment	7,668	1.45	Na

ST6 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	408	0	0	0	313	0	6,946	7,667
Miles	0.00	0.08	0.00	0.00	0.00	0.06	0.00	1.32	1.45
Percent of Total	0	5	0	0	0	4	0	91	

Summary

The percent of Fair and Good stream miles remained stable while 12.6 of the stream miles dropped from the Poor category to the Very Poor category with the addition of the infrastructure impacts. This degraded section with many infrastructure impacts is located in the western headwaters of the main channel. The infrastructure impacts consist of minor obstruction points, as well as moderate to severe erosion and dump sites, including a severe dump site which is blocking the channel and causing severe bank erosion.

Severn Run Tributary 6 received an overall stream length weighted MPHI score of 54.50 and is classified as Fair. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system, fell to 50.44, also classified as Fair.

Severn Run Tributary 7 (ST7)

Subwatershed Description

The Severn Run Tributary 7 subwatershed drains 865.6 acres in the northwestern portion of the Severn River watershed. The most highly represented land use is forest, which covers 43.4% of the subwatershed. The forested areas provide a 94.0% forested stream corridor. The remainder of the land use is best characterized by residential land uses, including medium and high-density development, and commercial land, including the Millersville Landfill. Perennial streams account for 93% of the 2.92 miles of stream in the subwatershed. Of the 2.80 miles of classifiable channels within the subwatershed, 64% are classified as unstable and entrenched G type channels, and 36% are low gradient, stable, E type channels.

Subwatershed Characteristics

ST7 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	201.9	23.3
IND – Industrial	12.8	1.5
OPS – Open space	18.2	2.1
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	131.0	15.1
R14 – Residential ¼ acre lots	85.9	9.9
R18 – Residential 1/8 acre lots	11.5	1.3
R21 – Residential 2 acre lots	15.3	1.8
RWD – Residential woods	11.8	1.4
SRC – Single Row Crops	0.4	0.0
TRN – Transportation	0.0	0.0
WAT – Water	1.4	0.2
WDS – Woods	375.5	43.4
Total Area	865.6	100.0
Impervious Area	223.8	25.9
Area served by BMPs	74.7	8.6

ST7 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	4678	1576	590	293	39.9	41.3	1.43E+13

*Fecal coliform bacteria reported in org/year

ST7 - TR-20 Results

	Peak flows (cfs)
2-yr	1002
100-yr	5609

Streams

ST7 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.3	2.3	<0.01	0.01	<0.005	<0.005	43	5

*Fecal coliform bacteria reported in org/100ml

ST7 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	14379	534	410	115	0	0	0	0	0	15438
Miles	2.72	0.10	0.08	0.02	0.00	0.00	0.00	0.00	0.00	2.92
Percent of Total	93	3	3	1	0	0	0	0	0	

ST7 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	8,801	1.67	61.2
Fair (MPHI)	3,801	0.72	26.4
Poor (MPHI)	1,480	0.28	10.3
Very Poor (MPHI)	296	0.06	2.1
Good (FHS)	7,664	1.45	53.3
Fair (FHS)	4,938	0.94	34.3
Poor (FHS)	1,222	0.23	8.5
Very Poor (FHS)	554	0.10	3.9
Forested Stream Length	14,473.0	2.74	94.0
Total Stream Length with Habitat Assessment	14,378	2.72	na

ST7 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	5,295	0	9,495	14,790
Miles	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.80	2.80
Percent of Total	0	0	0	0	0	36	0	64	

Summary

The stream miles in the Good category dropped from 61.2% to 53.3% with the addition of the infrastructure scores. Infrastructure points for bank erosion, channel obstructions, ditches and pipes were common in the downstream portions of the subwatershed.

Severn Run Tributary 7 received an overall stream length weighted MPHI score of 68.30 and an FHS of 64.84, both in the Fair range.

Severn Run Tributary 8 (ST8)

Subwatershed Description

Severn Run Tributary 8 is located in the northeastern portion of the Severn River watershed. ST8 drains 373.6 acres in a southwesterly direction to its confluence with Severn Run Mainstem 4. Forest is the dominant land use, covering 49.2% of the total area within the subwatershed and providing 84% of the stream length with a forested buffer. A mix of uses including 19.2% residential, 10.2% commercial, and 7.8% transportation represents the remainder of the land use. These uses combine to provide a 21.3% impervious surface value for the subwatershed. The topography is characterized by very wide, well developed floodplain regions with fairly steep slopes beginning at the edge of floodplain and flattening out toward the subwatershed boundary. The 0.73 mile stream system is made up of 50% perennial, 46% ephemeral, and 4% wetland. The channel classifications revealed 43 % highly sinuous and stable E type channels, 32% entrenched and moderately sinuous F type channels, and 25% slightly entrenched and highly sinuous C type channels.

Subwatershed Characteristics

ST8 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	38.2	10.2
IND – Industrial	16.8	4.5
OPS – Open space	6.8	1.8
R11 – Residential 1 Acre lots	9.5	2.5
R12 – Residential ½ acre lots	45.9	12.3
R14 – Residential ¼ acre lots	6.6	1.8
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	9.5	2.6
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	23.7	6.4
TRN – Transportation	29.1	7.8
WAT – Water	3.5	0.9
WDS – Woods	183.8	49.2
Total Area	373.6	100.0
Impervious Area	79.6	21.3
Area served by BMPs	121.1	32.4

ST8 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1567	491	199	128	18.7	82.9	5.42E+12

*Fecal coliform bacteria reported in org/year

ST8 - TR-20 Results

	Peak flows (cfs)
2-yr	375
100-yr	2446

Streams

ST8 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.93	0.93	<0.01	0.02	<0.005	<0.005	4	8

*Fecal coliform bacteria reported in org/100ml

ST8 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	1938	0	1769	0	0	0	0	151	0	3858
Miles	0.37	0.00	0.34	0.00	0.00	0.00	0.00	0.03	0.00	0.73
Percent of Total	50	0	46	0	0	0	0	4	0	

ST8 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.00
Fair (MPHI)	0	0.00	0.00
Poor (MPHI)	1,938	0.37	100.0
Very Poor (MPHI)	0	0.00	0.00
Good (FHS)	0	0.00	0.00
Fair (FHS)	0	0.00	0.00
Poor (FHS)	1,938	0.37	100.0
Very Poor (FHS)	0	0.00	0.00
Forested Stream Length	3,236	0.61	84.0
Total Stream Length with Habitat Assessment	1,938	0.37	na

ST8 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	740	0	0	1,251	947	0	2,938
Miles	0.00	0.00	0.14	0.00	0.00	0.24	0.18	0.00	0.56
Percent of Total	0	0	25	0	0	43	32	0	

Summary

Severn Run Tributary 8 is classified as Poor for its entire length. Degraded conditions exist throughout the entire system and are likely a result of the high quantities of stormflow directed through the system. Overall, the aquatic habitat is lacking due to the low flow conditions, which have led to stagnant shallow pools and large amounts of bacteria and algae.

The subwatershed received a weighted MPHI score of 18.33, classified as poor. The overall stream length weighted FHS, which accounts for infrastructure on the stream system, is 16.63, also Poor.

Severn Run Tributary 9 (ST9)

Subwatershed Description

Severn Run Tributary 9 is located in the northwest portion of the watershed and drains 344.1 acres in an easterly direction to a confluence with Severn Run. Land use in the subwatershed is characterized by commercial development along MD 175 and forestland along most of the stream corridor. Commercial use comprises 16.7%, while forestland is 61.9% of the subwatershed and buffers 86% of the stream miles. Ephemeral channels make up much of the stream system for Severn Run Tributary 9, accounting for 60% of the total. A major portion of the mainstem, totaling 2072 feet, is ephemeral and characterized by an entrenched G type channel with actively eroding banks and heavy sediment loads. Smaller channels in the headwaters were more stable with dense understory shrub growth.

Subwatershed Characteristics

ST9 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	57.6	16.7
IND – Industrial	0.0	0.0
OPS – Open space	27.3	7.9
R11 – Residential 1 Acre lots	5.8	1.7
R12 – Residential ½ acre lots	11.5	3.3
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	8.3	2.4
R21 – Residential 2 acre lots	1.1	0.3
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	18.2	5.3
TRN – Transportation	0.0	0.0
WAT – Water	1.1	0.3
WDS – Woods	213.1	61.9
Total Area	344.1	100.0
Impervious Area	54.3	15.8
Area served by BMPs	0.0	0.0

ST9 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1194	415	162	87	9.9	12	3.15E+12

*Fecal coliform bacteria reported in org/year

ST9 - TR-20 Results

	Peak flows (cfs)
2-yr	489
100-yr	2445

Streams

ST9 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	6.49	0.09	0.88	0.06	0.023	<0.005	>=2400	42

*Fecal coliform bacteria reported in org/100ml

ST9 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2753	796	5284	0	0	0	0	0	0	8833
Miles	0.52	0.15	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67
Percent of Total	31	9	60	0	0	0	0	0	0	

ST9 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	616	0.12	22.4
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	2,137	0.40	77.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	616	0.12	22.4
Fair (FHS)	0	0.00	0.0
Poor (FHS)	2,137	0.40	77.6
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	7,755	1.47	86.0
Total Stream Length with Habitat Assessment	2,753	0.52	na

ST9 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	783	0	0	0	0	1,196	3,463	5,442
Miles	0.00	0.15	0.00	0.00	0.00	0.00	0.23	0.66	1.03
Percent of Total	0	14	0	0	0	0	22	64	

Summary

Much of the stream habitat in Severn Run Tributary 9 is in small headwater streams with relatively stagnant conditions. Few reaches have riffle run sequences with appreciable depths, however, where they did occur habitat was rated Good. Nitrate, TKN and TP were found at detectable levels in the subwatershed. Fecal coliform bacteria was relatively high with >2,400 org/100ml found in the dry weather sample. Stagnant conditions both in the upstream reaches and at the most downstream portion of the stream system are likely a major contributor to detection of elevated pollutant levels.

Severn Run Tributary 9 received an overall stream length weighted MPHI score of 32.84 and an FHS of 31.84, both in the Poor range. Twenty-two percent of the stream miles were in the Good range and 77.6% were in the Poor range. There was very little infrastructure impact in the subwatershed.

Picture Spring Branch (PSB)

Subwatershed Description

Picture Spring Branch is a 1,566.7 acre drainage area bordered by Rte 32 on its northern edge. Woods make up 24.4% of the land use and forested buffers are present on 42% of the stream, primarily located in the downstream and northwestern portions of the subwatershed. Commercial use (10.4%) is located along Rte 175 and Rte 170 while industrial areas (13.5%) surround stream reaches in the middle of the watershed. Residential use (34.5%) is interspersed throughout the area. The imperviousness in Picture Spring Branch is high, at 32.8%, however the area served by BMPs is nearly equal at 32.6%.

Sixty-two percent of the stream miles in Picture Spring Branch are perennial, while 16% are ditch. Small amounts of wetland, floodway, SWM and intermittent channel make up the remainder. The mainstem is classified as entrenched G type for most of its length and for the most southeastern branches for a total of 47%. C type channels with greater floodplain connectivity make up 21% and are present in open space areas downstream of Rte 175.

Subwatershed Characteristics

PSB - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	163.6	10.4
IND – Industrial	212.1	13.5
OPS – Open space	125.8	8.0
R11 – Residential 1 Acre lots	31.6	2.0
R12 – Residential ½ acre lots	96.9	6.2
R14 – Residential ¼ acre lots	245.3	15.7
R18 – Residential 1/8 acre lots	151.6	9.7
R21 – Residential 2 acre lots	2.1	0.1
RWD – Residential woods	13.3	0.8
SRC – Single Row Crops	19.1	1.2
TRN – Transportation	120.5	7.7
WAT – Water	2.0	0.1
WDS – Woods	382.9	24.4
Total Area	1566.7	100.0
Impervious Area	513.7	32.8
Area served by BMPs	511.2	32.6

PSB - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL (Non-point Source)	9498	2893	1081	681	104.5	359.1	3.91E+13
TOTAL (Point Source)					58446.72		

*Fecal coliform bacteria reported in org/year

PSB - TR-20 Results

	Peak flows (cfs)
2-yr	1962
100-yr	9415

Streams

PSB - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.5	1.1	0.53	<0.01	0.008	<0.005	23	2

*Fecal coliform bacteria reported in org/100ml

PSB - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	23640	194	3147	6177	603	0	0	2779	1545	38085
Miles	4.48	0.04	0.60	1.17	0.11	0.00	0.00	0.53	0.29	7.21
Percent of Total	62	1	8	16	2	0	0	7	4	

PSB - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	6,237	1.18	34.6
Fair (MPHI)	3,346	0.63	18.6
Poor (MPHI)	12,446	2.36	69.1
Very Poor (MPHI)	1,614	0.31	9.0
Good (FHS)	6,237	1.18	34.6
Fair (FHS)	3,346	0.63	18.6
Poor (FHS)	8,963	1.70	49.8
Very Poor (FHS)	5,097	0.97	28.3
Forested Stream Length	16,129	3.05	42.0
Total Stream Length with Habitat Assessment	18,005	3.41	na

PSB - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	5,391	0	0	8,157	467	12,262	26,277
Miles	0.00	0.00	1.02	0.00	0.00	1.54	0.09	2.32	4.98
Percent of Total	0	0	21	0	0	31	2	47	

Summary

Picture Spring Branch received an overall stream length weighted MPHI score of 61.36 and an FHS of 53.67, both in the Fair range. Of the 3.41 miles of stream with habitat assessments conducted, 34.6% are Good, 69.1% are Poor and 9.0% are Very Poor the for MPHI. As the infrastructure scores are incorporated the percent Good remains constant but the percent Very Poor increases to 28.3 percent, indicating a substantial effect from infrastructure on the habitat.

Much of the downstream mainstem habitat in Picture Spring Branch is characterized by good velocity and depth diversity, riffle/pool sequences and good cover in pools and undercut banks. However in the upstream portions of the subwatershed, especially in the southeastern reaches, headcuts, entrenched channels and poor habitat quality are present. Heavy bank and bed erosion has exposed numerous utilities and is delivering heavy sediment loads to downstream reaches, reducing the habitat quality. A large headcut with a heavily incised channel exists adjacent to Rte 175. The channel invert is approximately 15 feet below road level.

A large beaver created wetland occurs immediately upstream of Rte 32. Further upstream a Nevamar Corporation pond outfall is delivering substantial discharge to the mainstem

Jabez Branch 1 (JZ1)

Subwatershed Description

Jabez Branch 1 is an 839.1acre drainage area bordered by Rte 32 on its northeastern edge. Woods make up 47.7% of the land use and large contiguous tracts are located in the downstream portions of the subwatershed. Forested buffers are found on 90% of the 2.62 total miles of stream. Medium-density residential and agriculture combine to make up 31.6% of the land use. Developed portions of the subwatershed are located along the Rte 175 corridor in the upstream and southwestern half of the subwatershed.

Fifty-five percent of the stream miles in Jabez Branch 1 are perennial, while 37% are ephemeral. Small amounts of ditch and floodway make up the remainder. Narrow, relatively steep stream valleys with highly sinuous channels characterize the topography in the subwatershed. Stable F type channels dominate the system (69%) and occur along the downstream mainstem and the southern branch. Upstream reaches are narrower, more entrenched and are classified as G type channels (31%).

Subwatershed Characteristics

JZ1 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	21.4	2.6
IND – Industrial	10.1	1.2
OPS – Open space	16.3	1.9
R11 – Residential 1 Acre lots	137.5	16.4
R12 – Residential ½ acre lots	42.2	5.0
R14 – Residential ¼ acre lots	77.3	9.2
R18 – Residential 1/8 acre lots	17.3	2.1
R21 – Residential 2 acre lots	4.9	0.6
RWD – Residential woods	10.0	1.2
SRC – Single Row Crops	85.5	10.2
TRN – Transportation	16.2	1.9
WAT – Water	0.0	0.0
WDS – Woods	400.7	47.7
Total Area	839.5	100.0
Impervious Area	83.1	9.9
Area served by BMPs	23.6	2.8

JZ1 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	2318	768	316	146	22	56	7.81×10^{12}

*Fecal coliform bacteria reported in org/year

JZ1 - TR-20 Results

	Peak flows (cfs)
2-yr	859
100-yr	4077

Streams

JZ1 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.6	1.4	0.12	0.02	<0.005	<0.005	30	3

*Fecal coliform bacteria reported in org/100ml

JZ1 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	7654	0	5116	858	0	0	0	0	208	13836
Miles	1.45	0.00	0.97	0.16	0.00	0.00	0.00	0.00	0.04	2.62
Percent of Total	55	0	37	6	0	0	0	0	2	

JZ1 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	7,009	1.33	91.6
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	645	0.12	8.4
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	7,009	1.33	91.6
Fair (FHS)	0	0.00	0.0
Poor (FHS)	645	0.12	8.4
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	12,404	2.35	90.0
Total Stream Length with Habitat Assessment	7,654	1.45	na

JZ1 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	0	5,782	2,608	8,390
Miles	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.49	1.59
Percent of Total	0	0	0	0	0	0	69	31	

Summary

Jabez Branch 1 received an overall stream length weighted MPHI score of 84.02 and an FHS of 78.33, both in the Good range. Of the 1.45 miles of stream with habitat assessments conducted, 91.6% are in the Good range and 8.4% are in the Poor range for both MPHI and FHS. There is very little infrastructure impact in the subwatershed.

Much of the stream habitat in Jabez Branch 1 is characterized by good velocity and depth diversity, riffle/pool sequences and good cover in pools and undercut banks. The nearly complete forested buffer is providing excellent shading and bank stability. The midstream perennial and upstream ephemeral portions of the system are characterized by channels with unstable banks, high gradient and high sediment loads.

Jabez Branch 2 (JZ2)

Subwatershed Description

Jabez Branch 2 is a 1,179.8 acre drainage area separated from Jabez Branch 1 by Rte 32 on its southwestern edge. The mainstem of Jabez Branch 2 begins at the confluence of Jabez Branches 1 and 4 at a culvert under Rte 32. Jabez Branch 3 flows into Jabez Branch 2 near the confluence with Severn Run. Woods make up 43.5% of the land use and contiguous forest tracts are located on 96% of the stream miles. Residential woods and low-density two acre lots make up make up 28.3% of the subwatershed while commercial, medium and high-density residential areas combine to make up only 10% of the land use. Developed portions of the subwatershed are interspersed between the main tributaries and along the northern border of the subwatershed.

Eighty-three percent of the stream miles in Jabez Branch 2 are perennial, while 9% are ephemeral. Small amounts of ditch, wetland and intermittent channel make up the remainder. The mainstem is classified as a B type channel for 1.37 miles. The mainstem is moderately entrenched, with a moderate to low gradient slope and a riffle/pool dominated channel. The upstream portions are characterized by narrow, steep valleys and high gradient, highly sinuous G type (54%) channels. The downstream portions of the tributaries are in the mainstem floodplain and are E type (19%) channels. A large beaver created wetland exists just downstream of Rte 32 and appears to provide excellent wildlife habitat.

Subwatershed Characteristics

JZ2 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	15.5	1.3
IND – Industrial	8.7	0.7
OPS – Open space	29.7	2.5
R11 – Residential 1 Acre lots	80.4	6.8
R12 – Residential ½ acre lots	15.5	1.3
R14 – Residential ¼ acre lots	9.3	0.8
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	107.7	9.1
RWD – Residential woods	226.0	19.2
SRC – Single Row Crops	100.6	8.5
TRN – Transportation	71.8	6.1
WAT – Water	0.9	0.1
WDS – Woods	513.5	43.5
Total Area	1179.8	100.0
Impervious Area	116.7	9.9
Area served by BMPs	18.1	1.5

JZ2 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3007	983	440	279	37.7	197.5	8.87E+12

*Fecal coliform bacteria reported in org/year

JZ2 - TR-20 Results

	Peak flows (cfs)
2-yr	2865
100-yr	16552

Streams

JZ2 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.0	2.0	<0.01	<0.01	<0.005	<0.005	43	6

*Fecal coliform bacteria reported in org/100ml

JZ2 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	28608	282	3235	695	0	0	0	1636	0	34456
Miles	5.42	0.05	0.61	0.13	0.00	0.00	0.00	0.31	0.00	6.53
Percent of Total	83	1	9	2	0	0	0	5	0	

JZ2 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	21,074	3.99	75.0
Fair (MPHI)	3,025	0.57	10.8
Poor (MPHI)	3,994	0.76	14.2
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	21,074	3.99	75.0
Fair (FHS)	3,025	0.57	10.8
Poor (FHS)	3,994	0.76	14.2
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	32,999	6.25	96.0
Total Stream Length with Habitat Assessment	28,093	5.32	na

JZ2 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	7,220	264	0	0	5,241	0	15,199	27,924
Miles	0.00	1.37	0.05	0.00	0.00	0.99	0.00	2.88	5.29
Percent of Total	0	26	1	0	0	19	0	54	

Summary

Jabez Branch 2 received an overall stream length weighted MPHI score of 80.16 and an FHS of 76.97, both in the Good range. Of the 5.32 miles of stream with habitat assessments conducted, 75.0% were in the Good range, 10.8% in the Fair range and 14.2% were in the Poor range for both MPHI and FHS. There is very little infrastructure impact in the subwatershed.

Stream habitat on the mainstem of Jabez Branch 2 is characterized by good velocity/depth diversity and moderate cover from pools and woody debris. The forested buffer is providing excellent shading and bank stability along the mainstem. The tributaries are very steep and narrow and do not have adequate depth in riffles or pools to provide a variety of cover types.

The corrugated pipe crossing at Farm Road has created a downstream scour pool and is approximately 2.5 feet above the channel invert. This has effectively created a barrier to fish passage between Jabez Branch 2 and Jabez Branches 1 and 4.

Jabez Branch 3 (JZ3)

Subwatershed Description

Jabez Branch 3 is a 782.1 acre drainage area that includes Rte 3, Rte 32 and a large portion of their interchange. These major highways, along with secondary roadways make up 19.9% of the land use, and are the main contributors to the 25.4% imperviousness value. Jabez Branch 3 drains into Jabez Branch 2 before its eventual confluence with Severn Run. Woods make up 25.8% of the land use and forested buffers are present on 61% of the stream miles. Residential areas make up 37.8% of the subwatershed and are most heavily concentrated in the upstream portions of the subwatershed, south of the Rte3/32 interchange.

Forty-seven percent of the stream miles in Jabez Branch 3 are perennial, while the remainder are ephemeral (28%) and ditch (25%). The majority of the mainstem is classified as G type channel for 1.37 miles. The ephemeral channels upstream of Rte 32 are unstable with many headcuts. Areas upstream of Rte 3 are considerably entrenched with unstable banks and appear to deliver heavy sediment loads to downstream reaches. The downstream reaches have a wider floodplain and are made up of a combination of braided systems with associated wetlands and unstable G type reaches.

Subwatershed Characteristics

JZ3 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	39.5	5.0
IND – Industrial	0.0	0.0
OPS – Open space	29.3	3.8
R11 – Residential 1 Acre lots	187.0	23.9
R12 – Residential ½ acre lots	27.2	3.5
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	63.4	8.1
RWD – Residential woods	18.2	2.3
SRC – Single Row Crops	60.2	7.7
TRN – Transportation	155.8	19.9
WAT – Water	0.0	0.0
WDS – Woods	201.5	25.8
Total Area	782.1	100.0
Impervious Area	198.5	25.4
Area served by BMPs	159.3	20.4

JZ3 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	4269	1313	625	407	65.4	397.5	1.23E+13

*Fecal coliform bacteria reported in org/year

JZ3 - TR-20 Results

	Peak flows (cfs)
2-yr	2852
100-yr	16407

Streams

JZ3 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.0	1.0	<0.01	0.01	<0.005	<0.005	4	3

*Fecal coliform bacteria reported in org/100ml

JZ3 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8290	0	5051	4412	0	0	0	0	0	17753
Miles	1.57	0.00	0.96	0.84	0.00	0.00	0.00	0.00	0.00	3.36
Percent of Total	47	0	28	25	0	0	0	0	0	

JZ3 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	1,883	0.36	22.7
Fair (MPHI)	5,778	1.09	69.7
Poor (MPHI)	630	0.12	7.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	1,883	0.36	22.7
Fair (FHS)	3,177	0.60	38.3
Poor (FHS)	3,231	0.61	39.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	10,874	2.06	61.0
Total Stream Length with Habitat Assessment	8,291	1.57	na

JZ3 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	3,056	465	630	7,210	11,361
Miles	0.00	0.00	0.00	0.00	0.58	0.09	0.12	1.37	2.15
Percent of Total	0	0	0	0	27	4	6	63	

Summary

Jabez Branch 3 received an overall stream length weighted MPHI score of 55.58 and an FHS of 50.63, both in the Fair range. Of the 1.57 miles of stream with habitat assessments conducted, 22.7% are in the Good range for both MPHI and FHS. The stream miles in the Fair range however dropped from 69.7% to 38.3% with the introduction of the infrastructure scores.

Two large dump sites located just downstream of Rte 3 are major contributors to the large decrease in stream miles in the Fair category.

Jabez Branch 4 (JZ4)

Subwatershed Description

Jabez Branch 4 is a 597.1 acre drainage area bounded by Rte 32 and Rte 3 and their associated interchange on the eastern edge. Rte 3 bisects the subwatershed lengthwise and is a main contributor to the 8.4% imperviousness value along with commercial and industrial uses. Jabez Branch 4 begins as roadside and agricultural ditches in the upstream portions of the subwatershed and drains into Jabez Branch 3 at Rte 32. Woods make up the largest portion (36.4%) of the land use and forested buffer is present on 64% of the stream miles. Agricultural use makes up the 27.6% of the land and is in the southern upstream half of the watershed. Residential areas make up a combined 18.6% of the subwatershed. Developed portions of the subwatershed are located primarily in the upstream portion of the drainage area.

Perennial streams make up only 19% of the 2.18 stream miles in Jabez Branch 4. A large portion of the streams are classified as ephemeral (42%) and ditch (40%). The mainstem is classified as an F type channel for the most downstream 0.24 miles, making up 51% of the total. The more upstream reach has a narrower floodplain within a steep valley and is classified as a G type channel for 0.23 miles.

Subwatershed Characteristics

JZ4 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	20.5	3.4
IND – Industrial	12.6	2.1
OPS – Open space	55.0	9.2
R11 – Residential 1 Acre lots	48.2	8.1
R12 – Residential ½ acre lots	9.7	1.6
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	29.3	4.9
RWD – Residential woods	24.1	4.0
SRC – Single Row Crops	164.9	27.6
TRN – Transportation	13.7	2.3
WAT – Water	2.0	0.3
WDS – Woods	217.1	36.4
Total Area	597.1	100.0
Impervious Area	50.0	8.4
Area served by BMPs	20.7	3.5

JZ4 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1350	428	225	100	12.9	43.8	4.15E+12

*Fecal coliform bacteria reported in org/year

JZ4 - TR-20 Results

	Peak flows (cfs)
2-yr	747
100-yr	3657

Streams

JZ4 - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.6	1.4	0.12	0.02	<0.005	<0.005	30	3

*Fecal coliform bacteria reported in org/100ml

JZ4 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2138	0	4788	4567	0	0	0	0	0	11493
Miles	0.40	0.00	0.91	0.86	0.00	0.00	0.00	0.00	0.00	2.18
Percent of Total	19	0	42	40	0	0	0	0	0	

JZ4 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	2,136	0.40	100.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	2,136	0.40	100.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	7,340	1.39	64.0
Total Stream Length with Habitat Assessment	2,136	0.40	na

JZ4 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G
Feet	0	0	0	0	0	0	1,264	1,212
Miles	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.23
Percent of Total	0	0	0	0	0	0	51	49

Summary

Jabez Branch 4 received an overall stream length weighted MPHI score of 89.00 and an FHS of 86.50, both in the Good range. Of the 0.40 miles of stream with habitat assessments conducted, 100.0% are in the Good range for both MPHI and FHS. There is very little infrastructure impact on the assessed portions of perennial streams.

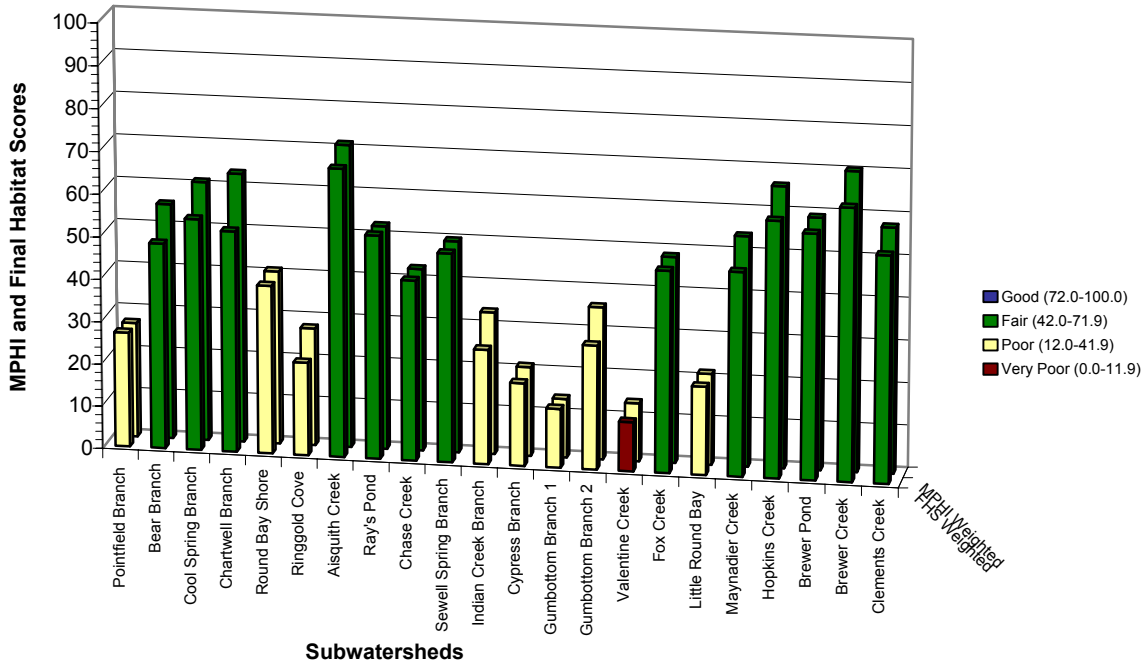
The ephemeral channels upstream of the perennial portion have considerable impact from ditches, and road crossings near the Rte 3 and 175 intersection, including lengths of concrete channel immediately downstream of Rte 3. A bank rehabilitation effort is also located on the ephemeral reaches downstream of Rte 3.

4.2 North and South Shore of Tidal Severn

The north and south shore of the tidal Severn includes 27 subwatersheds. Pointfield Branch, Bear Branch, Cool Spring Branch and Chartwell Branch are located on the north shore in the central portion of the Watershed, and drain to the upstream tidal waters. The remainder of the north shore subwatersheds are generally less than 300 acres and are characterized by small headwater streams, in steep valleys and highly erodable materials. Most, including Stevens Creek and Ringgold Cove contain primarily first order streams draining directly to the tidal Severn. The south shore subwatersheds such as Maynadier and Clements Creeks are also characterized by steep valleys and erodable soils, however drainage areas are generally greater than 400 acres and stream systems and habitat complexity are more developed.

Twenty-two subwatersheds in this portion of the Severn had perennial streams and habitat assessments conducted. The overall stream length weighted subwatershed Maryland Physical Habitat Index (MPHI) and Final Habitat Scores (FHS) are presented in Figure 4.2 to highlight the difference between the MPHI and the FHS. The average difference between the MPHI and FHS was 3.6, with Chartwell Branch having the biggest influences from infrastructure and environmental features. Valentine Creek was the only subwatershed to drop from one category to another and was the only subwatershed rated as Very Poor.

Figure 4.2 Stream length Weighted Subwatershed Scores (MPHI Scores are displayed in the back row)



The following sections summarize the results of the stream assessment and modeling. The *Subwatershed Description* section describes pertinent land use data, subwatershed features and the types and classifications of the stream channels. *Subwatershed Characteristics* are then presented including land use data and PLOAD and TR-20 modeling results. The *Streams* section presents water quality data, stream type results, habitat information including MPHI and FHS and channel classification results. Refer to Section 2.5 for information on the derivation and categories used for the MPHI and FHS. The final *Summary* briefly interprets the habitat scores and gives the primary and probable influences on the score.

Pointfield Branch (PFB)

Subwatershed Description

Pointfield Branch subwatershed is approximately 104.4 acres and drains in a southeasterly direction into the very top of the tidal Severn River. The land use in the subwatershed is very diverse with almost all uses represented. Transportation, medium-density residential, and wooded areas combine to account for over 70% of the land use. Maryland 97 occupies a large area within the western headwaters of the subwatershed and accounts for the majority of the transportation land use. The topography of the subwatershed consists of a broad flat floodplain in the southern portion of the subwatershed, with steep slopes adjacent to the stream channel in the headwaters. The 1.13 miles of stream in Pointfield Branch consist of 44% ephemeral, 37% ditch, 10% wetland, 7% perennial and 2% stormwater management. Of the 0.42 classifiable stream miles within the subwatershed, 21% are moderately entrenched and low gradient F type, and 79% are entrenched and unstable G type channels.

Subwatershed Characteristics

PFB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.5	1.5
IND – Industrial	9.2	8.8
OPS – Open space	2.8	2.6
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	23.5	22.5
R14 – Residential ¼ acre lots	2.3	2.2
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	5.0	4.8
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	6.8	6.5
TRN – Transportation	24.8	23.8
WAT – Water	0.0	0.0
WDS – Woods	28.5	27.3
Total Area	104.4	100.0
Impervious Area	33.5	32.1
Area served by BMPs	3.8	3.6

PFB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	651	190	88	57	9.3	63.5	2.29E+12

*Fecal coliform bacteria reported in org/year

PFB-TR-20 Results

	Peak flows (cfs)
2-yr	290
100-yr	1073

Streams

PFB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	3.8	3.8	0.04	0.03	<0.005	<0.005	43	25

*Fecal coliform bacteria reported in org/100ml

PFB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	447	0	2596	2213	124	0	0	582	0	5962
Miles	0.08	0.00	0.49	0.42	0.02	0.00	0.00	0.11	0.00	1.13
Percent of Total	7	0	44	37	2	0	0	10	0	

PFB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	448	0.08	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	448	0.08	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	3,625	0.69	61.0
Total Stream Length with Habitat Assessment	448	0.08	

PFB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	0	474	1,751	2,225
Miles	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.33	0.42
Percent of Total	0	0	0	0	0	0	21	79	

Summary

Pointfield Branch received and overall stream length weighted MPHI and FHS score of 27 and is classified as Poor for both. The FHS reflects the lack of infrastructure points within the habitat assessment reaches. Habitat assessments were not performed for the upstream ephemeral channels. This portion of the subwatershed is extremely unstable with large areas of erosion along both banks, which is likely due to flashy, intense stormflows impacting the channels.

Bear Branch (BRB)

Subwatershed Description

Bear Branch is located on the north shore of the Severn and drains 655.8 acres in a southerly direction to the confluence with the tidal Severn River. The land use within the subwatershed is fairly diverse. High and medium-density residential landuses make up 49.1% of the subwatershed land use. The majority of the remaining land use consists of 11.5% commercial, 11.2% transportation, and 20.5% forested. The forested areas are immediately surrounding the stream channel for most of its length providing a forested buffer for 75% of the stream length. The topography within Bear Branch is characterized by wide floodplains with fairly steep valley slopes and relatively flat headwater regions. Perennial streams account for 68% of the 2.72 miles of stream within the Bear Branch subwatershed. The remainder of the stream miles consists of 20% ditch, 5% stormwater management, and 6% wetland. The channel classifications vary considerably. The most upstream portion of the subwatershed is an entrenched and unstable G, while the middle portions have more floodplain connectivity yet still characterized as slightly entrenched C type channels and the downstream portions have even more active floodplains and are dominated by braided sections.

Subwatershed Characteristics

BRB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	75.6	11.5
IND – Industrial	12.7	1.9
OPS – Open space	20.2	3.1
R11 – Residential 1 Acre lots	1.1	0.2
R12 – Residential ½ acre lots	73.8	11.3
R14 – Residential ¼ acre lots	247.7	37.8
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.6	0.1
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	16.2	2.5
TRN – Transportation	73.8	11.2
WAT – Water	0.0	0.0
WDS – Woods	134.1	20.5
Total Area	655.8	100.0
Impervious Area	196.9	30.0
Area served by BMPs	150.9	23.0

BRB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3977	1251	519	279	47.2	205.1	1.35E+13

*Fecal coliform bacteria reported in org/year

BRB- TR-20 Results

	Peak flows (cfs)
2-yr	1285
100-yr	6096

Streams

BRB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.6	1.6	0.05	0.02	<0.005	<0.005	9	4

*Fecal coliform bacteria reported in org/100ml

BRB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	9814	0	0	2931	760	0	0	880	0	14385
Miles	1.86	0.00	0.00	0.56	0.14	0.00	0.00	0.17	0.00	2.72
Percent of Total	68	0	0	20	5	0	0	6	0	

BRB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	6,701	1.27	67.9
Poor (MPHI)	3,161	0.60	32.1
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	6,701	1.27	67.9
Poor (FHS)	3,161	0.60	32.1
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	10,793	2.04	75.0
Total Stream Length with Habitat Assessment	9,862	1.87	

BRB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	663	0	2,493	850	2,505	3,239	9,750
Miles	0.00	0.00	0.13	0.00	0.47	0.16	0.47	0.61	1.85
Percent of Total	0	0	7	0	26	9	26	33	

Summary

Bear Branch received an overall stream length weighted MPHI score of 55.46 and a final habitat assessment score of 48.38, both in the Fair category. The variation in scores is due to many utility, crossing, obstruction, pipe and ditch infrastructure points. High and medium-density residential areas border a majority of the stream corridor. Localized areas of degradation occurred at many points throughout the system near stormwater outfalls. Overall, 67.9% of the stream miles remained in the Fair category considering infrastructure.

Cool Spring Branch (CSB)

Subwatershed Description

Cool Spring Branch is located on the north shore of the Severn and drains 348.1 acres in a southerly direction to the confluence with the tidal Severn River. The land use within the subwatershed includes over 70% high-density residential. Residential woods and forest make up another 19.7% of the subwatershed land use. The topography within Cool Spring Branch is characterized by wide flat floodplains with gentle valley slopes and mildly sloping headwater regions. Perennial streams account for 79% of the 0.96 miles of stream within the Cool Spring Branch subwatershed. The remainder of the stream miles consist of 11% ephemeral, 5% tidal and 5% ditch. All of the 0.47 miles of classifiable channel are characterized as C type, sinuous and slightly entrenched with broad well-developed floodplains.

Subwatershed Characteristics

CSB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	8.5	2.4
IND – Industrial	0.0	0.0
OPS – Open space	0.0	0.0
R11 – Residential 1 Acre lots	17.3	5.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	253.7	72.9
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	49.4	14.2
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	19.3	5.5
Total Area	348.1	100.0
Impervious Area	62.3	17.9
Area served by BMPs	8.5	2.4

CSB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1639	549	193	67	13.7	9.9	6.03E+12

*Fecal coliform bacteria reported in org/year

CSB- TR-20 Results

	Peak flows (cfs)
2-yr	33
100-yr	1032

Streams

CSB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.4	2.4	0.11	0.03	<0.005	<0.005	4	2

*Fecal coliform bacteria reported in org/100ml

CSB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	4007	0	549	274	0	0	236	0	0	5066
Miles	0.76	0.00	0.10	0.05	0.00	0.00	0.04	0.00	0.00	0.96
Percent of Total	79	0	11	5	0	0	5	0	0	

CSB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	2,483	0.47	100.0
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	2,483	0.47	100.0
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	1,669	0.32	33.0
Total Stream Length with Habitat Assessment	2,483	0.47	

CSB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	2,484	0	0	0	0	0	2,484
Miles	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.47
Percent of Total	0	0	100	0	0	0	0	0	

Summary

Cool Spring Branch received an overall stream length weighted MPHI score of 61.05 and an FHS of 54.51. The variation in scores is due to many obstruction, headcut, pipe and ditch infrastructure points. High-density residential areas border a majority of the stream corridor. Localized areas of degradation occurred at many points throughout the system near stormwater outfalls. Cool Spring Branch is rated in the Fair category for its entire length even with infrastructure impacts considered.

The stream system is piped underground for approximately 1,600 feet extending upstream of the confluence with the tidal Severn River. No habitat assessment was performed for this section.

Chartwell Branch (CWB)

Subwatershed Description

Chartwell Branch is located on the north shore of the Severn River, draining 815.9 acres in a southerly direction to the tidal Severn River. The topography is characterized by relatively gentle valley slopes and fairly flat headwater regions. Residential land use, high- and medium-density, comprise the majority of the subwatershed, accounting for 62.6% of the land use. The Chartwell Country Club accounts a majority of the open space as well as a portion of the commercial land use, and is centrally located within the subwatershed. Forest occupies only 7% of the land use and is not commonly found along the stream corridor resulting in a low intact forest buffer of 24.0%. The majority of the 2.09 mile stream system is represented by perennial and ephemeral channels, and includes the 0.45 mile long section of lake located on the Chartwell Country Club property. F type channels, entrenched with a moderate to high width/depth ratio and moderate sinuosity, account for 32% of the classifiable channels. Braided DA type channels and very highly sinuous E type channels with well-developed floodplains are present in the wide floodplain areas upstream and downstream of the lake.

Subwatershed Characteristics

CWB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	34.8	4.3
IND – Industrial	0.0	0.0
OPS – Open space	187.4	23.0
R11 – Residential 1 Acre lots	239.5	29.3
R12 – Residential ½ acre lots	151.1	18.5
R14 – Residential ¼ acre lots	120.9	14.8
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	7.5	0.9
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	6.8	0.8
WDS – Woods	57.5	7.0
Total Area	815.9	100.0
Impervious Area	104.3	12.8
Area served by BMPs	156.8	19.2

CWB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3049	1034	351	137	25.1	20.6	1.09E+13

*Fecal coliform bacteria reported in org/year

CWB- TR-20 Results

	Peak flows (cfs)
2-yr	247
100-yr	2650

Streams

CWB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2.6	2.6	<0.01	0.01	<0.005	<0.005	93	2

*Fecal coliform bacteria reported in org/100ml

CWB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	5546	0	1870	117	750	2397	125	225	0	11030
Miles	1.05	0.00	0.35	0.02	0.14	0.45	0.02	0.04	0.00	2.09
Percent of Total	50	0	17	1	7	22	1	2	0	

CWB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	1,286	0.24	23.2
Fair (MPHI)	3,579	0.68	64.5
Poor (MPHI)	682	0.13	12.3
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	1,286	0.24	23.2
Fair (FHS)	3,579	0.68	64.5
Poor (FHS)	682	0.13	12.3
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	2,697	0.51	24.0
Total Stream Length with Habitat Assessment	5,547	1.05	

CWB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	423	231	231	1,015	874	1,766	1,053	5,593
Miles	0.00	0.08	0.04	0.04	0.19	0.17	0.33	0.20	1.06
Percent of Total	0	8	4	4	18	16	32	19	

Summary

The percent of Fair and Good streams in Chartwell Branch remained at 87.7% when considering infrastructure scores. The overall stream length weighted MPHI score of 63.42 places Chartwell Branch in the Fair classification. When considering the infrastructure, the overall FHS dropped to 52.02, also a Fair classification. Infrastructure impacts include multiple buffer encroachments with moderate impacts, multiple obstruction points, and crossing points.

Stevens Creek (STC)

Subwatershed Description

Stevens Creek subwatershed covers approximately 150 acres on the north shore of the tidal Severn River. The subwatershed contains no perennial stream systems. There is a large pond draining into the open water portion of Stevens Creek. The pond is fed by a short 0.08 mile wetland to the northwest and a 0.20 mile ditch system to the northeast. The gently sloping northern headwaters of the subwatershed are characterized by medium-density residential with a very small portion of commercial land use. Steep forested valleys and low-density residential characterize the southern portions of the watershed.

Subwatershed Characteristics

STC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.7	1.2
IND – Industrial	0.0	0.0
OPS – Open space	0.1	0.1
R11 – Residential 1 Acre lots	80.0	53.4
R12 – Residential ½ acre lots	25.0	16.7
R14 – Residential ¼ acre lots	14.5	9.7
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	2.7	1.8
WDS – Woods	25.7	17.1
Total Area	149.8	100.0
Impervious Area	16.9	11.3
Area served by BMPs	41.9	27.9

STC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	540	183	59	19	4.2	3.3	2.11E+12

*Fecal coliform bacteria reported in org/year

STC- TR-20 Results

	Peak flows (cfs)
2-yr	22
100-yr	469

Streams

STC- Dry Weather Sampling Results
No samples taken.

STC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	0	1037	0	0	0	435	0	1472
Miles	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.08	0.00	0.28
Percent of Total	0	0	0	70	0	0	0	30	0	

STC- Habitat Assessment Results
No streams located in STC. Habitat assessment not conducted.

STC – Channel Classification Results
No classifiable channels located in STC. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in Stevens Creek. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Forked Creek (FRC)

Subwatershed Description

Forked Creek is located on the north shore of the Severn River between Stevens Creek and Evergreen Creek. The subwatershed is relatively small covering approximately 150 acres. Forked Creek as the name implies splits in two open water segments north of the confluence with the Severn River. There is a large pond draining into the western segment of the creek. The pond is almost entirely surrounded by forest while the headwaters are mostly medium-density residential development. There is a large portion of low-density land use located to the south of the pond and along the main open water channel of Forked Creek. The eastern segment of Forked Creek is fed by a short 0.02 mile intermittent stream along with a 0.02 mile ditch system. The open water is heavily surrounded by low-density residential development, while the headwaters are characterized by forest and medium-density residential development.

Subwatershed Characteristics

FRC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	9.6	3.8
IND – Industrial	0.0	0.0
OPS – Open space	1.0	0.4
R11 – Residential 1 Acre lots	55.1	22.2
R12 – Residential ½ acre lots	0.1	0.0
R14 – Residential ¼ acre lots	77.0	31.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	67.0	27.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	4.5	1.8
WDS – Woods	34.2	13.8
Total Area	248.3	100.0
Impervious Area	37.0	14.9
Area served by BMPs	17.7	7.1

FRC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1071	355	119	44	9.1	6.5	3.91E+12

*Fecal coliform bacteria reported in org/year

FRC- TR-20 Results

	Peak flows (cfs)
2-yr	274
100-yr	1769

Streams

FRC- Dry Weather Sampling Results

No samples taken.

FRC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	80	0	130	0	0	12	0	0	222
Miles	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04
Percent of Total	0	36	0	59	0	0	5	0	0	

FRC- Habitat Assessment Results

No streams located in FRC. Habitat assessment not conducted.

FRC – Channel Classification Results

No classifiable channels located in FRC. Channel classification not conducted.

Summary

No perennial streams were located in Forked Creek. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Evergreen Creek (EVC)

Subwatershed Description

Evergreen Creek is a small 80.8 acre subwatershed situated between Yantz Creek and Forked Creek on the northern shore of the Severn River. The subwatershed drains in a southerly direction to the tidal Severn. Approximately 60% of the subwatershed consists of residential land uses, with most located in the headwaters. The subwatershed consists of 21.2% forest occurring mostly along the stream corridor and providing a 92% forested stream length. Ephemeral channels make up 57% of the 0.28 mile stream system with wetlands accounting for the remaining 43%. No perennial stream systems occur in the Evergreen Creek subwatershed.

Subwatershed Characteristics

EVC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	5.2	6.5
IND – Industrial	0.0	0.0
OPS – Open space	9.8	12.1
R11 – Residential 1 Acre lots	10.7	13.3
R12 – Residential ½ acre lots	25.7	31.8
R14 – Residential ¼ acre lots	12.2	15.1
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	17.1	21.2
Total Area	80.8	100.0
Impervious Area	11.9	14.7
Area served by BMPs	31.4	38.9

EVC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	290	113	37	14	2.5	2.3	1.13E+12

*Fecal coliform bacteria reported in org/year

EVC- TR-20 Results

	Peak flows (cfs)
2-yr	50
100-yr	394

Streams

EVC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	21.05	0.05	1.4	0.28	0.22	0.21	1600	4600

*Fecal coliform bacteria reported in org/100ml

EVC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	847	0	0	0	0	43	0	1477
Miles	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.12	0.00	0.28
Percent of Total	0	0	57	0	0	0	0	43	0	

EVC- Habitat Assessment Results
No streams located in STC. Habitat assessment not conducted.

EVC – Channel Classification Results
No classifiable channels located in EVC. Channel classification not conducted.

Summary

No perennial streams were located in Evergreen Creek. Therefore, no habitat assessments or channel classifications were conducted.

Yantz Creek (YZC)

Subwatershed Description

Yantz Creek is situated between Evergreen Creek and Sullivan Cove on the north shore of the tidal Severn. The subwatershed is relatively small at 204 acres and is dominated by high-density residential development. Severna Park High School accounts for a majority of the 8.4% commercial land use and is situated in the northern headwaters of the subwatershed. This subwatershed contains one short ditch system that drains in an easterly direction to the open waters of Yantz Creek. No perennial stream systems occur in the Yantz Creek subwatershed.

Subwatershed Characteristics

YZC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	17.2	8.4
IND – Industrial	0.0	0.0
OPS – Open space	14.2	7.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	1.9	0.9
R14 – Residential ¼ acre lots	165.9	81.3
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	4.9	2.4
Total Area	204.0	100.0
Impervious Area	48.1	23.6
Area served by BMPs	0.0	0.0

YZC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1181	394	143	51	10	7.3	4.15E+12

*Fecal coliform bacteria reported in org/year

YZC- TR-20 Results

	Peak flows (cfs)
2-yr	152
100-yr	1133

Streams

YZC- Dry Weather Sampling Results

No samples taken.

YZC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	0	280	0	0	0	0	0	280
Miles	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
Percent of Total	0	0	0	100	0	0	0	0	0	

YZC- Habitat Assessment Results
No streams located in STC. Habitat assessment not conducted.

YZC – Channel Classification Results
No classifiable channels located in YZC. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in the Yantz Creek subwatershed. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Sullivan Cove (SVC)

Subwatershed Description

Sullivan Cove is a small subwatershed located on the northern shore of the Severn River between Yantz Creek and Round Bay Shore. The subwatershed drains in a southerly direction to the tidal Severn. Approximately 77% of the subwatershed is comprised of medium-density residential lots. Together with only 2.6% of the subwatershed classified as commercial use they make up an imperviousness of 17.1%. Sullivan Cove subwatershed contains no flowing streams or defined channels.

Subwatershed Characteristics

SVC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	4.3	2.6
IND – Industrial	0.0	0.0
OPS – Open space	17.3	10.6
R11 – Residential 1 Acre lots	1.4	0.8
R12 – Residential ½ acre lots	11.9	7.3
R14 – Residential ¼ acre lots	112.7	68.6
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.6	0.3
WDS – Woods	16.0	9.8
Total Area	164.2	100.0
Impervious Area	28.1	17.1
Area served by BMPs	0.3	0.2

SVC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	760	256	89	30	6.3	4.5	2.78E+12

*Fecal coliform bacteria reported in org/year

SVC- TR-20 Results

	Peak flows (cfs)
2-yr	190
100-yr	1127

Streams

SVC - Dry Weather Sampling Results
No streams located in SVC. No dry weather sample taken.

SVC - Stream Type Results
No streams located in SVC.

SVC - Habitat Assessment Results
No streams located in SVC. Habitat assessment not conducted.

SVC – Channel Classification Results
No streams located in SVC. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in Sullivan Cove. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Round Bay Shore (RBS)

Subwatershed Description

Round Bay Shore is a small subwatershed located centrally on the northern shore of the tidal Severn. The subwatershed is situated between Ringgold Cove and Sullivan Cove. The northern portion of the watershed is almost entirely medium-density residential land use. Most of the southern half of the subwatershed is characterized by low-density residential land use with some residential woods. Round Bay Shore has only one very minor channel system draining into the open water. The entire 0.22 mile stream is surrounded by low-density residential uses. The system is ephemeral in the steep headwaters and comprises only 4% of the total stream length. The remainder of the system is comprised of 62% perennial and 34% wetland draining directly into the tidal Severn. The 0.10 miles of classifiable channel is characterized as F type, entrenched with moderate sinuosity.

Subwatershed Characteristics

RBS- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	2.2	1.8
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	28.6	22.9
R14 – Residential ¼ acre lots	27.4	22.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	45.2	36.2
RWD – Residential woods	21.3	17.1
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	0.0	0.0
Total Area	124.7	100.0
Impervious Area	15.8	12.7
Area served by BMPs	1.3	1.0

RBS- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	495	166	58	19	4.1	2.9	1.87E+12

*Fecal coliform bacteria reported in org/year

RBS- TR-20 Results

	Peak flows (cfs)
2-yr	244
100-yr	1657

Streams

RBS- Dry Weather Sampling Results

No samples taken.

RBS- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	719	0	44	0	0	0	0	398	0	1161
Miles	0.14	0.00	0.01	0.00	0.00	0.00	0.00	0.08	0.00	0.22
Percent of Total	62	0	4	0	0	0	0	34	0	

RBS- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	546	0.10	75.7
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	175	0.03	24.3
Good (FHS)	0	0.00	0.0
Fair (FHS)	546	0.10	75.7
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	175	0.03	24.3
Forested Stream Length	0	0.00	0.0
Total Stream Length with Habitat Assessment	721	0.14	

RBS- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	0	546	0	546
Miles	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0	0.10
Percent of Total	0	0	0	0	0	0	100	0	

Summary

Round Bay Shore received an overall stream length weighted MPHI score of 41 and is classified as Poor. The subwatershed received an overall stream length weighted FHS of 40, which reflects the limited impact of infrastructure on the stream system in Round Bay Shore. Overall, Round Bay Shore has over 70% of its streams in the Fair category.

Ringgold Cove (RGC)

Subwatershed Description

Ringgold Cove subwatershed is located on the north shore of the Severn River. The subwatershed is approximately 121.0 acres and is situated between Round Bay Shore and Aisquith Creek. Steep slopes with very few flat areas characterize the topography within the subwatershed. The land use within the subwatershed is primarily residential with low-density accounting for 59.3% and medium-density covering 24.1% of the subwatershed. A forested area in the northern portion of the subwatershed accounts for most of the remaining land use. There are 0.63 miles of stream within the subwatershed. Two stream systems drain into the open water portion of Ringgold Cove. One stream system is located within the wooded section of the subwatershed and accounts for the 43% buffered stream miles. The second stream system is located in the middle of the subwatershed and surrounded by low-density residential and open space land uses. Over 90% of the 0.50 classifiable stream miles within the subwatershed are characterized as E type channels with high entrenchment ratios and good flood plain connectivity.

Subwatershed Characteristics

RGC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	3.3	2.7
R11 – Residential 1 Acre lots	29.2	24.1
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	71.8	59.3
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	16.7	13.8
Total Area	121.0	100.0
Impervious Area	11.1	9.2
Area served by BMPs	1.4	1.1

RGC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	403	135	47	15	3.4	2.3	1.53E+12

*Fecal coliform bacteria reported in org/year

RGC- TR-20 Results

	Peak flows (cfs)
2-yr	60
100-yr	929

Streams

RGC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	2	2	<0.01	0.08	<0.005	<0.005	<3	1

*Fecal coliform bacteria reported in org/100ml

RGC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2635	0	79	0	0	0	78	528	0	3320
Miles	0.50	0.00	0.01	0.00	0.00	0.00	0.01	0.10	0.00	0.63
Percent of Total	79	0	2	0	0	0	2	16	0	

RGC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	281	0.05	10.7
(MPHI)	1,975	0.37	75.3
Very Poor (MPHI)	366	0.07	14.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	281	0.05	10.7
Poor (FHS)	1,012	0.19	38.6
Very Poor (FHS)	1,329	0.25	50.7
Forested Stream Length	1,437	0.27	43.0
Total Stream Length with Habitat Assessment	2,622	0.50	

RGC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	232	0	0	0	2,384	0	0	2,616
Miles	0.00	0.04	0.00	0.00	0.00	0.45	0.00	0.00	0.50
Percent of Total	0	9	0	0	0	91	0	0	

Summary

Ringgold Cove received an overall stream length weighted MPHI score of 27.74, which is in the Poor category. The FHS incorporates impacts from infrastructure and was slightly lower, 21.90, also Poor. The FHS was lower due to severe impacts from a leaking manhole along the southern stream system and a severely eroded area with a failing pipe just above it in the headwaters of the northern stream system. With the addition of the infrastructure scores, 36.7% of the stream miles fell from the Poor into the Very Poor category.

Aisquith Creek (AQC)

Subwatershed Description

The Aisquith Creek subwatershed occupies 278.1 acres on the north shore of the tidal Severn. The subwatershed is composed of three tributary systems draining into the open water portion of the Creek. The southern shores of the creek are very steep in comparison to the gently sloping northern shores. The stream valleys are composed of well developed floodplains which give way to very steep slopes in the headwater regions of the subwatershed. The landuse within Aisquith Creek is mostly low-density residential (64.1%). The remainder of the landuse consists largely of forest (23%). Although forest cover is present in the stream valleys, only 54% of the stream length has a forested buffer.

Perennial streams dominate the 2.49 mile stream system within Aisquith Creek making up 58% of the streams. Intermittent and Ephemeral streams make up another 25% of the streams, with ditch, lake/pond, and tidal representing the remaining 17% of the stream miles. Channel classifications were completed for 1.33 miles of stream. Moderately entrenched and stable B type channels were the most dominant. Unstable and highly entrenched G type channels characterize steeper headwater regions. E type channels with good floodplain connectivity, were prevalent in downstream valleys.

Subwatershed Characteristics

AQC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.4	0.5
IND – Industrial	0.9	0.3
OPS – Open space	19.4	7.0
R11 – Residential 1 Acre lots	12.6	4.5
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	178.4	64.1
RWD – Residential woods	0.9	0.3
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.5	0.2
WDS – Woods	63.9	23.0
Total Area	278.1	100.0
Impervious Area	22.9	8.2
Area served by BMPs	18.6	6.7

AQC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	816	275	94	34	6.7	5.2	3.07E+12

*Fecal coliform bacteria reported in org/year

AQC- TR-20 Results

	Peak flows (cfs)
2-yr	377
100-yr	2368

Streams

AQC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	3.9	3.9	0.05	0.03	<0.005	<0.005	93	30

*Fecal coliform bacteria reported in org/100ml

AQC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	7617	1708	1594	1565	36	348	269	0	0	13137
Miles	1.44	0.32	0.30	0.30	0.01	0.07	0.05	0.00	0.00	2.49
Percent of Total	58	13	12	12	0	3	2	0	0	

AQC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	3,237	0.61	46.0
Fair (MPHI)	2,912	0.55	41.4
Poor (MPHI)	886	0.17	12.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	3,237	0.61	46.0
Fair (FHS)	2,454	0.46	34.9
Poor (FHS)	1,344	0.25	19.1
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	7,049	1.34	54.0
Total Stream Length with Habitat Assessment	7,035	1.33	

AQC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	3,122	0	0	189	2,405	0	1,301	7,017
Miles	0.00	0.59	0.00	0.00	0.04	0.46	0.00	0.25	1.33
Percent of Total	0	44	0	0	3	34	0	19	

Summary

The percent of stream miles within the Good habitat assessment category remained the same with the addition of the infrastructure scores while the amount of stream miles in the Fair category fell slightly. Though there were many infrastructure points present, very few of them were indicative of degraded conditions. A few pipes received high impact scores but most other points received only minor if any impact score.

Overall, Aisquith Creek received a stream length weighted MPHI score of 71.28 and a Final Habitat Score of 67.82, both in the Fair category. Overall, there was little infrastructure impact in the subwatershed as indicated by the small difference between the MPHI and FHS.

Rays Pond (RAP)

Subwatershed Description

Rays Pond drains 194.4 acres on the north shore of the tidal Severn River. The topography within the subwatershed is characterized by wide flat downstream floodplains, and steep valley slopes in the headwater regions. The land use within the subwatershed is dominated by wooded areas with forest and residential woods combining for 67.7% of the land use. Low- and medium-density residential land uses together account for 25.3% of the land use. The dominance of wooded areas and lack of commercial and industrial land use leads to a very low impervious surface value of 4.5%. There are three stream systems draining into the open water portion of Rays Pond. Of the 1.36 miles of stream in the subwatershed, 40% are perennial, 24% intermittent, and 20% ephemeral. Channel classifications were performed on 0.54 miles of stream channel. The channel classifications reflect the highly developed floodplains existent within the subwatershed. E, C, and DA type channels are all found within broad well-developed floodplains. E type channels are low gradient and highly sinuous while C type channels are slightly more entrenched and DA type channels are braided systems.

Subwatershed Characteristics

RAP- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	13.7	7.0
R11 – Residential 1 Acre lots	16.4	8.4
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	32.9	16.9
RWD – Residential woods	67.6	34.8
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	63.9	32.9
Total Area	194.4	100.0
Impervious Area	8.8	4.5
Area served by BMPs	8.5	4.3

RAP- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	318	116	37	23	2.4	3.5	1.07E+12

*Fecal coliform bacteria reported in org/year

RAP- TR-20 Results

	Peak flows (cfs)
2-yr	497
100-yr	2409

Streams

RAP- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.09	0.09	0.34	<0.01	<0.005	<0.005	4	21

*Fecal coliform bacteria reported in org/100ml

RAP- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2853	1706	1411	213	0	325	318	0	332	7158
Miles	0.54	0.32	0.27	0.04	0.00	0.06	0.06	0.00	0.06	1.36
Percent of Total	40	24	20	3	0	5	4	0	5	

RAP- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	1,559	0.30	54.6
Poor (MPHI)	1,294	0.25	45.4
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	1,559	0.30	54.6
Poor (FHS)	1,294	0.25	45.4
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	5,403	1.02	75.0
Total Stream Length with Habitat Assessment	2,853	0.54	

RAP- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	795	0	510	1,558	0	0	2,863
Miles	0.00	0.00	0.15	0.00	0.10	0.30	0.00	0.00	0.54
Percent of Total	0	0	28	0	18	54	0	0	

Summary

Rays Pond received an overall stream length weighted MPHI and FHS of 52.61 in the Fair Category. Two of the three stream systems within the subwatershed had no infrastructure points associated with them. The third is the ephemeral system located in the southwestern portion of the subwatershed. This ephemeral system is fairly degraded with heavy iron flocculent and bacterial sheen along the entire reach. Upstream degradation within the system includes an eight-foot headcut, major erosion issues around a manhole and a pipe headwall that has been scoured out to reveal the pipe behind it.

Chase Creek (CHC)

Subwatershed Description

Chase Creek covers 446.3 acres on the north shore and drains in a southwesterly direction to the tidal Severn River. The topography within the subwatershed is characterized by wide well developed floodplains in the downstream stream valleys and steep narrow headwater regions as well as steep slopes along the open water portions of the creek. The landuse is characterized mainly by forest (47.5%), medium-density residential (26.8%), and residential wooded areas (14.7%). The forested areas are located within and adjacent to the stream valleys, providing 97.0% of the stream miles with a forested buffer. These landuses combine to provide a fairly low impervious value of 5.7%.

The stream system within the subwatershed is made up of three separate tributary systems and a wetland draining into the open water portion of Chase Creek. Perennial streams make up 81% of the 1.90 miles of stream within the subwatershed. The remaining 19% of the stream miles are composed of intermittent and ephemeral stream, ditch, lake/pond and wetland segments. The channel classifications reflect the highly developed floodplains present within the subwatershed. E type channels with high entrenchment ratios, wide flood plains and good flood plain connectivity, represent 95% of the 1.90 miles of classifiable channel. Unstable and highly entrenched G type channels characterize the short, steep headwater regions.

Subwatershed Characteristics

CHC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.4	0.3
IND – Industrial	0.0	0.0
OPS – Open space	17.7	4.0
R11 – Residential 1 Acre lots	1.1	0.3
R12 – Residential ½ acre lots	119.8	26.8
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	27.8	6.2
RWD – Residential woods	65.6	14.7
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.8	0.2
WDS – Woods	212.0	47.5
Total Area	446.3	100.0
Impervious Area	25.6	5.7
Area served by BMPs	14.6	3.3

CHC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	932	330	110	54	7.3	8.3	3.25E+12

*Fecal coliform bacteria reported in org/year

CHC- TR-20 Results

	Peak flows (cfs)
2-yr	682
100-yr	3986

Streams

CHC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.44	0.44	0.04	0.27	<0.005	<0.005	23	22

*Fecal coliform bacteria reported in org/100ml

CHC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8108	85	436	0	0	845	0	570	0	10044
Miles	1.54	0.02	0.08	0.00	0.00	0.16	0.00	0.11	0.00	1.90
Percent of Total	81	1	4	0	0	8	0	6	0	

CHC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	3,644	0.69	44.9
Poor (MPHI)	4,464	0.85	55.1
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	3,644	0.69	44.9
Poor (FHS)	4,292	0.81	52.9
Very Poor (FHS)	172	0.03	2.1
Forested Stream Length	9,710	1.84	97.0
Total Stream Length with Habitat Assessment	8,108	1.54	

CHC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	7,678	0	418	8,096
Miles	0.00	0.00	0.00	0.00	0.00	1.45	0.00	0.08	1.53
Percent of Total	0	0	0	0	0	95	0	5	

Summary

The percent of stream miles within the Fair habitat assessment category remained the same with the addition of the infrastructure scores while a small amount of stream miles in the Poor category fell to the Very Poor category. There were some infrastructure points present although none of them were severe in impact rank. Most were minor with little to no impact score.

Overall, Chase Creek received a stream length weighted MPHI score of 42.91 and a Final Habitat Score of 42.43, both in the Fair category. Overall, there was little infrastructure impact in the subwatershed as indicated by the small difference between the MPHI and FHS.

Sewell Spring Branch (SSB)

Subwatershed Description

Sewell Spring Branch drains in a northeasterly direction to the upstream of the tidal Severn River, and consists of 475.6 acres. Steep slopes in the headwaters and flat, wide floodplains in downstream valleys characterize the topography. The southern headwaters are characterized by a mix of medium-density residential, single row crops and wooded areas, while the northern portion of the subwatershed is almost entirely forest. Together these uses represent a very low impervious surface value of 2.8%. All of the 0.86 miles of stream are located in this northern portion of the watershed resulting in a 100% intact forested buffer. Perennial streams make up 55% of the stream miles in Sewell Spring Branch and are generally comprised of F type channels, moderately sinuous and entrenched, with moderate to high width/depth ratios. E type channels with high entrenchment ratios, indicating wide flood plains and good flood plain connectivity, were prevalent in the downstream valleys. Ephemeral channels comprise the remaining 45% of the stream miles.

Subwatershed Characteristics

SSB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.3	0.3
IND – Industrial	0.0	0.0
OPS – Open space	6.8	1.4
R11 – Residential 1 Acre lots	90.0	18.9
R12 – Residential ½ acre lots	3.5	0.7
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.6	0.1
RWD – Residential woods	21.9	4.6
SRC – Single Row Crops	57.7	12.1
TRN – Transportation	0.6	0.1
WAT – Water	0.0	0.0
WDS – Woods	293.3	61.7
Total Area	475.6	100.0
Impervious Area	13.2	2.8
Area served by BMPs	0.0	0.0

SSB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	621	221	95	44	4.5	8	1.93E+12

*Fecal coliform bacteria reported in org/year

SSB- TR-20 Results

	Peak flows (cfs)
2-yr	292
100-yr	2136

Streams

SSB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.46	0.46	<0.01	<0.01	0.029	<0.005	4	2

*Fecal coliform bacteria reported in org/100ml

SSB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2491	0	2042	0	0	0	0	0	0	4533
Miles	0.47	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.86
Percent of Total	55	0	45	0	0	0	0	0	0	

SSB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	1,556	0.29	62.5
Poor (MPHI)	933	0.18	37.5
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	1,556	0.29	62.5
Poor (FHS)	933	0.18	37.5
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	4,535	0.86	100.0
Total Stream Length with Habitat Assessment	2,489	0.47	

SSB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	1,565	2,968	0	4,533
Miles	0.00	0.00	0.00	0.00	0.00	0.30	0.56	0.00	0.86
Percent of Total	0	0	0	0	0	35	65	0	

Summary

Sewell Spring Branch received an overall stream length weighted MPHI score of 49.82, which is in the Fair category. The FHS incorporates impacts from infrastructure and was just slightly lower, 49.19. The slight difference in the habitat scores is accounted for by the minor impact of a crossing just above the confluence with the Severn. Overall, Sewell Spring Branch has 62.5% of its stream miles in the Fair category and 37.5% in the Poor category for both the MPHI score and the FHS.

The dry weather sampling for Sewell Spring Branch found Copper was at 0.029 mg/L, over twice the COMAR chronic limit of 0.012 mg/L. The remaining water quality parameters are indicative of generally good water quality.

Indian Creek Branch (ICB)

Subwatershed Description

Indian Creek Branch is a large subwatershed covering 1447.0 acres on the south shore of the tidal Severn River. The topography within the subwatershed is characterized by very wide flat floodplains with moderate valley slopes at the edge of the floodplain and relatively flat headwater regions. Land use within the Indian Creek Branch subwatershed is very diverse. The land use within the subwatershed consists of 39.6% forest, 33.5% residential, 11.0% cropland, 10.3% open space, 3.8% transportation and 1.7% commercial. Together these uses represent a fairly low 8.1% impervious surface value. The stream system within the subwatershed is 2.92 miles in length. The majority of the stream miles are composed of perennial and ephemeral channels. The stream system generally consists of E type channels, low gradient, highly sinuous, with broad well-developed flood plains, and G type channels, entrenched and unstable, were present in the degraded upstream headwaters.

Subwatershed Characteristics

ICB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	24.8	1.7
IND – Industrial	0.0	0.0
OPS – Open space	149.5	10.3
R11 – Residential 1 Acre lots	243.4	16.8
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	24.3	1.7
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	114.6	7.9
RWD – Residential woods	102.3	7.1
SRC – Single Row Crops	159.5	11.0
TRN – Transportation	55.7	3.8
WAT – Water	0.0	0.0
WDS – Woods	572.8	39.6
Total Area	1447.0	100.0
Impervious Area	117.8	8.1
Area served by BMPs	38.1	2.6

ICB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3386	1117	497	266	37.4	160.9	1.03E+13

*Fecal coliform bacteria reported in org/year

ICB- TR-20 Results

	Peak flows (cfs)
2-yr	1045
100-yr	7338

Streams

ICB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.63	0.63	<0.01	0.02	0.011	<0.005	4	2

*Fecal coliform bacteria reported in org/100ml

ICB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	7583	0	5594	0	0	0	506	846	884	15413
Miles	1.44	0.00	1.06	0.00	0.00	0.00	0.10	0.16	0.17	2.92
Percent of Total	49	0	36	0	0	0	3	5	6	

ICB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	2,329	0.44	30.7
Poor (MPHI)	3,690	0.70	48.7
Very Poor (MPHI)	1,560	0.30	20.6
Good (FHS)	0	0.00	0.0
Fair (FHS)	2,329	0.44	30.7
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	5,250	0.99	69.3
Forested Stream Length	13,197	2.50	86.0
Total Stream Length with Habitat Assessment	7,579	1.44	

ICB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	8,050	0	1,071	9,121
Miles	0.00	0.00	0.00	0.00	0.00	1.52	0.00	0.20	1.73
Percent of Total	0	0	0	0	0	88	0	12	

Summary

The percent of very Poor streams in Indian Creek Branch jumped from 20.6% to 69.3% with the addition of the infrastructure scores. This is mostly due to two severe dump sites along the valley slope and within the floodplain of Indian Creek Branch. The dump sites were large in size and contained possibly toxic material including empty 55-gallon drums, appliances, and empty bleach bottles.

The overall stream length weighted MPHI score of 33.50 results in a Poor classification. The overall FHS dropped to 26.99, also Poor. Lack of infrastructure impacts in the downstream portions of the subwatershed allowed 30.7% of the stream miles to remain within the Fair category for both the MPHI and FHS. Extremely degraded conditions exist in upstream portions of the channel. A pipe under Waterbury Road is contributing to severe erosion immediately downstream. The pipe is exposed 15 feet above the bank and there is a 25-foot drop from the pipe to the channel invert.

Dry weather sampling revealed copper concentrations at 0.011 mg/L, just below the COMAR chronic limit of 0.012 mg/L. The remaining water quality parameters were well within COMAR standards.

Cypress Branch (CYB)

Subwatershed Description

Cypress Branch covers 272.0 acres on the southern shore of the tidal Severn. The subwatershed drains in a northeasterly direction. Open space, occupied by the Maryland Veterans Cemetery and the Severn Run Natural Environment Area, is the most highly represented land use within the subwatershed occupying 41.7% of the total land use. The topography within the subwatershed can be characterized by gently sloping headwater regions leading to steep valley slopes and wide, flat floodplains in the valley bottom. The valley is surrounded by forest for a majority of the length. A forested buffer is intact for 100% of the 0.20 miles of stream within Cypress Branch. Perennial streams account for 66% of the stream miles within the subwatershed and are entirely comprised of low gradient E type channels with well-developed flood plains. The remaining 34% of the stream miles are tidal and no habitat assessment or channel classification was performed for this area.

Subwatershed Characteristics

CYB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	18.7	6.9
IND – Industrial	0.0	0.0
OPS – Open space	113.5	41.7
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	25.0	9.2
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.6	0.2
RWD – Residential woods	6.5	2.4
SRC – Single Row Crops	23.4	8.6
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	84.4	31.0
Total Area	272.0	100.0
Impervious Area	21.3	7.8
Area served by BMPs	6.2	2.3

CYB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	546	191	77	42	4.3	6	1.51E+12

*Fecal coliform bacteria reported in org/year

CYB- TR-20 Results

	Peak flows (cfs)
2-yr	61
100-yr	501

Streams

CYB- Dry Weather Sampling Results

No samples taken.

CYB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	688	0	0	0	0	0	347	0	0	1035
Miles	0.13	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.20
Percent of Total	66	0	0	0	0	0	34	0	0	

CYB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	688	0.13	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	688	0.13	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	1,035	0.20	100.0
Total Stream Length with Habitat Assessment	688	0.13	

CYB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	684	0	0	684
Miles	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.13
Percent of Total	0	0	0	0	0	100	0	0	

Summary

Cypress Branch received an overall stream length weighted MPHI score of 21 and FHS of 19.5, both in the Poor category. The infrastructure impacts consisted of an obstruction and a dump site, both receiving minor impact ranks. Cypress Branch received moderate to low pollutant loading estimates for all parameters; this is due to the small size of the subwatershed and the dominance of forested and open space land use.

Arden Pond (ARP)

Subwatershed Description

Arden Pond subwatershed is 222.5 acres and is located on the southern shore of the tidal Severn. Over 70% of the land use in the subwatershed is high-density residential. Open space and wooded areas make up the majority of the remaining land use. The topography within the subwatershed is primarily characterized by gently sloping flat areas with fairly steep cliffs along the shores of the tidal Severn. Two valleys exist within the watershed, but neither contains a stream system. There are no perennial stream systems or defined channels within the Arden Pond subwatershed.

Subwatershed Characteristics

ARP- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.5	0.7
IND – Industrial	0.0	0.0
OPS – Open space	28.7	12.9
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	162.7	73.1
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	3.5	1.6
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.3	0.1
WDS – Woods	25.8	11.6
Total Area	222.5	100.0
Impervious Area	34.0	15.3
Area served by BMPs	2.4	1.1

ARP- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	931	312	109	36	7.8	5.5	3.48E+12

*Fecal coliform bacteria reported in org/year

ARP- TR-20 Results

	Peak flows (cfs)
2-yr	207
100-yr	1422

Streams

ARP- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.03	0.03	0.05	<0.01	0.005	<0.005	4	23

*Fecal coliform bacteria reported in org/100ml

ARP - Stream Assessment Results
No streams located in ARP.

ARP - Habitat Assessment Results
No streams located in ARP. Habitat assessment not conducted.

ARP - Channel Classification Results
No streams located in ARP. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in Arden Pond. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Gumbottom Branch 1 (GB1)

Subwatershed Description

Gumbottom Branch 1 is located along the southern shore of the Severn River, and drains into the tidal Plum Creek. The subwatershed consists of 810 acres, 42.8% of which are wooded. Residential land use comprises 39.8% of the subwatershed, including 23% and 16.8% medium- and high-density residential, respectively. The total impervious area of Gum Bottom Branch 1 is 45.6 acres (5%). Fifty-four percent (2.27 miles) of the stream miles are perennial, while 16%, 12%, 10%, 7%, and 1% are classified as ephemeral, wetland, floodway, ditch, and tidal, respectively. The majority of the classifiable stream miles, 61%, are E type channels, described as low gradient, meandering, efficient and stable. The remaining channels are classified as G type (21%), entrenched channels on moderate gradients, B type (12%), stable, moderately entrenched channels on moderate gradients, and F type (5%), entrenched, meandering on low gradients. Sixty-eight percent of the stream miles have forested buffers.

Subwatershed Characteristics

GB1- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	5.7	0.7
IND – Industrial	0.0	0.0
OPS – Open space	57.1	7.1
R11 – Residential 1 Acre lots	87.3	10.8
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	98.5	12.2
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	76.8	9.5
RWD – Residential woods	58.8	7.3
SRC – Single Row Crops	79.3	9.8
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	346.6	42.8
Total Area	810.0	100.0
Impervious Area	45.6	5.6
Area served by BMPs	29.3	3.6

GB1- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1580	552	216	87	12.1	13.3	5.40E+12

*Fecal coliform bacteria reported in org/year

GB1- TR-20 Results

	Peak flows (cfs)
2-yr	572
100-yr	4405

Streams

GB1- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.9	1.9	<0.01	0.04	<0.005	<0.005	<3	4

*Fecal coliform bacteria reported in org/100ml

GB1- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	11974	0	3572	1624	0	0	211	2637	2311	22329
Miles	2.27	0.00	0.68	0.31	0.00	0.00	0.04	0.50	0.44	4.23
Percent of Total	54	0	16	7	0	0	1	12	10	

GB1- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	10,089	1.91	84.3
Very Poor (MPHI)	1,884	0.36	15.7
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	10,089	1.91	84.3
Very Poor (FHS)	1,884	0.36	15.7
Forested Stream Length	15,170	2.87	68.0
Total Stream Length with Habitat Assessment	11,973	2.27	

GB1- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	1,480	0	0	0	7,332	635	2,520	11,967
Miles	0.00	0.28	0.00	0.00	0.00	1.39	0.12	0.48	2.27
Percent of Total	0	12	0	0	0	61	5	21	

Summary

Gumbottom Branch 1 habitat scores remained stable when considering infrastructure impacts. The overall MPHI and FHS scores are 13.87, rated as Poor. Gumbottom Branch 1 received a Poor rating for 84.3% of the stream miles, while 15.7% received a Very Poor Rating. The Poor and Very Poor ratings can be attributed to low flow regimes, silt and sand dominated channel beds, and lack of stream habitat diversity.

Gumbottom Branch 2 (GB2)

Subwatershed Description

The Gumbottom 2 subwatershed is located along the southern shore of the Severn River, and is 610.5 acres in size. The dominant land use type within the subwatershed is forest (64%), resulting in 89% of the stream miles having forested buffers. Residential land use comprises 31.2% of the Gumbottom Branch 2 subwatershed, including 22.3% low-density, 7.9% medium-density, and 1.0% low-density development. Impervious area covers 3.8% of the subwatershed. Seventy-four percent of the stream miles are perennial, and 11% and 8% are intermittent and ephemeral, respectively. The remaining stream miles are comprised of 3% ditches, 2% lakes/ponds, 1% tidal, and 1% wetland. The dominant classifiable streams consist of G type (48%), entrenched channel on moderate gradients, E type (27%), efficient, stable and meandering channels on low gradients, and F type (20%), entrenched, meandering riffle/pool streams.

Subwatershed Characteristics

GB2- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	8.1	1.3
IND – Industrial	0.0	0.0
OPS – Open space	6.8	1.1
R11 – Residential 1 Acre lots	48.3	7.9
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	6.1	1.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	5.8	0.9
RWD – Residential woods	130.4	21.4
SRC – Single Row Crops	9.9	1.6
TRN – Transportation	3.1	0.5
WAT – Water	1.4	0.2
WDS – Woods	390.5	64.0
Total Area	610.5	100.0
Impervious Area	23.2	3.8
Area served by BMPs	6.1	1.0

GB2- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	813	309	105	76	6.4	18.2	2.30E+12

*Fecal coliform bacteria reported in org/year

GB2- TR-20 Results

	Peak flows (cfs)
2-yr	825
100-yr	7373

Streams

GB2- Dry Weather SamplingResults

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.28	0.28	<0.01	0.03	<0.005	<0.005	4	14

*Fecal coliform bacteria reported in org/100ml

GB2- Stream Type Results

Stream Type	Pern	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	19350	2953	2001	779	0	540	293	133	0	26049
Miles	3.66	0.56	0.38	0.15	0.00	0.10	0.06	0.03	0.00	4.93
Percent of Total	74	11	8	3	0	2	1	1	0	

GB2- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	7,601	1.44	39.3
Poor (MPHI)	9,896	1.87	51.1
Very Poor (MPHI)	1,852	0.35	9.6
Good (FHS)	0	0.00	0.0
Fair (FHS)	7,601	1.44	39.3
Poor (FHS)	5,162	0.98	26.7
Very Poor (FHS)	6,586	1.25	34.0
Forested Stream Length	23,131	4.38	89.0
Total Stream Length with Habitat Assessment	19,349	3.66	

GB2- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	611	0	377	5,417	4,075	9,640	20,120
Miles	0.00	0.00	0.12	0.00	0.07	1.03	0.77	1.83	3.81
Percent of Total	0	0	3	0	2	27	20	48	

Summary

Gumbottom Branch 2 received an overall weighted MPHI score of 35.87, rated as Fair. When considering the impact due to infrastructure, Gumbottom Branch 2 received an FHS of 29.2, also rated as Fair. The percentage of streams with an MPHI rating of Fair remained stable when considering infrastructure. Approximately 24% of the stream miles rated as Poor dropped to a Very Poor rating when infrastructure was evaluated. Infrastructure impacts on the streams consist of bank erosion, channel obstructions, and pipes and ditches. Overall, the Poor and Very Poor designations are likely due to the channels being small in size with low flow regimes and the channel bed dominated by silt and sand.

Valentine Creek (VTC)

Subwatershed Description

Valentine Creek occupies 272.9 acres on the south shore of the tidal Severn River. The land use within the subwatershed is characterized by high-density residential land use along the open water portions and forested land use in the headwaters. Forested buffers exist along 86.0% of the stream miles. There are two channel systems within the subwatershed. Both drain in a northerly direction into wetland systems that drain into the open water portions of Valentine Creek. The 0.89 miles of stream within Valentine Creek consist of 59% perennial, 26 % wetland and 15% a combination of tidal and intermittent. The wetland portion of the stream miles is characterized by broad flat highly developed floodplains. The headwater portions of the subwatershed consist of very steep stream valleys steadily increasing in gradient towards the upstream end. Of the 0.53 classifiable stream miles, 84% are entrenched and unstable G type and 16% are slightly entrenched C type channels with an active floodplain.

Subwatershed Characteristics

VTC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	5.4	2.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	17.7	6.5
R14 – Residential ¼ acre lots	125.2	45.9
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	16.7	6.1
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	107.8	39.5
Total Area	272.9	100.0
Impervious Area	28.5	10.5
Area served by BMPs	8.2	3.0

VTC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	833	284	97	38	6.8	5.7	3.09E+12

*Fecal coliform bacteria reported in org/year

VTC- TR-20 Results

	Peak flows (cfs)
2-yr	371
100-yr	2712

Streams

VTC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
Sample 1	0.94	0.14	2.3	0.06	<0.005	<0.005	9	370
Sample 2	1.49	0.19	0.25	0.05	0.006	<0.005	4	120

*Fecal coliform bacteria reported in org/100ml

VTC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2541	264	0	0	0	0	371	1143	0	4319
Miles	0.48	0.05	0.00	0.00	0.00	0.00	0.07	0.22	0.00	0.82
Percent of Total	59	6	0	0	0	0	9	26	0	

VTC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	998	0.19	39.3
Very Poor (MPHI)	1,543	0.29	60.7
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	998	0.19	39.3
Very Poor (FHS)	1,543	0.29	60.7
Forested Stream Length	3,714	0.70	86.0
Total Stream Length with Habitat Assessment	2,541	0.48	

VTC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	458	0	0	0	0	2,331	2,789
Miles	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.44	0.53
Percent of Total	0	0	16	0	0	0	0	84	

Summary

Valentine Creek received and overall stream length weighted MPHI score of 13.70 and is classified as Poor. The overall stream length weighted FHS, which considers the impact of infrastructure on the stream was 11.58, classifies as Very Poor. Those habitat reaches rated as Good and Fair remained stable when considering infrastructure. The infrastructure impacts were derived from 2 dump sites and one obstruction. One of the dump sites received a moderated ranking due to tires and appliances located within the stream channel. Overall, the habitat quality within the Valentine Creek is lacking, mostly due to low stream flow, unstable banks and high embeddedness values.

Fox Creek (FXC)

Subwatershed Description

Fox Creek is a fairly small subwatershed, 116.7 acres, located on the southern shore of the Severn River. The most dominant land use is residential, occupying over 70% of the subwatershed. Forested areas are also highly represented comprising 24.4% of the land use within the subwatershed. The topography within Fox Creek is characterized by broad well-developed floodplains along with gentle slopes associated with the valleys and into the headwater portions of the subwatershed. The majority of the stream miles within Fox Creek are ephemeral (44%), with wetlands and perennial streams each occupying 23% of the stream miles. The 0.10 mile perennial stream segment was classified as an E type channel, low gradient, highly sinuous channel with a broad well developed floodplain.

Subwatershed Characteristics

FXC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.5	1.3
IND – Industrial	0.0	0.0
OPS – Open space	4.1	3.5
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	39.1	33.5
R14 – Residential ¼ acre lots	35.6	30.5
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	8.0	6.9
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	28.5	24.4
Total Area	116.7	100.0
Impervious Area	15.1	13.0
Area served by BMPs	6.7	5.8

FXC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	446	147	51	18	3.8	2.8	1.68E+12

*Fecal coliform bacteria reported in org/year

FXC- TR-20 Results

	Peak flows (cfs)
2-yr	167
100-yr	1132

Streams

FXC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.33	0.33	<0.01	0.01	<0.005	<0.005	43	5

*Fecal coliform bacteria reported in org/100ml

FXC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	515	0	973	0	0	0	41	499	182	2210
Miles	0.10	0.00	0.18	0.00	0.00	0.00	0.01	0.09	0.03	0.42
Percent of Total	23	0	44	0	0	0	2	23	8	

FXC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	515	0.10	100.0
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	515	0.10	100.0
Poor (FHS)	0	0.00	0.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	1,505	0.29	68.0
Total Stream Length with Habitat Assessment	515	0.10	

FXC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	504	0	0	504
Miles	0.00	0.00	0.00	0.00	0.00	0.10	0	0	0.10
Percent of Total	0	0	0	0	0	100	0	0	

Summary

Fox Creek received an overall stream length weighted MPHI score of 48.5 and an FHS of 47.5, both in the Fair range. All of the assessable 0.10 stream miles were in the Fair range. There was very little infrastructure impact in the subwatershed. Much of the ephemeral reaches that did not receive a habitat assessment score appeared stable were situated within an area of relatively low-density development.

Little Round Bay (LRB)

Subwatershed Description

Little Round Bay drains 415.7 acres on the south shore of the tidal Severn River. Land use in the subwatershed is dominated by forest, making up 51.1% of the total land use, concentrated in the western portion of the subwatershed. The remaining land use is dominated by residential uses, occupying 39.8% of the land use. The dominance of forested land coupled with minimal commercial development within the subwatershed leads to a low impervious value of 8.3%. Little Round Bay has one stream system draining into the open water portions of the subwatershed. The 1.25-mile stream system is located in the western, forested, portion of the subwatershed, resulting in a 91% intact forest buffer. Perennial streams make up 32% of the 1.25 stream miles. The 0.39 miles of classifiable channels include 67% entrenched and unstable G type channels occurring in the steeper upstream valleys. The remaining 33% are classified as highly sinuous E type channels, occurring in the broad well developed downstream floodplains.

Subwatershed Characteristics

LRB- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	6.6	1.6
IND – Industrial	0.0	0.0
OPS – Open space	5.5	1.3
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	112.5	27.1
R14 – Residential ¼ acre lots	52.7	12.7
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	26.0	6.3
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	212.4	51.1
Total Area	415.7	100.0
Impervious Area	34.3	8.3
Area served by BMPs	37.3	9.0

LRB- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1052	356	122	55	8.5	8.6	3.79E+12

*Fecal coliform bacteria reported in org/year

LRB- TR-20 Results

	Peak flows (cfs)
2-yr	620
100-yr	3483

Streams

LRB- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.07	0.07	<0.01	0.02	<0.005	<0.005	4	8

*Fecal coliform bacteria reported in org/100ml

LRB- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2085	252	1663	40	0	283	0	1337	929	6589
Miles	0.39	0.05	0.31	0.01	0.00	0.05	0.00	0.25	0.18	1.25
Percent of Total	32	4	25	1	0	4	0	20	14	

LRB- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	716	0.14	34.3
Very Poor (MPHI)	1,369	0.26	65.7
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	716	0.14	34.3
Very Poor (FHS)	1,369	0.26	65.7
Forested Stream Length	5,986	1.13	91.0
Total Stream Length with Habitat Assessment	2,085	0.39	

LRB- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	685	0	1,369	2,054
Miles	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.26	0.39
Percent of Total	0	0	0	0	0	33	0	67	

Summary

The Little Round Bay subwatershed received and overall stream length weighted MPHI score of 21.42 and is classified as Poor. The overall stream length weighted FHS, which considers the impact infrastructure has on the stream was 20.77, also Poor. Overall, the habitat quality within Little Round Bay was less than desirable, mostly due to low stream flow, lacking velocity and depth diversity, eroding bank conditions, and fine particles lining the channel bed.

Maynadier Creek (MAC)

Subwatershed Description

Maynadier Creek is a 1,069.8-acre subwatershed located on the south shore of the Severn River. The dominant land use consists of woods (66.4%), including 94% of the stream miles with forested buffers. Residential land use includes 25.9% of the subwatershed, which is comprised of 10.8% medium- and 15.1% low-density. Impervious area is generally low, including 4.3% of the subwatershed. The stream reaches within the watershed include 67% perennial, 24% ephemeral, 6% wetland, and 3% ditch. Maynadier Creek classifications include 66% G type, entrenched channels on moderate gradients, 19% E type, stable, efficient, meandering channels on low gradients, 13% F type, entrenched, meandering channels on low gradients, and DA type, stable, multiple channels with well developed floodplains.

Subwatershed Characteristics

MAC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	23.5	2.2
IND – Industrial	0.0	0.0
OPS – Open space	40.9	3.8
R11 – Residential 1 Acre lots	84.3	7.9
R12 – Residential ½ acre lots	14.5	1.4
R14 – Residential ¼ acre lots	16.4	1.5
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	52.6	4.9
RWD – Residential woods	108.6	10.2
SRC – Single Row Crops	19.1	1.8
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	710.0	66.4
Total Area	1069.8	100.0
Impervious Area	45.9	4.3
Area served by BMPs	15.6	1.5

MAC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1589	588	204	128	12	19	4.76E+12

*Fecal coliform bacteria reported in org/year

MAC- TR-20 Results

	Peak flows (cfs)
2-yr	1269
100-yr	7812

Streams

MAC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.82	0.82	0.05	0.02	<0.005	<0.005	<3	20

*Fecal coliform bacteria reported in org/100ml

MAC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	26954	0	9741	1075	0	0	0	2528	0	40298
Miles	5.10	0.00	1.84	0.20	0.00	0.00	0.00	0.48	0.00	7.63
Percent of Total	67	0	24	3	0	0	0	6	0	

MAC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	9,458	1.79	35.1
Fair (MPHI)	8,551	1.62	31.7
Poor (MPHI)	6,013	1.14	22.3
Very Poor (MPHI)	2,930	0.55	10.9
Good (FHS)	7,903	1.50	29.3
Fair (FHS)	10,106	1.91	37.5
Poor (FHS)	5,529	1.05	20.5
Very Poor (FHS)	3,414	0.65	12.7
Forested Stream Length	37,944	7.19	94.0
Total Stream Length with Habitat Assessment	26,952	5.10	

MAC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	747	5,137	3,433	17,896	27,213
Miles	0.00	0.00	0.00	0.00	0.14	0.97	0.65	3.39	5.15
Percent of Total	0	0	0	0	3	19	13	66	

Summary

The Maynadier Creek Watershed received and overall weighted MPHI score of 54.88, a rating of Fair. The overall FHS score, which considers the impacts of infrastructure, dropped to 47.97, also Fair. The percent of stream miles with an MPHI rating of Good and Fair (66.8%) remained stable when considering infrastructure, although 5.8% of the stream miles fell from Good to Fair. The dominant infrastructure impacts on the stream system consist of bank erosion, channel obstructions, dump sites, and ditches.

Hopkins Creek (HOC)

Subwatershed Description

Hopkins Creek is located on the south shore of the tidal Severn River. The subwatershed covers approximately 482.4 acres. The topography of the subwatershed consists of flat wide floodplains, expansive toward the confluence with the open water portion of the creek, and steep slopes adjacent to the floodplain and around the headwaters of the tributaries. The land use is dominated by forest, covering 61.7% of the subwatershed area. Residential land uses including residential woods and low- to medium-density residential development cover another 32.7% of the subwatershed. The dominance of wooded areas and lack of commercial and high-density residential development has resulted in a very low impervious value of 2.7%. The stream system within the subwatershed consists of 61% perennial, 33% ephemeral, 4% tidal, and 2% wetland. Two separate systems drain into the open water portion of Hopkins Creek. The main system drains in a northeasterly direction from the southern end of the subwatershed. The second system is entirely ephemeral and drains in a northwesterly direction almost directly to the mouth of Hopkins Creek. The downstream areas, with broad well developed floodplains and low gradients, are characterized by F, DA and E type channels. Moderately entrenched and stable B type channels and G type channels in the unstable and highly entrenched areas characterize the steeper headwater regions. The stream system has a 90% intact forest buffer.

Subwatershed Characteristics

HOC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	22.3	4.6
R11 – Residential 1 Acre lots	36.2	7.5
R12 – Residential ½ acre lots	0.1	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	55.1	11.4
RWD – Residential woods	56.7	11.8
SRC – Single Row Crops	13.8	2.9
TRN – Transportation	0.0	0.0
WAT – Water	0.5	0.1
WDS – Woods	297.7	61.7
Total Area	482.4	100.0
Impervious Area	12.9	2.7
Area served by BMPs	1.9	0.4

HOC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	607	228	78	47	4.3	7.3	1.92E+12

*Fecal coliform bacteria reported in org/year

HOC- TR-20 Results

	Peak flows (cfs)
2-yr	853
100-yr	4288

Streams

HOC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.26	0.26	<0.01	0.05	<0.005	<0.005	<3	3

*Fecal coliform bacteria reported in org/100ml

HOC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	10533	0	5594	0	0	0	637	387	0	17151
Miles	1.99	0.00	1.06	0.00	0.00	0.00	0.12	0.07	0.00	3.25
Percent of Total	61	0	33	0	0	0	4	2	0	

HOC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	6,331	1.20	60.1
Fair (MPHI)	1,729	0.33	16.4
Poor (MPHI)	2,472	0.47	23.5
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	4,638	0.88	44.0
Fair (FHS)	3,422	0.65	32.5
Poor (FHS)	2,472	0.47	23.5
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	15,463	2.93	90.0
Total Stream Length with Habitat Assessment	10,532	1.99	

HOC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	6,205	0	0	506	1,191	1,683	986	10,571
Miles	0.00	1.18	0.00	0.00	0.10	0.23	0.32	0.19	2.00
Percent of Total	0	59	0	0	5	11	16	9	

Summary

Hopkins Creek received an overall stream length weighted MPHI score of 66.10 and is classified as Fair. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system was 60.23, also Fair. The percent of Good streams in Hopkins Creek dropped from 60.1% to 44.0% with the addition of the infrastructure scores. This is mostly due to the buffer issues along River Road, in addition to multiple obstruction and headcut points.

Brewer Pond (BWP)

Subwatershed Description

Brewer Pond subwatershed covers 400.9 acres on the south shore of the tidal Severn River. The topography within the subwatershed is characterized by very steep slopes in the headwater tributaries, and steep valley slopes originating at the edge of broad well developed floodplains. The central floodplain within the subwatershed is especially expansive toward the confluence of the creek with the open water and has wetland areas common throughout the floodplain. The subwatershed is generally characterized by 74.1% forest, 15.3% residential woods, and 6.4% cropland. Together these uses represent a very low 1.0% impervious surface value. The entire 2.30 mile stream system has an intact forested buffer. Impervious areas are minimal with only a small area of residential development along the edge of the subwatershed. Perennial streams make up 57% of the stream miles in Brewer Pond. These streams are generally characterized as E type channels, low gradient, highly sinuous channels with broad well developed floodplains and F type channels, entrenched with broad well- developed floodplains, moderate sinuosity, and, G type channels, entrenched and unstable, were present in the steeper headwater regions.

Subwatershed Characteristics

BWP- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.3	0.1
IND – Industrial	0.0	0.0
OPS – Open space	11.8	2.9
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	4.6	1.1
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	61.2	15.3
SRC – Single Row Crops	25.8	6.4
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	297.3	74.1
Total Area	400.9	100.0
Impervious Area	4.0	1.0
Area served by BMPs	0.0	0.0

BWP- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	282	118	44	36	1.6	5.5	6.57E+11

*Fecal coliform bacteria reported in org/year

BWP- TR-20 Results

	Peak flows (cfs)
2-yr	750
100-yr	4239

Streams

BWP- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	5.3	5.3	0.05	0.08	<0.005	<0.005	<3	10

*Fecal coliform bacteria reported in org/100ml

BWP- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	6882	496	4464	0	0	0	321	0	0	12163
Miles	1.30	0.09	0.85	0.00	0.00	0.00	0.06	0.00	0.00	2.30
Percent of Total	57	4	37	0	0	0	3	0	0	

BWP- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	2,864	0.54	34.4
Fair (MPHI)	1,672	0.32	20.1
Poor (MPHI)	2,346	0.44	28.2
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	2,864	0.54	34.4
Fair (FHS)	1,672	0.32	20.1
Poor (FHS)	2,346	0.44	28.2
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	12,115	2.29	100.0
Total Stream Length with Habitat Assessment	6,882	1.30	

BWP- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	2,816	2,288	1,759	6,863
Miles	0.00	0.00	0.00	0.00	0.00	0.53	0.43	0.33	1.30
Percent of Total	0	0	0	0	0	41	33	26	

Summary

When considering infrastructure the percent of Good, Fair, and Poor habitat reaches remained stable. There were few infrastructure points present within the subwatershed. Brewer Pond received and overall stream length weighted MPHI of 59.18 and is classified as Fair. The overall stream length weighted FHS, which accounts for infrastructure on the stream system was 57.66, also Fair. Overall, Brewer Pond has over 50% of its streams in the Good and Fair range.

Dry weather sampling results within Brewer Pond revealed high nitrate concentrations, measured at 5.3 mg/L. The remaining water quality parameters are indicative of general good water quality.

Brewer Creek (BWC)

Subwatershed Description

Brewer Creek is situated between Brewer Pond and Clements Creek on the south shore of the tidal Severn River. The subwatershed covers approximately 439.1 acres of land that is characterized mostly by 53.4% residential land uses, including residential woods and medium-density residential development, and 41.8% forest. The topography is characterized by gently sloping upland areas with fairly steep headwaters of the tributaries and wide well developed floodplains downstream. The 2.70 miles of stream are composed of 58% perennial, 21% ephemeral, 13% intermittent, 5% wetland and 2% tidal. The entrenched and moderately sinuous F type channel is dominant within the subwatershed occupying 56% of the classifiable channels. Entrenched and unstable G type channels are present in the steep upstream headwaters and the low gradient, stable E type channels are present within the expansive most downstream portion of the mainstem floodplain.

Subwatershed Characteristics

BWC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	4.9	1.1
IND – Industrial	0.0	0.0
OPS – Open space	11.4	2.6
R11 – Residential 1 Acre lots	147.6	33.6
R12 – Residential ½ acre lots	49.7	11.3
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	37.4	8.5
SRC – Single Row Crops	4.7	1.1
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	183.4	41.8
Total Area	439.1	100.0
Impervious Area	29.7	6.8
Area served by BMPs	6.8	1.6

BWC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1045	362	125	55	8.4	8.3	3.68E+12

*Fecal coliform bacteria reported in org/year

BWC- TR-20 Results

	Peak flows (cfs)
2-yr	1046
100-yr	5180

Streams

BWC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.7	1.7	0.03	0.02	<0.005	<0.005	<3	4

*Fecal coliform bacteria reported in org/100ml

BWC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8330	1893	2942	0	0	0	332	765	0	14262
Miles	1.58	0.36	0.56	0.00	0.00	0.00	0.06	0.14	0.00	2.70
Percent of Total	58	13	21	0	0	0	2	5	0	

BWC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	4,484	0.85	53.8
Fair (MPHI)	2,033	0.39	24.4
Poor (MPHI)	604	0.11	7.3
Very Poor (MPHI)	1,209	0.23	14.5
Good (FHS)	4,484	0.85	53.8
Fair (FHS)	2,033	0.39	24.4
Poor (FHS)	604	0.11	7.3
Very Poor (FHS)	1,209	0.23	14.5
Forested Stream Length	11,406	2.16	80.0
Total Stream Length with Habitat Assessment	8,330	1.58	

BWC- Channel Classification Results

Stream Type	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	1,093	4,642	2,531	8,266
Miles	0.00	0.00	0.00	0.00	0.00	0.21	0.88	0.48	1.57
Percent of Total	0	0	0	0	0	13	56	31	

Summary

Brewer Creek received a weighted MPHI score of 70.34, within the Fair category. The FHS reflects the infrastructure impacts on the system and was also in the Fair range with a score of 64.05. Pipe and ditch points are fairly common in the downstream most portion of the subwatershed while a few obstruction points and an erosion point occur further upstream within the channel. Overall, 53.8% of the stream miles were in the Good category.

Brewer Shore (BWS)

Subwatershed Description

Brewer Shore is a very small subwatershed located on the southern shore of the tidal Severn. The 43.1 acre subwatershed is 100% medium-density residential land use. The subwatershed contains one fairly steep stream valley along the western edge of the watershed. A 0.13 mile ephemeral channel exists at the base of this stream valley. The remainder of the subwatershed is characterized by fairly steep slopes along the shores of the Severn River with more gently sloping headwater regions. The Brewer Shore subwatershed contains no perennial streams.

Subwatershed Characteristics

BWS- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	0.0	0.0
R11 – Residential 1 Acre lots	43.1	100
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
0.0 TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	0.0	0.0
Total Area	43.1	100.0
Impervious Area	4.7	11.0
Area served by BMPs	0.0	0.0

BWS- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	169	56	20	6	1.4	0.9	6.44E+11

*Fecal coliform bacteria reported in org/year

BWS- TR-20 Results

	Peak flows (cfs)
2-yr	305
100-yr	1140

Streams

BWS - Dry Weather Sampling Results

No streams located in BWS. No dry weather sample taken.

BWS- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	668	0	0	0	0	0	0	688
Miles	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Percent of Total	0	0	100	0	0	0	0	0	0	

BWS - Habitat Assessment Results

No perennial streams located in BWS. Habitat assessment not conducted.

BWS – Channel Classification Results

No classifiable streams located in BWS. Channel classification not conducted.

Summary

No flowing streams were located in Brewer Shore. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Clements Creek (CLC)

Subwatershed Description

The Clements Creek subwatershed is located on the south shore of the Severn River, and encompasses 757.3 acres. Residential land use dominates the subwatershed, including 37.8% medium- and 24.1% low-density development. The subwatershed is 36.9% wooded, which is concentrated along the stream systems, resulting in 92% of the stream length being forested. Sixty-nine percent of the stream miles are perennial and 22% are ephemeral. The channel classifications include 72% E type, very efficient, stable, meandering channels on low gradients, 24% G type, entrenched channels on moderate gradients, and 4% C type, meandering channels on low gradients with well developed floodplains.

Subwatershed Characteristics

CLC- Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	6.8	0.9
R11 – Residential 1 Acre lots	157.2	20.8
R12 – Residential ½ acre lots	128.8	17.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	1.3	0.2
RWD – Residential woods	181.3	23.9
SRC – Single Row Crops	1.2	0.2
TRN – Transportation	0.0	0.0
WAT – Water	1.3	0.2
WDS – Woods	279.4	36.9
Total Area	757.3	100.0
Impervious Area	45.8	6.0
Area served by BMPs	22.2	2.9

CLC- PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1654	587	194	94	12.9	14.3	5.81E+12

*Fecal coliform bacteria reported in org/year

CLC- TR-20 Results

	Peak flows (cfs)
2-yr	639
100-yr	4123

Streams

CLC- Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.61	0.61	0.05	0.03	<0.005	<0.005	4	3

*Fecal coliform bacteria reported in org/100ml

CLC- Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	15240	0	4858	293	0	614	671	387	0	22063
Miles	2.89	0.00	0.92	0.06	0.00	0.12	0.13	0.07	0.00	4.18
Percent of Total	69	0	22	1	0	3	3	2	0	

CLC- Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	7,302	1.38	47.9
Fair (MPHI)	3,753	0.71	24.6
Poor (MPHI)	3,932	0.74	25.8
Very Poor (MPHI)	264	0.05	1.7
Good (FHS)	7,302	1.38	47.9
Fair (FHS)	0	0.00	0.0
Poor (FHS)	7,685	1.46	50.4
Very Poor (FHS)	264	0.05	1.7
Forested Stream Length	20,265	3.84	92.0
Total Stream Length with Habitat Assessment	15,251	2.89	

CLC- Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	656	0	0	11,717	0	3,925	16,298
Miles	0.00	0.00	0.12	0.00	0.00	2.22	0.00	0.74	3.09
Percent of Total	0	0	4	0	0	72	0	24	

Summary

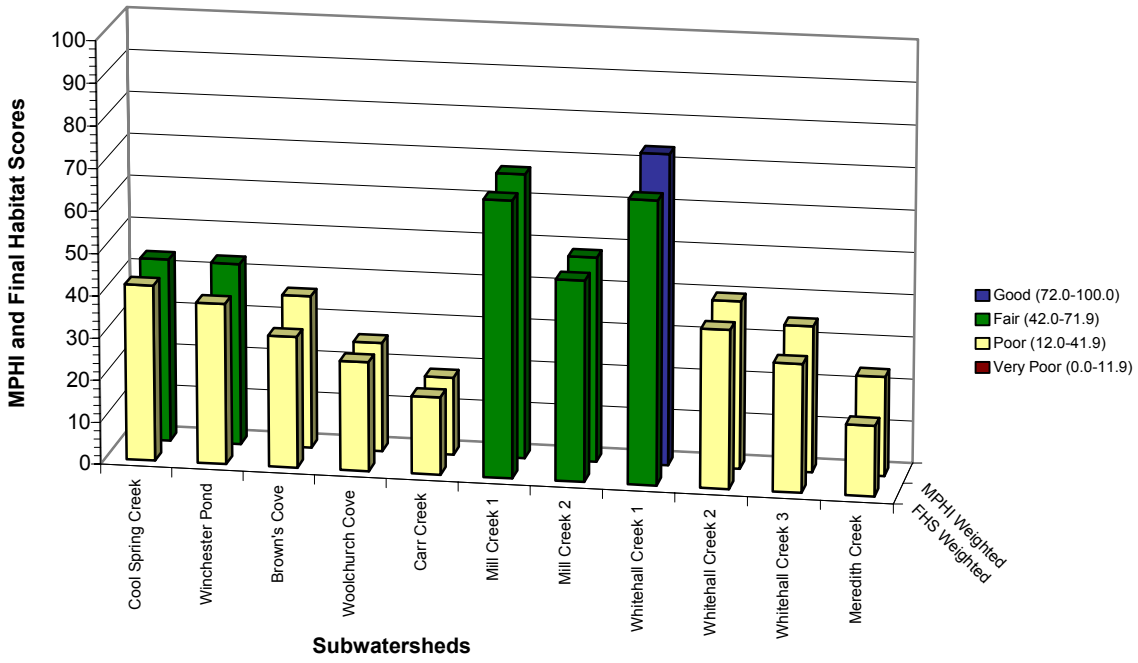
The Clements Creek subwatershed received and overall weighted MPHI of 57.69, a rating of Fair. The subwatershed received an overall FHS, which considers the affects of infrastructure on the stream system, of 53.38, also a Fair rating. The habitat scores listed as Good, Poor and Very Poor remained stable when considering infrastructure impacts. All of the stream systems that received an MPHI rating of Fair (24.6%) were rated as Poor when considering infrastructure. The reduction of habitat score and rating due to infrastructure is the result of bank erosion, channel obstructions, pipes and ditches observed within these stream reaches.

4.3 Lower North Shore of Tidal Severn

The Lower North Shore of the Tidal Severn includes 15 subwatersheds ranging in size from less than 100 acres in Jonas Green Pond, to over 1,500 acres in Mill Creek 2. Nine of the subwatersheds in this area, including Pendennis Mount Pond and Woolchurch Cove, are relatively small, drain directly to the tidal Severn and do not have major perennial systems. The Mill Creek and Whitehall Creek drainage areas are larger and are characterized by well developed streams, wetlands and floodplains along their mainstems. The Rte 50/301 transportation corridor is a major influence in this area of the Severn as it either bisects or borders nine of the subwatersheds in this area.

Eleven of the 15 of the subwatersheds in this area have perennial streams with habitat assessments conducted. The overall stream length weighted subwatershed Maryland Physical Habitat Index (MPHI) and Final Habitat Scores (FHS) are presented in Figure 4.3 to highlight the difference between the MPHI and the FHS. The average difference between the MPHI and FHS for the lower north shore was 3.2, with Meredith Creek and Whitehall Creek 1 having the biggest influences from infrastructure and environmental features. Whitehall Creek 1 was the only subwatershed with a Good MPHI rating and the only one to drop from one category to another.

Figure 4.3 Stream length Weighted Subwatershed Scores (MPHI Scores are displayed in the back row)



The following sections summarize the results of the stream assessment and modeling. The *Subwatershed Description* section describes pertinent land use data, subwatershed features and the types and classifications of the stream channels. *Subwatershed Characteristics* are then presented including land use data and PLOAD and TR-20 modeling results. The *Streams* section presents water quality data, stream type results, habitat information including MPHI and FHS and channel classification results. Refer to Section 2.5 for information on the derivation and categories used for the MPHI and FHS. The final *Summary* briefly interprets the habitat scores and gives the primary and probable influences on the score.

Cool Spring Creek (CSC)

Subwatershed Description

Cool Spring Creek subwatershed covers 114.4 acres and is located immediately north of MD 50 on the north shore of the tidal Severn River. The land use within the subwatershed is unique in that it is 87.9% residential woods. The remainder of the land use is spread between low-density residential (5.7%), transportation (3.9%), and forest (2.5%). The topography within the subwatershed is characterized by steep slopes with wide flood plains at the base of the valleys. Only 0.16 miles of perennial stream exist within the Cool Spring Creek subwatershed. Perennial streams make up 44% of the stream miles in Cool Spring Creek and are generally comprised of E type channels with high entrenchment ratios, indicating good floodplain connectivity and wide floodplains. Braided DA type channels were also fairly prevalent in the broad downstream valleys. The perennial stream system is located in the southeastern section of the subwatershed. Wetland systems exist at the base of three other valleys within the subwatershed.

Subwatershed Characteristics

CSC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	0.0	0.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	6.5	5.7
RWD – Residential woods	100.6	87.9
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	4.5	3.9
WAT – Water	0	0
WDS – Woods	2.8	2.5
Total Area	114.4	0.0
Impervious Area	114.4	8.4
Area served by BMPs	4.6	4.0

CSC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	237	86	32	25	2.6	13.6	6.62E+11

*Fecal coliform bacteria reported in org/year

CSC - TR-20 Results

	Peak flows (cfs)
2-yr	76
100-yr	809

Streams

CSC - Dry Weather Sampling Results

No samples were taken.

CSC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	830	269	107	249	0	0	0	307	127	1889
Miles	0.16	0.05	0.02	0.05	0	0	0	0.06	0.02	0.36
Percent of Total	44	14	6	13	0	0	0	16	7	

CSC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	534	0.10	64.3
Poor (MPHI)	296	0.06	35.7
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	242	0.05	29.2
Poor (FHS)	588	0.11	70.8
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	0	0.00	0.0
Total Stream Length with Habitat Assessment	830	0.16	

CSC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	292	550	0	0	842
Miles	0.00	0.00	0.00	0.00	0.06	0.10	0.00	0.00	0.16
Percent of Total	0	0	0	0	35	65	0	0	

Summary

The percent of stream miles within the Poor category rose from 35.7% to 70.8% with the addition of the infrastructure scores. The subwatershed in fact had very minimal infrastructure impact. There were only three habitat assessments performed for the subwatershed and all the MPHI scores were just above the Fair range so, with only minor infrastructure reductions they are categorized as Poor.

Overall, Cool Spring Creek received a stream length weighted MPHI score of 43.44 and a Final Habitat Score of 41.67, both in the Fair category. There was minimal infrastructure impact in the subwatershed as indicated by the small difference between the MPHI and FHS.

Winchester Pond (WCP)

Subwatershed Description

Winchester Pond is located on the north shore of the Severn River just south of MD 50. The watershed is relatively small covering 107.7 acres. The topography is characterized by relatively steep slopes in the headwaters and wide floodplains in the downstream valleys. Open space and wooded areas are the most highly represented land uses within the subwatershed. Forested areas along with residential woods cover the middle portions of the watershed and account for approximately 50% of the land use. The only stream system within the subwatershed is located within these two land uses resulting in a 100% forested stream length value. Of the 0.18 mile stream system in Winchester Pond, 7% is tidal, 53% perennial, 17% ephemeral and 23% ditch. Entrenched and unstable G type channels characterize all of the 0.13 miles of classifiable channels.

Subwatershed Characteristics

WCP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	29.1	27.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	13.6	12.6
RWD – Residential woods	19.3	17.9
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	11.0	10.2
WAT – Water	0	0
WDS – Woods	34.7	32.3
Total Area	107.7	100.0
Impervious Area	11.8	10.9
Area served by BMPs	0.6	0.5

WCP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	286	94	43	32	4.4	28.7	7.70E+11

*Fecal coliform bacteria reported in org/year

WCP - TR-20 Results

	Peak flows (cfs)
2-yr	253
100-yr	1502

Streams

WCP - Dry Weather Sampling Results

No samples were taken.

WCP - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	512	0	160	225	0	0	65	0	0	962
Miles	0.10	0	0.03	0.04	0	0	0.01	0	0	0.18
Percent of Total	53	0	17	23	0	0	7	0	0	

WCP - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	512	0.10	100.0
Poor (MPHI)	0	0.00	0.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	512	0.10	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	962	0.18	100.0
Total Stream Length with Habitat Assessment	512	0.10	

WCP - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	0	0	670	670
Miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
Percent of Total	0	0	0	0	0	0	0	100	

Summary

There was only one habitat assessment performed for Winchester Pond. The habitat reach received an MPHI score of 43.10, placing it in the Fair category. With the addition of the infrastructure scores, Winchester Pond received a Final Habitat Score of 38.10, in the Poor category. The drop in scores is indicative of two moderate scoring impacts, a fairly long buffer encroachment and a ditch, which is causing some erosion.

Browns Cove (BRC)

Subwatershed Description

Browns Cove subwatershed covers 186.2 acres on the lower north shore of the tidal Severn. Steep valley slopes with wide floodplains in the valley bottom characterize the topography of this subwatershed. The northern headwaters of Browns Cove are dominated by transportation land use with the MD 450/MD 50 interchange. Transportation accounts for 22.2% of the land use within the subwatershed. Forest and residential woods account for approximately 57% of the land use. Although forested areas are prevalent within the subwatershed they occur mostly in the headwaters and not along the stream channels. Of the 0.74 miles of stream in Browns Cove, only 38% have intact-forested buffer.

The 0.74 mile stream system is comprised of 63% perennial, 19% ephemeral, 10% tidal, 6% SWM, and 2% ditch. The most dominant channel type within Browns Cove is the low gradient, very highly sinuous E type channel. Also existent within the subwatershed is the entrenched meandering F type channel with high width/depth ratios.

Subwatershed Characteristics

BRC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.1	0.0
IND – Industrial	0.0	0.0
OPS – Open space	15.0	8.1
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	22.3	12.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	38.4	20.6
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	42.5	22.8
WAT – Water	0.0	0.0
WDS – Woods	68.0	36.5
Total Area	186.2	100.0
Impervious Area	41.4	22.2
Area served by BMPs	11.3	6.1

BRC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	775	186	107	86	13.7	107.8	2.32E+12

*Fecal coliform bacteria reported in org/year

BRC - TR-20 Results

	Peak flows (cfs)
2-yr	374
100-yr	1886

Streams

BRC - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	0.61	0.61	<0.01	0.02	<0.005	<0.005	<3	14

*Fecal coliform bacteria reported in org/100ml

BRC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2461	0	743	82	218	0	387	0	0	3891
Miles	0.47	0	0.14	0.02	0.04	0	0.07	0	0	0.74
Percent of Total	63	0	19	2	6	0	10	0	0	

BRC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	1,183	0.22	48.1
Poor (MPHI)	1,278	0.24	51.9
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	2,461	0.47	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	1,489	0.28	38.0
Total Stream Length with Habitat Assessment	2,461	0.47	

BRC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	1741	684	0	2,425
Miles	0.00	0.00	0.00	0.00.0	0.00	0.33	0.13	0.00	0.46
Percent of Total	0	0	0	0	0	72	28	0	

Summary

The single habitat reach receiving a Fair MPHI score fell to the Poor category with the addition of the infrastructure scores. Overall, Browns Cove received a stream length weighted MPHI score of 36.19 and a Final Habitat Score of 31.08, both in the Poor category. The impacts of transportation were certainly evident within this subwatershed with a very high number of ditch and pipe points recorded.

Jonas Green Pond (JGP)

Subwatershed Description

Covering only 58.4 acres, Jonas Green Pond is a very small subwatershed. The subwatershed is located east of Annapolis on the north shore of the Severn River. Medium-density residential is the dominant land use occupying approximately 58% of the subwatershed. Wooded areas account for much of the remaining land use, covering 28% of the subwatershed. The subwatershed is characterized by steep cliffs along the shore of the Severn with relatively flat topography in the headwaters. Two valleys exist within the subwatershed, one at the northern edge of the subwatershed and one at the southern edge. Neither valley contains a stream system. Jonas Green Pond subwatershed contains no flowing streams or defined channels.

Subwatershed Characteristics

JGP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	4.3	7.4
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	33.6	57.5
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	10.2	17.4
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	4.0	6.8
WAT – Water	0.0	0.0
WDS – Woods	6.4	10.9
Total Area	58.4	100.0
Impervious Area	8.9	15.3
Area served by BMPs	2.9	4.9

JGP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	245	79	31	16	2.8	11.1	8.43E+11

*Fecal coliform bacteria reported in org/year

JGP - TR-20 Results

	Peak flows (cfs)
2-yr	114
100-yr	690

Streams

JGP - Dry Weather Sampling Results

No samples were taken

JGP - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	0	1036	0	0	0	0	0	1036
Miles	0	0	0	0.20	0	0	0	0	0	0.20
Percent of Total	0	0	0	100	0	0	0	0	0	

JGP - Habitat Assessment Results
No streams located in MRP. Habitat Assessment not conducted.

JGP - Channel Classification Results
No classifiable channels located in JGP. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in the Jonas Green Pond subwatershed. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Pendennis Mount Pond (PMP)

Subwatershed Description

Pendennis Mount Pond is located northeast of Annapolis on the northern shore of the Severn River. The subwatershed is situated between Jonas Green Pond and Woolchurch Cove. Pendennis Mount Pond is small with a total area of 92.4 acres. The land use in the subwatershed is dominated my medium-density residential use. The residential land use along with 1.2% commercial and 8.3% transportation give Pendennis Mount Pond an imperviousness of 19.6%.

Subwatershed Characteristics

PMP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	1.1	1.2
IND – Industrial	0.0	0.0
OPS – Open space	0.0	0.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	70.6	76.4
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	7.7	8.3
WAT – Water	0.0	0.0
WDS – Woods	13.0	14.1
Total Area	92.4	100.0
Impervious Area	18.1	19.6
Area served by BMPs	0.2	0.2

PMP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	498	161	65	30	5.7	21.2	1.70E+12

*Fecal coliform bacteria reported in org/year

PMP - TR-20 Results

	Peak flows (cfs)
2-yr	319
100-yr	1366

Streams

PMP - Dry Weather Sampling Results

No Samples were taken.

PMP - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	1609	18	0	0	0	0	0	1627
Miles	0	0	0.30	0	0	0	0	0	0	0.31
Percent of Total	0	0	99	1	0	0	0	0	0	

PMP - Habitat Assessment Results

No perennial streams in PMP. Habitat assessment not conducted.

PMP - Channel Classification Results

No classifiable channels located in PMP. Channel classification not conducted.

Summary

No flowing streams or classifiable channels were located in Pendennis Mount Pond. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Woolchurch Cove (WCC)

Subwatershed Description

Woolchurch Cove is situated between Pendennis Mount Pond and Carr Creek on the lower north shore of the tidal Severn River. Much of the subwatershed is within the Naval Surface Warfare Center, Annapolis Detachment, facility. Of the 269.7 acres in Woolchurch Cove, 56.8% is occupied by commercial land use. The commercial land use along with 10.7% high-density residential land use results in an imperviousness value of 50.1% for the subwatershed, the highest of all subwatersheds. The majority of the commercial land use occupies the gently sloping southern half of the subwatershed. The northern portions are characterized by steep stream valleys with relatively flat headwaters. Two stream systems drain into Woolchurch Cove. There is a small 0.XX mile intermittent system draining in a southwesterly direction from the eastern portion of the watershed. A majority of this system is surrounded by forested land use. The second stream system present originates in the northwestern area of the subwatershed and drains in a southerly direction to the tidal open water of Woolchurch Cove. This system originates as a 0.03 mile wetland that drains to a 0.09 mile long perennial section which then drains into the tidal portions of Woolchurch Cove. This system is almost entirely surrounded by open space land use. Of the 0.34 miles of stream within Woolchurch Cove, only 33.0% has intact forested buffer.

Subwatershed Characteristics

WCC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	153.2	56.8
IND – Industrial	0.0	0.0
OPS – Open space	19.6	7.3
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	28.9	10.7
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	12.2	4.5
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	6.8	2.5
WDS – Woods	48.9	18.1
Total Area	269.7	100.0
Impervious Area	135.2	50.1
Area served by BMPs	0.9	0.3

WCC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	2648	902	344	179	23	23.7	6.90E+12

*Fecal coliform bacteria reported in org/year

WCC - TR-20 Results

	Peak flows (cfs)
2-yr	1657
100-yr	5137

Streams

WCC - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	1.19	0.69	0.32	0.01	<0.005	<0.005	4	6

*Fecal coliform bacteria reported in org/100ml

WCC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	465	315	371	0	0	0	467	177	0	1795
Miles	0.09	0.06	0.07	0	0	0	0.09	0.03	0	0.34
Percent of Total	26	18	21	0	0	0	26	10	0	

WCC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	464	0.09	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	464	0.09	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	586	0.11	33.0
Total Stream Length with Habitat Assessment	464	0.09	

WCC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	462	0	0	462
Miles	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.09
Percent of Total	0	0	0	0	0	100	0	0	

Summary

There was one short habitat assessment performed in Woolchurch Cove. The subwatershed received an MPHI and FHS score of 25.90, placing it in the Poor category. There were no infrastructure impacts recorded within the stream system. The low scores simply reflect the lack of habitat mostly due to extremely low flows which limit habitat variability.

Carr Creek (CRC)

Subwatershed Description

Carr Creek subwatershed is 398.8 acres located on the lower north shore of the tidal Severn River. Carr Creek is situated between Woolchurch Cove and Mill Creek. Carr Creek subwatershed is located entirely within the Naval Surface Warfare Center, Annapolis Detachment, facility. The land use within the subwatershed is dominated by open space (59.0%), with most of the remaining commercial land use (33.1%). The topography within the entire watershed is flat to gently sloping. There are two stream systems present that drain in an easterly direction to the northern portion of the open water of Carr Creek. There is a 0.11 mile ephemeral channel system and a 0.07 mile perennial system. The perennial system is classified as an E type channel with high entrenchment ratios, indicating good flood plain connectivity and wide floodplains. Both systems are heavily surrounded by forested land use leading to a 79% forested stream length.

Subwatershed Characteristics

CRC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	131.9	33.1
IND – Industrial	0.0	0.0
OPS – Open space	235.3	59.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	1.0	0.3
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	30.6	7.7
Total Area	398.8	0.0
Impervious Area	112.2	28.1
Area served by BMPs	0.0	0.0

CRC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL (Non-point Source)	2191	752	293	164	19	22.1	5.52E+12
TOTAL (Point Source)		1773.9	6205				1.934E+10

*Fecal coliform bacteria reported in org/year

CRC - TR-20 Results

	Peak flows (cfs)
2-yr	1442
100-yr	4446

Streams

CRC - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	1.32	0.92	0.53	<0.01	<0.005	<0.005	70	24

*Fecal coliform bacteria reported in org/100ml

CRC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	381	0	563	0	0	0	246	0	0	1190
Miles	0.07	0	0.11	0	0	0	0.05	0	0	0.23
Percent of Total	32	0	47	0	0	0	21	0	0	

CRC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	379	0.07	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	379	0.07	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	944	0.18	79.0
Total Stream Length with Habitat Assessment	379	0.07	

CRC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	372	0	0	372
Miles	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.07
Percent of Total	0	0	0	0	0	100	0	0	

Summary

Overall, Carr Creek receive a weighted MPHI score and a Final Habitat Score of 18.4, placing it within the Poor category for both. There were no infrastructure impacts reported within the habitat assessment reach. The low scores simply reflect the lack of habitat.

Mill Creek 1 (MC1)

Subwatershed Description

Mill Creek 1 is a very large subwatershed located on the lower north shore of the tidal Severn River. The Mill Creek 1 subwatershed drains 1430.2 acres and consists of the largest tributary draining into the open water portion of Mill Creek. The topography within the subwatershed is characterized by very wide well developed floodplains, especially so in the downstream portions of the subwatershed, and moderate to steep slopes originating from the edge of the floodplain. Few flat areas exist within the subwatershed other than within the floodplains. Wooded areas consisting of 38.9% forest and 21.9% residential woods dominate land use within the subwatershed. Residential development accounts for 27.8% of the land use and includes 16.4% medium-density, 9.6% high-density, and 1.8% low-density residential development. Commercial properties are spread throughout the subwatershed and accounts for 6.6% of the land use.

The stream system in Mill Creek 1 is 5.99 miles in length and consists of 66% perennial, 26% ephemeral, 6% wetland, 2% floodway and 1% ditch. Of the 3.92 miles of classifiable channels the most highly represented channel type is the low gradient, very highly sinuous E type channel with broad well developed floodplains. Entrenched and unstable G type, as well as the slightly entrenched C type channels are found in the upstream portions of the tributaries to the Mill Creek 1 mainstem. The stream system in Mill Creek 1 is buffered by forest for 83% of its length.

Subwatershed Characteristics

MC1 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	93.8	6.6
IND – Industrial	0.0	0.0
OPS – Open space	20.2	1.4
R11 – Residential 1 Acre lots	86.1	6.0
R12 – Residential ½ acre lots	148.9	10.4
R14 – Residential ¼ acre lots	32.0	2.2
R18 – Residential 1/8 acre lots	106.3	7.4
R21 – Residential 2 acre lots	25.1	1.8
RWD – Residential woods	312.5	21.9
SRC – Single Row Crops	1.3	0.1
TRN – Transportation	45.9	3.2
WAT – Water	1.4	0.1
WDS – Woods	556.7	38.9
Total Area	1430.2	100.0
Impervious Area	211.5	14.8
Area served by BMPs	311.6	21.8

MC1 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	4877	1669	614	349	49.1	152.9	1.59E+13

*Fecal coliform bacteria reported in org/year

MC1 - TR-20 Results

	Peak flows (cfs)
2-yr	2800
100-yr	13626

Streams

MC1 - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	1.10	1.10	0.06	<0.01	<0.005	<0.005	9	11

*Fecal coliform bacteria reported in org/100ml

MC1 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	20747	0	8183	174	0	0	0	2008	494	31606
Miles	3.93	0	1.55	0.03	0	0	0	0.38	0.09	5.99
Percent of Total	66	0	26	1	0	0	0	6	2	

MC1 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	10,387	1.97	50.8
Fair (MPHI)	6,399	1.21	31.3
Poor (MPHI)	3,282	0.62	16.1
Very Poor (MPHI)	679	0.13	3.3
Good (FHS)	10,387	1.97	50.8
Fair (FHS)	6,399	1.21	31.3
Poor (FHS)	3,282	0.62	16.1
Very Poor (FHS)	679	0.13	3.3
Forested Stream Length	26,100	4.94	83.0
Total Stream Length with Habitat Assessment	20,428	3.87	

MC1 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	3,547	0	1,104	10,188	1,693	4,152	20,684
Miles	0.00	0.00	0.67	0.00	0.21	1.93	0.32	0.79	3.92
Percent of Total	0	0	17	0	5	49	8	20	

Summary

The downstream portions of Mill Creek 1 above Route 50 are well preserved with numerous wetland systems within the broad, developed floodplains. The highest habitat scores were found in this region.

Mill Creek 1 received an overall stream length weighted MPHI score of 67.40 and a final habitat assessment score of 65.51. Both scores are well within the Fair classification, not far from Good. There is only slight variation between the scores due to the lack of a significant amount of infrastructure points. Fortunately a majority of the stream system is bordered by forested landuse and as such has remained fairly well preserved.

Mill Creek 2 (MC2)

Subwatershed Description

The Mill Creek 2 subwatershed covers 1581.9 acres on the lower north shore of the tidal Severn River. The subwatershed consists of all the minor tributaries that drain directly to the open water portions of Mill Creek. There are a total of 7 perennial systems draining into the open water portion of Mill Creek. The Mill Creek 1 subwatershed covers the drainage area for the most significant of the tributaries, considered the mainstem of Mill Creek. The Mill Creek 2 subwatershed consists of the remaining 6 perennial tributaries along with a single intermittent system draining in a northeasterly direction on the western shore of Mill Creek.

Land use within Mill Creek 2 is dominated by residential uses. Residential land uses including medium-density (25.1%), low-density (9.3%), high-density (2.5%), and residential wooded (25.9%) account for 62.8% of the land use within the subwatershed. A majority of the remaining land use is accounted for by forest (21.3%). The forested land uses provide for a 70% forested buffer along the stream system.

There are 4.47 miles of stream within Mill Creek 2. The stream system consists of 40% perennial, 23% ephemeral/intermittent, 17% tidal, 12% floodway, and 8% ditch. Of the 1.87 miles of classifiable channel 84% are E type or low gradient and very highly sinuous with well developed flood plains. The remaining 16% of the stream miles are characterized as unstable and entrenched G type channels.

Subwatershed Characteristics

MC2 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	19.6	1.2
IND – Industrial	0.0	0.0
OPS – Open space	103.3	6.5
R11 – Residential 1 Acre lots	185.0	11.7
R12 – Residential ½ acre lots	211.9	13.4
R14 – Residential ¼ acre lots	35.8	2.3
R18 – Residential 1/8 acre lots	2.7	0.2
R21 – Residential 2 acre lots	147.6	9.3
RWD – Residential woods	409.5	25.9
SRC – Single Row Crops	106.6	6.7
TRN – Transportation	19.5	1.2
WAT – Water	3.9	0.2
WDS – Woods	336.5	21.3
Total Area	1581.9	100.0
Impervious Area	130.1	8.2
Area served by BMPs	107.7	6.8

MC2 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	3987	1391	522	243	35.1	79.4	1.35E+13

*Fecal coliform bacteria reported in org/year

MC2 - TR-20 Results

	Peak flows (cfs)
2-yr	5112
100-yr	24650

Streams

MC2 - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	0.38	0.38	0.03	<0.01	<0.005	<0.005	<3	10

*Fecal coliform bacteria reported in org/100ml

MC2 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	9538	349	5073	1902	0	0	3951	0	2772	23585
Miles	1.81	0.07	0.96	0.36	0	0	0.75	0	0.52	4.47
Percent of Total	40	1	22	8	0	0	17	0	12	

MC2 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	908	0.17	9.5
Fair (MPHI)	4,167	0.79	43.7
Poor (MPHI)	4,464	0.85	46.8
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	908	0.17	9.5
Fair (FHS)	4,167	0.79	43.7
Poor (FHS)	4,464	0.85	46.8
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	16,695	3.16	70.0
Total Stream Length with Habitat Assessment	9,539	1.81	

MC2 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	8,345	0	1,550	9,895
Miles	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.29	1.87
Percent of Total	0	0	0	0	0	84	0	16	

Summary

The percent of stream miles within each of the habitat assessment categories remained the same with the addition of the infrastructure scores. Though there were infrastructure points present, very few of them were indicative of degraded conditions.

Overall, Mill Creek 2 received a stream length weighted MPHI score of 48.53 and a final habitat assessment score of 47.55, both in the Fair category. There was very little infrastructure impact in the subwatershed as indicated by the small difference between the MPHI and FHS.

Whitehall Creek 1 (WH1)

Subwatershed Description

Whitehall Creek 1 is a large subwatershed located on the lower north shore of the tidal Severn River. The Whitehall Creek 1 subwatershed drains 739.1 acres and includes the largest perennial tributary draining to the open water portion of Whitehall Creek. Topography within the subwatershed is characterized by wide, well developed floodplains along stream channels in the downstream portions of the subwatershed, with moderate slopes originating from the edge of the floodplain. A wide variety of landuses occur within the subwatershed. The most highly represented landuses include woods (35.7%), low-density residential (15.2%), transportation (9.7%), and commercial (8.1%). These landuses combine for a fairly high 21.8% impervious value.

There are 4.46 miles of stream within the Whitehall Creek 1 subwatershed. Perennial (47%) and ephemeral (27%) streams account for a majority of the stream miles. Channel classifications were performed on 2.24 miles of stream. The channel classifications reflect the floodplain connectivity present within the subwatershed. E and DA type channels are all found within broad well-developed floodplains. E type channels have low gradients and high sinuosity while DA type channels are braided systems. A short section of F type channel is present within the transition area from the open water section of Whitehall Creek into the more confined main tributary. F type channels are entrenched meandering systems on low gradients with high width/depth ratios. A section of entrenched and unstable G type channel is also found within the subwatershed within the northern headwaters.

Subwatershed Characteristics

WH1 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	59.8	8.1
IND – Industrial	0.0	0.0
OPS – Open space	23.0	3.1
R11 – Residential 1 Acre lots	29.6	4.0
R12 – Residential ½ acre lots	27.0	3.6
R14 – Residential ¼ acre lots	58.5	7.9
R18 – Residential 1/8 acre lots	33.8	4.6
R21 – Residential 2 acre lots	112.7	15.2
RWD – Residential woods	41.7	5.6
SRC – Single Row Crops	17.3	2.3
TRN – Transportation	72.0	9.7
WAT – Water	0.0	0.0
WDS – Woods	263.8	35.7
Total Area	739.1	0.0
Impervious Area	157.0	21.2
Area served by BMPs	174.8	23.6

WH1 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	3371	1112	465	263	41.3	198.3	1.06E+13

*Fecal coliform bacteria reported in org/year

WH1 - TR-20 Results

	Peak flows (cfs)
2-yr	1354
100-yr	6422

Streams

WH1 - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	0.58	0.58	0.28	0.03	0.008	<0.005	<3	4

*Fecal coliform bacteria reported in org/100ml

WH1 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	11033	0	6259	3009	1169	0	0	1763	301	23534
Miles	2.09	0	1.19	0.57	0.22	0	0	0.33	0.06	4.46
Percent of Total	47	0	27	13	5	0	0	7	1	

WH1 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	6,847	1.30	62.1
Fair (MPHI)	3,291	0.62	29.8
Poor (MPHI)	480	0.09	4.4
Very Poor (MPHI)	413	0.08	3.7
Good (FHS)	6,847	1.30	62.1
Fair (FHS)	3,291	0.62	29.8
Poor (FHS)	480	0.09	4.4
Very Poor (FHS)	413	0.08	3.7
Forested Stream Length	15,732	2.98	67.0
Total Stream Length with Habitat Assessment	11,031	2.09	

WH1 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	1,385	8,266	1,349	804	11,804
Miles	0.00	0.00	0.00	0.00	0.26	1.57	0.26	0.15	2.24
Percent of Total	0	0	0	0	12	70	11	7	

Summary

The percent of stream miles within each habitat assessment category remained stable with the addition of the infrastructure impact scores. Approximately 92% of the stream miles fall within the Good and Fair habitat assessment categories.

Whitehall Creek 1 received an overall stream length weighted MPHI score of 73.63 and is classified as Good. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system was 67.08 and is classified as Fair. Although there were many infrastructure points recorded throughout the subwatershed, their impact on the system is not severe.

Whitehall Creek 2 (WH2)

Subwatershed Description

The Whitehall Creek 2 subwatershed covers 912.5 acres on the lower north shore of the tidal Severn River. The subwatershed includes the minor tributaries that drain directly to the open water portions of Whitehall Creek from the western shore of the Creek. The Whitehall Creek 2 subwatershed consists of 4 perennial, 6 ephemeral, and 1 wetland system which drain from the western shore of the open water portion of Whitehall Creek. The most prevalent landuses within the subwatershed include cropland (30.9%), residential woods (21.3%), forest (16.5%), and low-density residential (14.4%). The forested landuses provide for forested buffers along 74% of the stream system.

There are 2.35 miles of stream within Whitehall Creek 2. The stream system includes 37% perennial, 37% ephemeral, 11% tidal, 9% ditch, and 5% intermittent. Of the 0.87 miles of classifiable channel 74% are E type with low gradients, highly sinuosity, and well developed flood plains. The remaining 26% of the stream miles are characterized as braided, stable DA type channels with well vegetated floodplains and associated wetlands.

Subwatershed Characteristics

WH2 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	3.1	0.3
IND – Industrial	0.0	0.0
OPS – Open space	25.8	2.8
R11 – Residential 1 Acre lots	85.0	9.3
R12 – Residential ½ acre lots	0.0	0. 0
R14 – Residential ¼ acre lots	39.7	4.4
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	131.8	14.4
RWD – Residential woods	194.6	21.3
SRC – Single Row Crops	281.6	30.9
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	150.9	16.5
Total Area	912.5	100.0
Impervious Area	44.1	4.8
Area served by BMPs	9.4	1.0

WH2 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	1664	543	292	83	11.5	12.6	5.37E+12

*Fecal coliform bacteria reported in org/year

WH2 - TR-20 Results

	Peak flows (cfs)
2-yr	2231
100-yr	8864

Streams

WH2 - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	13.00	0.00	1.1	0.01	<0.005	<0.005	30	170

*Fecal coliform bacteria reported in org/100ml

WH2 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	4612	640	4525	1155	0	60	1391	0	0	12383
Miles	0.87	.012	0.86	0.22	0	0.01	0.26	0	0	2.35
Percent of Total	37	5	37	9	0	0	11	0	0	

WH2 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	1,447	0.27	31.4
Poor (MPHI)	3,158	0.60	68.6
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	1,447	0.27	31.4
Poor (FHS)	3,158	0.60	68.6
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	9,215	1.75	74.0
Total Stream Length with Habitat Assessment	4,605	0.87	

WH2 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	1,199	3,404	0	0	4,603
Miles	0.00	0.00	0.00	0.00	0.23	0.64	0.00	0.00	0.87
Percent of Total	0	0	0	0	26	74	0	0	

Summary

The percent of stream miles within each habitat assessment category remained stable with the addition of the infrastructure impact scores. Whitehall Creek 2 received an overall stream length weighted MPHI score of 39.78 and is classified as Poor. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system was 37.58 and is also classified as Poor. The only infrastructure points recorded within the subwatershed were crossing points, and only one received a moderate score due to downstream bed erosion. Overall, the infrastructure points recorded did not indicate an impacted stream system.

Whitehall Creek 3 (WH3)

Subwatershed Description

The Whitehall Creek 3 subwatershed covers 417.0 acres on the lower north shore of the tidal Severn River. The drainage area includes 4 tributaries draining the eastern shore of the tidal portion of Whitehall Creek. The most prevalent landuses within the subwatershed are forest (25.8%), cropland (20.3%), open space (18.3%), medium-density residential (11.3%), and low-density residential (9.5%). Forested landuses provide for forested buffers along 80% of the stream system.

There are 1.11 miles of stream in the Whitehall Creek 3 subwatershed. The stream miles consist of 29% perennial, 25% ephemeral, 21% ditch, 12% tidal, 10% intermittent and 4% SWM. Of the 0.31 miles of classifiable channel, 64% are E type with low gradients and very high sinuosity, along with well developed flood plains. The remaining 36% of the stream miles are characterized as unstable and entrenched G type channels occurring in the upstream headwater reaches.

Subwatershed Characteristics

WH3 - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	23.0	5.5
IND – Industrial	0.0	0.0
OPS – Open space	76.2	18.3
R11 – Residential 1 Acre lots	47.3	11.3
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	39.6	9.5
RWD – Residential woods	24.0	5.8
SRC – Single Row Crops	84.7	20.3
TRN – Transportation	14.0	3.4
WAT – Water	0.8	0.2
WDS – Woods	107.4	25.8
Total Area	417.0	100.0
Impervious Area	42.2	10.1
Area served by BMPs	12.2	2.9

WH3 - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	1099	360	174	82	11.3	42.7	3.13E+12

*Fecal coliform bacteria reported in org/year

WH3 - TR-20 Results

	Peak flows (cfs)
2-yr	717
100-yr	2778

Streams

WH3 - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	0.00	0.00	0.13	0.14	0.006	<0.005	30	200

*Fecal coliform bacteria reported in org/100ml

WH3 - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	1687	565	1435	1222	207	0	722	0	0	5838
Miles	0.32	0.11	0.27	0.23	0.04	0	0.14	0	0	1.11
Percent of Total	29	10	25	21	4	0	12	0	0	

WH3 - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	537	0.10	31.8
Poor (MPHI)	1,154	0.22	68.2
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	537	0.10	31.8
Poor (FHS)	1,154	0.22	68.2
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	4,691	0.89	80.0
Total Stream Length with Habitat Assessment	1,691	0.32	

WH3 - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	0	1,064	0	593	1,657
Miles	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.11	0.31
Percent of Total	0	0	0	0	0	64	0	36	

Summary

The percent of Fair streams in Whitehall Creek 3 remained stable with the addition of the infrastructure scores. The overall stream length weighted MPHI score of 34.67 places WH3 in the Poor classification. The overall FHS dropped to 37.58, also a Poor classification. Infrastructure impacts include multiple ditch, pipe, obstruction, and crossing points, only a few of which received moderate impact ranks. Overall, the habitat within Whitehall Creek 3 is lacking due to low flow conditions and lack of habitat variability.

Sharps Point (SHP)

Subwatershed Description

Sharps Point subwatershed occupies 133.6 acres on the north shore of the tidal Severn River. The subwatershed is characterized by very little topographical relief. The headwaters majority of the subwatershed is flat making for good farmland. Sharps Point subwatershed is unique in the fact that it has the highest percentage of cropland. Single row crops occupy approximately 42% of the land use within the subwatershed. Low and medium-density represent another 42.7% of the land use with the low-density located along the picturesque Severn River coastline. The lack of commercial, industrial, transportation and high-density residential land uses results in a low 4.7% impervious surface value for the subwatershed. There is a single wetland system draining in a southerly direction into the Severn. There are no perennial stream systems located within the Sharps Point subwatershed.

Subwatershed Characteristics

SHP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	10.8	8.1
R11 – Residential 1 Acre lots	30.4	22.7
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	26.7	20.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	55.8	41.8
TRN – Transportation	0.0	0.0
WAT – Water	0.9	0.7
WDS – Woods	8.9	6.7
Total Area	133.6	100.0
Impervious Area	6.3	4.7
Area served by BMPs	39.6	29.6

SHP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	255	78	43	8	1.7	1.4	9.44E+11

*Fecal coliform bacteria reported in org/year

SHP - TR-20 Results

	Peak flows (cfs)
2-yr	573
100-yr	1984

Streams

SHP - Dry Weather Sampling Results

No streams located in SHP. No dry weather sample taken.

SHP - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	0	163	0	0	0	1464	0	1627
Miles	0	0	0	0.03	0	0	0	0.28	0	0.31
Percent of Total	0	0	0	10	0	0	0	90	0	

SHP - Habitat Assessment Results

No streams located in SHP. No habitat assessment conducted.

SHP - Channel Classification Results

No classifiable channels located in SHP. Channel classification not conducted.

Summary

No flowing streams or classifiable channels were located in Sharps Point. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Meredith Creek (MEC)

Subwatershed Description

Meredith Creek drains 971.7 acres in a southerly direction to the mouth of the tidal Severn River. There is very little topographical relief within the subwatershed. The entire subwatershed is nearly flat. The most highly represented land use is forest, covering 45.8% of the subwatershed, with cropland highly represented covering 24.7% of the subwatershed. Residential land uses, including low (7.1%), medium (13.6%), and high-density residential (1.2%), account for a majority of the remaining land use. The 1.72 miles of stream within the subwatershed are composed of 38% perennial, 28% ditch, 17% ephemeral, and 17% tidal. Only 0.65 miles of classifiable channels exist within the subwatershed. The most dominant channel type within Meredith Creek is the low gradient, very highly sinuous E type channel. Also existent within the subwatershed is the slightly entrenched C type channel, which like the E type channel is associated with broad, well developed flood plains.

Subwatershed Characteristics

MEC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	10.6	1.1
IND – Industrial	0.0	0.0
OPS – Open space	14.6	1.5
R11 – Residential 1 Acre lots	17.7	1.8
R12 – Residential ½ acre lots	114.5	11.8
R14 – Residential ¼ acre lots	11.5	1.2
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	68.7	7.1
RWD – Residential woods	17.2	1.8
SRC – Single Row Crops	240.4	24.7
TRN – Transportation	31.7	3.3
WAT – Water	0.0	0.0
WDS – Woods	444.9	45.8
Total Area	971.7	100.0
Impervious Area	65.8	6.8
Area served by BMPs	9.8	1.0

MEC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	2061	667	354	149	21.5	91.4	6.11E+12

*Fecal coliform bacteria reported in org/year

MEC - TR-20 Results

	Peak flows (cfs)
2-yr	1442
100-yr	5272

Streams

MEC - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
TOTAL	0.00	0.00	0.34	0.03	0.005	<0.005	<3	93

*Fecal coliform bacteria reported in org/100ml

MEC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	3418	0	1592	2575	0	0	1523	0	0	9108
Miles	0.65	0	0.30	0.49	0	0	0.29	0	0	1.72
Percent of Total	38	0	17	28	0	0	17	0	0	

MEC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	3,416	0.65	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	3,416	0.65	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	5,285	1.00	58.0
Total Stream Length with Habitat Assessment	3,416	0.65	

MEC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	683	0	0	2,750	0	0	3,433
Miles	0.00	0.00	0.13	0.00	0.00	0.52	0.00	0.00	0.65
Percent of Total	0	0	20	0	0	80	0	0	

Summary

Meredith Creek received an overall stream length weighted MPHI score of 23.52, and is classified as Poor. When considering infrastructure, the overall FHS dropped to 16.66, also poor. The variation in scores is due to multiple crossing, ditch, pipe, and dump site points. Although present, none were indicative of severely degraded conditions. Overall, the aquatic habitat along Meredith Creek was less than desirable, primarily due to low flow conditions.

Hacketts Point to Sandy Point (HSP)

Subwatershed Description

Hacketts Point to Sandy Point is the eastern most subwatershed in the Severn River Watershed. The subwatershed is located at the mouth of the Severn River where it flows into the Chesapeake Bay. The subwatershed is of moderate size, covering 548.5 acres. The 10.1% commercial land use and 14.7% transportation land use values contribute to a 21.4% impervious value for the subwatershed. Other highly represented land uses include open space (25.4%), wooded areas (21.1%), and single row crops (20.2%). The topography reflects its coastal location and is very flat. The Hacketts Point to Sandy Point subwatershed contains no perennial stream systems.

Subwatershed Characteristics

HSP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	55.6	10.1
IND – Industrial	0.0	0.0
OPS – Open space	139.2	25.4
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	12.7	2.3
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	110.8	20.2
TRN – Transportation	80.7	14.7
WAT – Water	33.9	6.2
WDS – Woods	115.7	21.1
Total Area	548.5	100.0
Impervious Area	117.3	21.4
Area served by BMPs	3.1	0.6

HSP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC
TOTAL	2748	922	409	254	37.2	212.4	6.56E+12

*Fecal coliform bacteria reported in org/year

HSP - TR-20 Results

	Peak flows (cfs)
2-yr	1634
100-yr	5332

Streams

HSP - Dry Weather Sampling Results

Pollutants	TN	NOx	TP	Zn	Cu	Pb	FC	TSS
SAMPLE 1	0.00	0.00	0.20	0.20	0.009	<0.005	9	74
SAMPLE 2	8.18	0.48	1.0	0.08	0.009	0.016	80	860

*Fecal coliform bacteria reported in org/100ml

HSP - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	0	0	0	1226	552	0	1305	0	0	3083
Miles	0	0	0	0.23	0.10	0	0.25	0	0	0.58
Percent of Total	0	0	0	40	18	0	42	0	0	

HSP - Habitat Assessment Results

No streams located in HSP. Habitat assessment not conducted.

HSP - Channel Classification Results

No classifiable channels located in HSP. Channel classification not conducted.

Summary

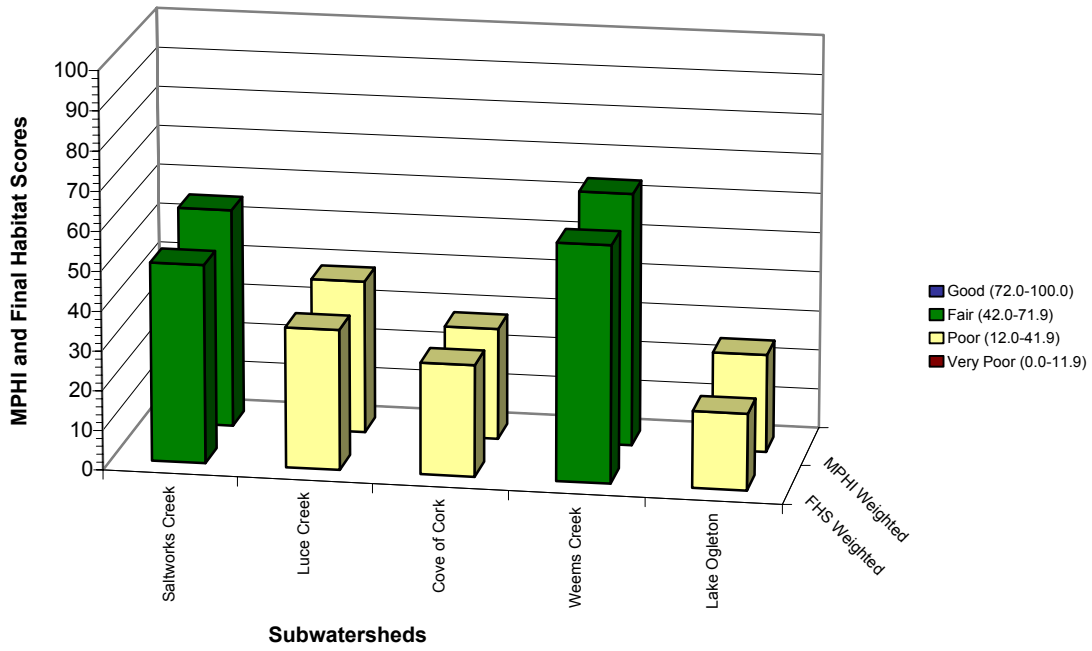
No flowing streams or classifiable channels were located in Hacketts Point to Sandy Point. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

4.4 Lower South Shore of Tidal Severn

The Lower South Shore of the Tidal Severn includes eight subwatersheds ranging in size from less than 60 acres in Martins Pond, to over 1,500 acres in Weems Creek. Martins Pond, Cove of Cork, Chase Pond, Heron Lake and Lake Ogleton are relatively small, and either drain directly to the tidal Severn or do not have major perennial systems. The Saltworks Creek, Luce Creek and Weems Creek drainage areas are larger and are characterized by well developed streams, wetlands and floodplains along their main stems. The City of Annapolis divides this area into two sections such that Chase Pond, Heron Lake and Lake Ogleton are not contiguous with the other subwatersheds at the extreme southeastern portion of the Watershed.

Five of the eight subwatersheds in this area have perennial streams with habitat assessments conducted. The overall stream length weighted subwatershed Maryland Physical Habitat Index (MPHI) and Final Habitat Scores (FHS) are presented in Figure 4.4 to highlight the difference between the MPHI and the FHS. The average difference between the MPHI and FHS for the lower south shore was 3.6, with Lake Ogleton and Saltworks Creek having the biggest influences from infrastructure and environmental features. Cove of Cork and had very little influence from infrastructure and environmental features at the subwatershed level.

Figure 4.4 Stream length Weighted Subwatershed Scores (MPHI Scores are displayed in the back row)



The following sections summarize the results of the stream assessment and modeling. The *Subwatershed Description* section describes pertinent land use data, subwatershed features and the types and classifications of the stream channels. *Subwatershed Characteristics* are then presented including land use data and PLOAD and TR-20 modeling results. The *Streams* section presents water quality data, stream type results, habitat information including MPHI and FHS and channel classification results. Refer to Section 2.5 for information on the derivation and categories used for the MPHI and FHS. The final *Summary* briefly interprets the habitat scores and gives the primary and probable influences on the score.

Saltworks Creek (SWC)

Subwatershed Description

Saltworks Creek is located north of Annapolis and drains in a northeasterly direction to the tidal Severn. The topography is characterized by steep slopes in the headwaters and flat wide floodplains in downstream valleys. The northern portions of the subwatershed are characterized by forest and low-density residential land uses while the southern headwaters are fringed by commercial and industrial uses, which make up the majority of the 14.3% impervious area. Of the 4.82 miles of stream in Saltworks Creek, 86% has intact-forested buffer. Perennial streams make up 61% of the stream miles in Saltworks Creek and are generally comprised of E type channels with high entrenchment ratios, indicating good floodplain connectivity and wide floodplains. Braided, DA classed channels were prevalent in the broad downstream valleys. Ephemeral channels comprise 15% of the stream miles and dominate the valleys in the steeper headwaters.

Saltworks Creek is home to a large wetland in the valley basin immediately upstream of the open water portions of the creek. The wetland and stream complex is made up of both freshwater and estuarine wetlands providing excellent habitat for many wildlife species.

Subwatershed Characteristics

SWC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	58.3	6.1
IND – Industrial	59.2	6.2
OPS – Open space	45.4	4.8
R11 – Residential 1 Acre lots	111.5	11.7
R12 – Residential ½ acre lots	109.9	11.6
R14 – Residential ¼ acre lots	5.9	0.6
R18 – Residential 1/8 acre lots	4.6	0.5
R21 – Residential 2 acre lots	38.4	4.0
RWD – Residential woods	154.9	16.3
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	361.4	38.1
Total Area	949.4	100.0
Impervious Area	135.6	14.3
Area served by BMPs	413.9	43.6

SWC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	3106	1018	355	203	26.9	27.1	1.20E+13

*Fecal coliform bacteria reported in org/year

SWC - TR-20 Results

	Peak flows (cfs)
2-yr	2108
100-yr	9581

Streams

SWC - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.82	0.82	0.09	0.01	<0.005	<0.005	93	3

*Fecal coliform bacteria reported in org/100ml

SWC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	15640	1091	3884	2490	345	0	227	1529	259	25465
Miles	2.96	0.21	0.74	0.47	0.07	0.00	0.04	0.29	0.05	4.82
Percent of Total	61	4	15	10	1	0	1	6	1	

SWC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	7653	1.45	48.9
Fair (MPHI)	2420	0.46	15.5
Poor (MPHI)	4715	0.89	30.1
Very Poor (MPHI)	852	0.16	5.4
Good (FHS)	3330	0.63	21.3
Fair (FHS)	6743	1.28	43.1
Poor (FHS)	3695	0.70	23.6
Very Poor (FHS)	1872	0.35	12.0
Forested Stream Length	21833	4.14	86.0
Total Stream Length with Habitat Assessment	15640	2.96	

SWC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	2553	12829	1015	0	16397
Miles	0.00	0.00	0.00	0.00	0.48	2.43	0.19	0.00	3.11
Percent of Total	0	0	0	0	16	78	6	0	

Summary

The percent of Good stream miles in Saltworks Creek dropped from 48.9% to 21.3% with the addition of the infrastructure scores. This is due, in large part, to industrial use impacts on ditches and water quality from discharge and runoff in the headwaters of the system. Consequently, the aquatic habitat in Saltworks Creek appears to be degraded in localized portions of the headwaters adjacent to these industrial and commercial uses.

Saltworks Creek received an overall stream length weighted MPHI score of 55.21 and is classified as Fair. The overall stream length weighted FHS, which reflects the impact of infrastructure on the stream system was 50.10, also Fair. Overall, Saltworks Creek has over 60% of its streams in the Fair and Good categories.

Martins Pond (MRP)

Subwatershed Description

Martins Pond is a small subwatershed situated north of Annapolis between Saltworks Creek and Luce Creek. The Pond is essentially a tidally influenced bay separated from the Severn by a small peninsula. Land use within the 58 acre subwatershed is dominated almost fully by mature forest. Impervious areas are minimal with only a few roadways on the outer edges of the subwatershed boundary. Steep slopes are found throughout and are steepest near the pond. A small wetland area is located immediately east of the pond in the valley bottom. Martins Pond subwatershed contains no flowing streams or defined channels.

Subwatershed Characteristics

MRP - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	0.0	0.0
IND – Industrial	0.0	0.0
OPS – Open space	0.0	0.0
R11 – Residential 1 Acre lots	1.3	2.2
R12 – Residential ½ acre lots	0.0	0.0
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	8.8	15.1
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	48.0	82.7
Total Area	58.1	100.0
Impervious Area	0.6	1.0
Area served by BMPs	0.4	0.7

MRP - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	41	18	5	5	0.2	0.8	9.95E+10

*Fecal coliform bacteria reported in org/year

MRP - TR-20 Results

	Peak flows (cfs)
2-yr	48
100-yr	516

Streams

MRP - Dry Weather Sampling Results

No streams located in MRP. No dry weather sample taken.

MRP - Stream Type Results

No streams located in MRP.

MRP - Habitat Assessment Results
No streams located in MRP. Habitat assessment not conducted.

MRP - Channel Classification Results
No streams located in MRP. Channel classification not conducted.

Summary

Because of its small size and forested land use, pollutant loading estimates for Martins Pond are among the lowest for the entire watershed for all parameters modeled. No flowing streams or defined channels are located in Martins Pond. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Luce Creek (LUC)

Subwatershed Description

Luce Creek drains directly to the tidal Severn and is located immediately north of Annapolis on the southern shore. The Luce Creek subwatershed is relatively small at 384.8 acres. Three separate channel systems flow into the open water portion of Luce Creek. Two of these systems are minor and are located on the southern shore of Luce in residential areas. The main channel flows in a northeasterly direction and drains forested land use as well as commercial and residential uses in its headwaters. These commercial and residential areas make up the impervious area in Luce Creek which totals 12.9% of the subwatershed. Fifty four percent of the 2.54 mile stream system in Luce Creek is ephemeral channels, which occur primarily in the headwater reaches. Braided stream systems make up 61% of the channel length and were located in the relatively broad floodplain of the main channel.

Subwatershed Characteristics

LUC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	35.3	9.2
IND – Industrial	0.0	0.0
OPS – Open space	7.7	2.0
R11 – Residential 1 Acre lots	57.2	14.9
R12 – Residential ½ acre lots	24.0	6.2
R14 – Residential ¼ acre lots	22.7	5.9
R18 – Residential 1/8 acre lots	2.7	0.7
R21 – Residential 2 acre lots	0.2	0.0
RWD – Residential woods	88.6	23.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.1	0.0
WAT – Water	0.0	0.0
WDS – Woods	146.4	38.1
Total Area	384.8	100.0
Impervious Area	49.8	12.9
Area served by BMPs	90.9	23.6

LUC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1148	386	137	71	9.2	11.7	3.76E+12

*Fecal coliform bacteria reported in org/year

LUC - TR-20 Results

	Peak flows (cfs)
2-yr	470
100-yr	3187

Streams

LUC - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	1.9	1.9	<0.01	0.04	<0.005	<0.005	23	6

*Fecal coliform bacteria reported in org/100ml

LUC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	4180	0	7259	1478	202	0	312	0	0	13431
Miles	0.79	0.00	1.37	0.28	0.04	0.00	0.06	0.00	0.00	2.54
Percent of Total	31	0	54	11	2	0	2	0	0	

LUC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	2679	0.51	64.1
Poor (MPHI)	1501	0.28	35.9
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	4180	0.79	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	9806	1.86	73.0
Total Stream Length with Habitat Assessment	4180	2.54	

LUC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	2531	1134	497	0	4162
Miles	0.00	0.00	0.00	0.00	0.48	0.21	0.09	0.00	0.79
Percent of Total	0	0	0	0	61	27	12	0	

Summary

Luce Creek received an overall stream length weighted MPHI score of 38.55, which is in the Poor category. The final habitat score incorporates impacts from infrastructure and was slightly lower, 35.34, also Poor. The final score is lower due to dump sites located in the floodplain of the main channel. The percent of stream miles in the Poor category went from 35.9% to 100.0% with the addition of the infrastructure scores. Luce Creek is characterized by a residential setting, stable channels, good floodplain access, muddy substrate and low flow conditions.

Cove of Cork (COC)

Subwatershed Description

Cove of Cork is a small 108.8 acre subwatershed located on the southern shore of the Severn River immediately north of Annapolis. The subwatershed drains in a northeasterly direction to the tidal Severn. Route 50/301 borders the subwatershed on its southeastern edge. Approximately 70% of the subwatershed is comprised of residential land uses, with medium-density lots making up much of this total. Together with some commercial use they make up an imperviousness of 19.6%. Forested buffer surrounds the entire 0.49 mile stream corridor. Ephemeral channels make up 77% of the stream system in Cove of Cork. All of the classifiable portions of the subwatershed are braided channels with high entrenchment ratios, good floodplain access and high levels of sinuosity.

Subwatershed Characteristics

COC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	7.8	7.1
IND – Industrial	0.0	0.0
OPS – Open space	6.8	6.2
R11 – Residential 1 Acre lots	1.3	1.2
R12 – Residential ½ acre lots	55.0	50.5
R14 – Residential ¼ acre lots	18.7	17.2
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.6	0.5
RWD – Residential woods	2.1	2.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	2.8	2.6
WAT – Water	0.0	0.0
WDS – Woods	13.7	12.6
Total Area	108.8	100.0
Impervious Area	21.3	19.6
Area served by BMPs	12.8	11.7

COC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	538	176	65	27	5	10.4	1.91E+12

*Fecal coliform bacteria reported in org/year

COC - TR-20 Results

	Peak flows (cfs)
2-yr	310
100-yr	1350

Streams

COC - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	3.0	3.0	<0.01	<0.01	<0.005	<0.005	43	

*Fecal coliform bacteria reported in org/100ml

COC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	494	0	1995	0	0	0	91	0	0	2580
Miles	0.09	0.00	0.38	0.00	0.00	0.00	0.02	0.00	0.00	0.49
Percent of Total	19	0	77	0	0	0	4	0	0	

COC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	497	0.09	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	497	0.09	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	2568	0.49	100.0
Total Stream Length with Habitat Assessment	497	0.09	

COC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	465	0	0	0	465
Miles	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09
Percent of Total	0	0	0	0	100	0	0	0	

Summary

Cove of Cork received an overall stream length weighted MPHI and final score of 28.10 in the Poor category. There were no scores from infrastructure features. The Cove of Cork stream system is characterized by a relatively small drainage area and residential land uses. The stream flows are typically low and do not provide significant variation in velocity or depth, pools or stable habitat for instream biota.

Weems Creek (WEC)

Subwatershed Description

Weems Creek is located on the southern shore of the tidal Severn and is partially located in both Anne Arundel County and the City of Annapolis. Weems Creek was only assessed in the County portions of the subwatershed. The 1,537 acre subwatershed drains in a northeasterly direction via 6.29 miles of stream and ditch. Route 50/301 and its associated interchanges bisect the subwatershed and make up 7.6% of its land use. Commercial areas dominate the headwaters and make up 64.4% of the land use. Perennial streams comprise 26% of the stream system. Ditches associated with the Rte 50/301 interchange with Bestgate Road make up most of the remainder, 43%. Much of the actual stream system, 64%, is bordered by forested land use when the ditch lengths are factored out. Much of the channel was classified as an E type with high entrenchment ratios and stable banks, however more entrenched unstable F and G type channels made up 23% of the total classified reaches.

A large wetland system almost 1200 feet in length has been created by a rip rap check dam immediately upstream of Admiral Drive and appears to have excellent wildlife habitat value.

Subwatershed Characteristics

WEC - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial / includes Annapolis City	990.9	64.4
IND – Industrial	0.2	0.0
OPS – Open space	57.3	3.7
R11 – Residential 1 Acre lots	35.3	2.3
R12 – Residential ½ acre lots	82.5	5.4
R14 – Residential ¼ acre lots	32.0	2.1
R18 – Residential 1/8 acre lots	105.1	6.8
R21 – Residential 2 acre lots	15.3	1.0
RWD – Residential woods	7.6	0.5
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	116.2	7.6
WAT – Water	3.4	0.2
WDS – Woods	91.8	6.0
Total Area	1537.6	100.0
Impervious Area	415.1	27.0
Area served by BMPs	374.8	24.4

WEC - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	7683	2400	998	551	86.1	341.4	2.32E+13

*Fecal coliform bacteria reported in org/year

WEC - TR-20 Results

Lacking data for the City of Annapolis. Model not run.

Streams

WEC - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
TOTAL	0.6	0.6	0.02	<0.01	<0.005	<0.005	93	6

*Fecal coliform bacteria reported in org/100ml

WEC - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	8764	0	4351	14316	2271	0	1602	1361	567	33232
Miles	1.66	0.00	0.82	2.71	0.43	0.00	0.30	0.26	0.11	6.29
Percent of Total	26	0	13	43	7	0	5	4	2	

WEC - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	1764	0.33	20.1
Fair (MPHI)	6171	1.17	70.4
Poor (MPHI)	829	0.16	9.5
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	1764	.033	20.1
Fair (FHS)	4401	0.83	50.2
Poor (FHS)	2599	0.49	29.7
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	12270	2.32	37.0
Total Stream Length with Habitat Assessment	8764	1.66	

WEC - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	2027	5773	1531	774	10105
Miles	0.00	0.00	0.00	0.00	0.38	1.09	0.29	0.15	1.91
Percent of Total	0	0	0	0	20	57	15	8	

Summary

Weems Creek received an overall stream length weighted MPHI score of 63.86 and final score of 59.68, both in the Fair category. Over 70% of the 1.66 stream miles assessed were in the Fair and Good ranges for final score. Weems Creek is intimately associated with its SWM system and is largely comprised of it. Ditches and SWM systems make up fully half of the stream system and relatively long ephemeral channels are generally located between stormwater outfalls and perennial reaches. These ephemeral channels are not included in the habitat scores but were generally entrenched and appeared to be delivering high sediment loads downstream. Recent bank stabilization attempts were observed on these ephemeral reaches indicating the impact that commercial land use is having on the headwaters and channel stability of Weems Creek.

Chase Pond (CPO)

Subwatershed Description

Chase Pond is located immediately south of Annapolis along the south shore of the Severn. Chase Pond is 86.0 acres and is dominated by residential land uses including both high-density and low-density development. The Chase Pond subwatershed contains no flowing streams or defined channels. The pond makes up 7.2% of the subwatershed while the residential use areas combine to make up 24.4% imperviousness.

Subwatershed Characteristics

CPO - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial / includes Annapolis City	7.5	8.7
IND – Industrial	0.0	0.0
OPS – Open space	14.6	17.0
R11 – Residential 1 Acre lots	0.0	0.0
R12 – Residential ½ acre lots	21.6	25.1
R14 – Residential ¼ acre lots	6.3	7.3
R18 – Residential 1/8 acre lots	29.8	34.6
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	6.2	7.2
WDS – Woods	0.0	0.0
Total Area	86.0	100.0
Impervious Area	21.0	24.4
Area served by BMPs	0.8	0.9

CPO - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	455	162	48	16	3.6	2.3	1.62E+12

*Fecal coliform bacteria reported in org/year

CPO - TR-20 Results

	Peak flows (cfs)
2-yr	194
100-yr	839

Streams

CPO - Dry Weather Sampling Results
No streams located in CPO. No dry weather sample taken.

CPO - Stream Type Results
No streams located in CPO.

CPO - Habitat Assessment Results
No streams located in CPO. Habitat assessment not conducted

CPO - Channel Classification Results
No streams located in CPO. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in Chase Pond. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Heron Lake (HLA)

Subwatershed Description

Heron Lake is located south of Annapolis along the south shore of the Severn. Much of the subwatershed drains directly to the tidal Severn. Heron Lake has a total area of 60.2 acres with 4.8 acres of open water. Fifty percent of the land use is medium-density residential with some commercial areas totaling 13.3%. The Heron Lake subwatershed contains no flowing streams or defined channels. Impervious areas make up 19.5% of the subwatershed.

Subwatershed Characteristics

HLA - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial	8.0	13.3
IND – Industrial	0.0	0.0
OPS – Open space	7.7	12.8
R11 – Residential 1 Acre lots	3.1	5.2
R12 – Residential ½ acre lots	30.5	50.7
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	0.0	0.0
R21 – Residential 2 acre lots	0.0	0.0
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	4.8	8.0
WDS – Woods	6.1	10.1
Total Area	60.2	100.0
Impervious Area	11.7	19.5
Area served by BMPs	0.8	1.3

HLA - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	340	121	37	16	2.7	2.3	1.05E+12

*Fecal coliform bacteria reported in org/year

HLA - TR-20 Results

	Peak flows (cfs)
2-yr	314
100-yr	1055

Streams

HLA - Dry Weather Sampling Results
No streams located in HLA. No dry weather sample taken.

HLA - Stream Type Results
No streams located in HLA.

HLA - Habitat Assessment Results
No streams located in HLA. Habitat assessment not conducted.

HLA - Channel Classification Results
No streams located in HLA. Channel classification not conducted.

Summary

No flowing streams or defined channels were located in Heron Lake. Therefore, no dry weather sampling, habitat assessments or channel classifications were conducted.

Lake Ogleton (LKO)

Subwatershed Description

Lake Ogleton is located at the mouth of the Severn River along its south shore. Lake Ogleton is open to the Severn and is tidally influenced but is hemmed in by a peninsula at the base of its southeastern end. The subwatershed is 486.0 acres and contains two small streams that drain in an easterly direction and total 0.66 miles. Almost half of the channel in Lake Ogleton is ephemeral or ditch and just less than half of the channel is surrounded by a forested buffer. Medium-density residential development makes up 59.2% of the subwatershed and completely surrounds the open water tidal portions of the stream. Much of the stream system was classified as an E type channel with high entrenchment ratios, stable banks and high width/depth ratios.

Subwatershed Characteristics

LKO - Land Use Mapping Results

Land Use Type	Acres	Percent of Total
COM – Commercial / includes Annapolis City	15.1	3.1
IND – Industrial	0.0	0.0
OPS – Open space	71.9	14.8
R11 – Residential 1 Acre lots	9.9	2.0
R12 – Residential ½ acre lots	287.9	59.2
R14 – Residential ¼ acre lots	0.0	0.0
R18 – Residential 1/8 acre lots	4.8	1.0
R21 – Residential 2 acre lots	2.3	0.5
RWD – Residential woods	0.0	0.0
SRC – Single Row Crops	0.0	0.0
TRN – Transportation	0.0	0.0
WAT – Water	0.0	0.0
WDS – Woods	94.1	19.4
Total Area	486.0	100.0
Impervious Area	51.7	10.6
Area served by BMPs	65.4	13.5

LKO - PLOAD Results

Pollutant loads (lb/yr)	TN	NOx	TP	Zn	Cu	Pb	FC*
TOTAL	1663	552	191	72	14	10.8	6.22E+12

*Fecal coliform bacteria reported in org/year

LKO - TR-20 Results

	Peak flows (cfs)
2-yr	936
100-yr	4146

Streams

LKO - Dry Weather Sampling Results

Pollutants (mg/l)	TN	NOx	TP	Zn	Cu	Pb	FC*	TSS
Sample 1	1.4	1.4	0.13	<0.01	<0.005	<0.005	4	12
Sample 2	0.04	0.04	0.07	0.25	0.008	<0.005	4	59

*Fecal coliform bacteria reported in org/100ml

LKO - Stream Type Results

Stream Type	Peren	Inter	Ephem	Ditch	SWM	Lake/ Pond	Tidal	Wetland	Flood way	Total
Feet	2031	0	608	823	0	0	0	0	0	3462
Miles	0.38	0.00	0.12	0.16	0.00	0.00	0.00	0.00	0.00	0.66
Percent of Total	59	0	18	24	0	0	0	0	0	

LKO - Habitat Assessment Results

Habitat Assessment Category	Feet	Miles	Percent of Total
Good (MPHI)	0	0.00	0.0
Fair (MPHI)	0	0.00	0.0
Poor (MPHI)	2031	0.38	100.0
Very Poor (MPHI)	0	0.00	0.0
Good (FHS)	0	0.00	0.0
Fair (FHS)	0	0.00	0.0
Poor (FHS)	2031	0.38	100.0
Very Poor (FHS)	0	0.00	0.0
Forested Stream Length	1641	0.31	47.0
Total Stream Length with Habitat Assessment	2031	0.38	

LKO - Channel Classification Results

Classification	A	B	C	D	DA	E	F	G	Total
Feet	0	0	0	0	668	1216	144	0	2028
Miles	0.00	0.00	0.00	0.00	0.13	0.23	0.03	0.00	0.38
Percent of Total	0	0	0	0	33	60	7	0	

Summary

Lake Ogleton received an overall stream length weighted MPHI score of 24.67 and a final habitat score of 19.28, both in the Poor category. All of the subwatersheds 0.38 miles of assessed stream are in the Poor range. Several buffer encroachments occur along the channel and were main factors in the final score's reduction. The channel substrates are sandy and mud bottomed and due to low water levels do not display high levels of velocity depth diversity, pool quality or riffle run sequences.

5.0 Conclusions and Recommendations

5.1 Conclusions

The work done for Phase II to assess the current conditions of the watershed consisted of several major tasks:

- Update and creation of GIS layers
    - Land use
    - Imperviousness
    - Stream coverage
- Mapping and inventory of stormwater management (SWM) facilities
- Delineation of subwatersheds and catchments
- Current condition hydrologic and pollutant load modeling (TR-20 and PLOAD)
- Stream assessment on all perennial streams
- Dry weather flow (baseflow) sampling
- Collection of detailed stream assessment data at 15 stations

In areas where the land use map was developed independently using the orthophotography as a base, the procedure was successful and in many ways simpler than updating the County's 1995 coverage. The procedure and rules which were developed for identifying and mapping different land uses resulted in fairly similar, though not identical, land use maps when created by different staff members. Procedures using infrared or satellite imagery and classification with image analysis software were not investigated in any depth in this project. These are approaches that might yield more consistency over the whole watershed or County, at the risk of being less consistent over time, because of the different imagery used. It should be noted that classification of imagery could also be subjective.

SWM facility mapping was successful within the limitations of the project budget. The County's records of privately owned facilities were excellent. Files were well organized and complete, so that information could be found when it was not in the database. The database itself was fairly complete, and the I&P staff has done a good job of keeping it up to date within their budget and staff limitations.

Development of an ArcView interface to the TR-20 model went through two iterations, with the first an attempt to use off-the-shelf software. This proved difficult to integrate with the project GIS data, so a customized interface was developed which calculates most of the input parameters from GIS and tabular data. It appears that this interface will be successful in creating TR-20 models using the databases created for this project. Further refinement of the interface will continue in the next phase of the project.

Pollutant load modeling with PLOAD was carried out successfully. Data limitations are always an issue in water quality modeling. For this project, however, MDE's EMC data provided good local loading concentrations for the land uses most commonly found in the watershed. The literature search was thorough and identified the best local data available.

The fieldwork for the stream assessment and conversion of the field data to GIS coverages were the two most successful efforts. The field teams were able to complete a comprehensive assessment of 152 miles by averaging 1.8 miles per day. Teams conducted 352 separate habitat assessments on 89 miles of perennial stream. There were 381 cross sections conducted on the same number of reaches, each receiving a channel type classification. To record and track the volume of data collected it was imperative that teams were able to move quickly and collect data accurately.

An automated data collection procedure was developed which relied on data collectors linked to GPS units. Data conversion from the data collector to ArcView shapefiles was programmed, tested, and worked successfully to create coverages of stream type, habitat, geomorphology, and data points, which will be incorporated in the Watershed Management Tool.

The GPS system used was fairly inexpensive, lightweight and provided the level of accuracy required for planning efforts. The data collector proved durable and allowed for easy point and click data entry. Satellite reception was not a major issue in most areas. The assessment was conducted during leaf-off conditions in winter and early spring. Side slopes and steep valleys were the most limiting factors in satellite reception. Where satellite reception was poor the ability to digitize point locations allowed teams to continue working.

Collecting and entering the data only one time in the field increased the quality of data and decreased the time required to enter and check the data. Digital mapping allowed for an instant check on the location of each data point as it was collected and because each point is spatially referenced, the data quickly transfers to GIS for analysis and generation of mapping products. The stream assessment procedures proved effective for the collection of many types of data for a wide geographic area.

5.2 Recommendations

Imperviousness estimates were derived from the land use using sample areas, which allowed for better modeling using load data instead of literature values. Two refinements to the process could be made. First would be to choose more area to sample and reduce the uncertainty in the land use / imperviousness correlation. Second would be to take a completely different approach by using GIS analysis to close streets, buildings, driveways, and other impervious surfaces as polygons and summarizing the impervious area directly. This requires more effort than was allowed for in this project, but has the potential for a more accurate result. When the County acquires planimetric mapping in the future, delivery of the coverage with polygons for impervious area would be recommended.

Because BMP facilities are central to many of the issues in watershed management, the project team recommends that database maintenance be given more emphasis and that responsibility be relocated to an agency with a focus on water quality, watershed management, NPDES compliance, and infrastructure.

EMCs for agriculture and forests were taken from nationwide studies. The County should petition MDE to conduct new or additional monitoring of runoff from rural areas for use in all of Maryland's watershed studies.

Future upgrades to the study should focus on keeping the GIS data up to date. Key coverages are land use, BMPs, and catchment boundaries. If this information is current, then the TR-20 and PLOAD model results will also be current.

Periodic stream walks similar to the ones done for the entire watershed should be made for subwatersheds that appear to be undergoing changes or under development stress. Further identification and ranking of these areas will be made in subsequent phases of the project.

6.0 References

Anne Arundel County (AACo). 2002. *Citizens Restore Severn River Tributary.* http://www.aacounty.org/news/news_cedar.htm

Boward, Daniel, P. Kazyak, S. Stranko, M. Hurd, and A. Prochaska. 1999. *From the Mountains to the Sea: The State of Maryland's Freshwater Streams.* Maryland Department of Natural Resources. Annapolis, Maryland.

Bahr, Raymond. 1997. *Maryland's National Pollutant Discharge Elimination System Municipal Stormwater Monitoring*. Maryland Department of the Environment, Water Management Administration. Baltimore, Maryland.

Bahr, Raymond. 2001. Personal Communication.

Brush, Grace S., C. Lenk, and J. Smith. 1976. *Vegetation Map of Maryland, The Existing Natural Forests*. Johns Hopkins University, Department of Geography and Environmental Engineering. Baltimore, Maryland.

Camp, Dresser, & McKee (CDM). 1993. *Standard Operating Procedures for the NPDES Part 2 Storm Water Permit Application: Representative & Long Term Outfall Storm Event Monitoring Programs.* Prepared for City of Chesapeake. Chesapeake, Virginia.

Camp, Dresser, & McKee (CDM). 1996. *Memorandum: Stormwater EMCs for Urban Watershed Initiative based on Atlanta Regional Storm Water Characterization Study (ARSWCS) monitoring data (1992 - 1996*). Camp, Dresser, & McKee. Cambridge, Massachusetts.

Center for Watershed Protection (CWP). 2000. *National Pollutant Removal Performance Database For Stormwater Treatment Practices, 2nd ed.* Center for Watershed Protection. Ellicott City, Maryland.

Glaser, John D. 1976. *Anne Arundel County: Geology, Mineral Resources, Land Modification, and Shoreline Conditions. County Atlas No. 1.* Maryland Department of Natural Resources, Maryland Geological Survey and Johns Hopkins University. Baltimore, Maryland.

KCI Technologies, Inc. (KCI). 2002. *Severn River Watershed Management Master Plan Phase I Final Report.* Prepared for Anne Arundel County Department of Public Works. Annapolis, Maryland.

Lucus, Richard C. 1976. *Anne Arundel County Ground-Water Information: Selected Well Records, Chemical-Quality Data, Pumpage, Appropriation Data, and Selected Well Logs.* Maryland Department of Natural Resources, Maryland Geological Survey. Baltimore, Maryland.

Maryland Department of Natural Resources (MDNR). 1987. *The Quantity and Natural Quality of Ground Water in Maryland*. Maryland Department of Natural Resources, Water Resources Administration. Annapolis, Maryland.

MDNR. 1998. *1998 Maryland Section 305(b) Water Quality Report.* Maryland Department of Natural Resources, Resource Assessment Service. Annapolis, Maryland.

MDNR. 2002. *Sandy Point State Park.*
http://www.dnr.state.md.us/publiclands/southern/sandypoint.html

Maryland Department of the Environment (MDE). 2002. *Glossary of stormwater BMP structures in the Maryland SWM database*. Maryland Department of the Environment, Technical and Regulatory Services Administration. Baltimore, Maryland.

Maryland Geological Survey (MGS). 2002. *Geologic Map of Anne Arundel County, 1968*. Accessed 2002 at http://www.mgs.md.gov/esic/geo/ann.html

Millard, Christopher J., P.F. Kazyak and A.P. Prochaska. 2001. *Anne Arundel County Results of the 1994-1997 Maryland Biological Stream Survey: County-Level Assessments.* Maryland Department of Natural Resources, Resource Assessment Service, Monitoring and Non-Tidal Assessment Division. Annapolis, Maryland.

Northern Virginia Planning District Commission (NVPDC). 1979. *Guidebook for Screening Urban Nonpoint Pollution Management Strategies.* Metropolitan Council of Governments, Northern Virginia Planning District Commission. Annandale, Virginia.

Ostrowski, D.T., C.J. Millard, P.F. Kayzak and D.M. Boward. 1999. *West Chesapeake Basin, Environmental Assessment of Stream Conditions.* Maryland Department of Natural Resources, Resource Assessment Service, Monitoring and Non-Tidal Assessment Division. Annapolis, Maryland.

Post, Buckley, Schuh, and Jernigan (PBS&J). 2000. *South River Watershed Management Master Plan Study*. Prepared for Anne Arundel County Department of Public Works. Annapolis, MD.

Rosgen, Dave. 1996. *Applied River Morphology.* Wildland Hydrology. Pagosa Springs, Colorado.

Roth, Nancy E., J.C. Chaillou, and M. Gaughan. 1997. *Guide to Using 1995 Maryland Biological Stream Survey Data.* Prepared by Versar, Inc. Prepared for Maryland Department of Natural Resources. Annapolis, Maryland.

Scheuler, Thomas R., 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments. Washington, DC.

Severn River Association, Inc. (SRA). 2000. *Anne Arundel County Legislative Initiative for Bog Preservation*. Prepared for Anne Arundel County Council. Annapolis, Maryland.

Terrene Institute. 1996. *A Watershed Approach to Urban Runoff: Handbook for Decision Makers.* Terrene Institute. Washington, D.C.

The Trust for Public Land (TPL). 2000. *Easement to Protect Nearly 300 Acres Along the Severn River (MD).* Accessed at http://www.tpl.org/tier3_cd.cfm?content_item_id=1861

United States Department of Agriculture – Soil Conservation Service (USDA-SCS). 1973. *Soil Survey of Anne Arundel County, Maryland*. USDA and Maryland Agricultural Experiment Station. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 1983. *Results of the Nationwide Urban Runoff Program, Volume I, Final Report*. U.S. EPA, Water Planning Division. Washington, D.C.

U.S. EPA. 2002. *Permit Compliance System*. U.S. EPA, Office of Compliance and Enforcement. Accessed 2002 at http://www.epa.gov/compliance/planning/data/water/pcssys.html.

Vlavianos, Lina. 2001. *The Jabez Branch: A Unique and Fragile Coastal Plain Stream*. Severn River Commission. Annapolis, MD. Accessed at http://www.co.anne-arundel.md.us/severn_comm/jabez.htm

Young, G.K., S. Stein, P. Cole, T. Kammer, and F. Graziano, 1996. *Evaluation and Management of Highway Runoff Water Quality*. U.S. Department of Transportation, Federal Highway Administration. Washington, D.C.

Zarbock, H., A. Janicki, D. Wade, D, Heimbuch, and H. Wilson, 1994. *Estimates of Total Nitrogen, Total Phosphorus, and Total Suspended Solids to Tampa Bay, Florida.* Technical Publication 04-94. Prepared by Coastal Environmental for the Tampa Bay National Estuary Program. Tampa Bay, Florida.