BALTIMORE COUNTY
NPDES - Municipal Stormwater Discharge Permit

2009 Annual Report

Management Programs
Fiscal Analysis
Monitoring Results
Pollutant Load Reduction

BALTIMORE COUNTY
MARYLAND

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Table of Contents

Document Overview
Section 1: Stormwater Management Program…… DO-1
Section 2: Sediment Control Program…… DO-1
Section 3: County Road/Property Maintenance and Recycling Activities …… DO-1
Section 4: NPDES Education Program……..…… DO-1
Section 5: Illicit Connections Program…….…….…. DO-2
Section 6: Geographic Information System and Databases…… DO-2
Section 7: Watershed Planning and Restoration…… DO-2
Section 8: Discharge Characterization and Assessment of Controls…….…… DO-2
Section 9: Watershed and Restoration Monitoring…… DO-3
Section 10: BMP Pollutant Load Reduction..……..... DO-3
Section 11: Permit Administration, Legal Authority, and Fiscal Analysis…… DO-3

Section 1: Stormwater Management Program
1.0 Permit Requirements…… 1-1
1.1 Introduction……...…… 1-2
1.2 Plan, and Variance and Fee-in-lieu Reviews…… 1-2
1.2.1 Plan Reviews…….…….. 1-2
1.2.2 Variance and Fee-in-lieu Reviews…….. 1-2
1.3 Approved Stormwater Management Facility Analysis…… 1-3
1.4 Inspections…… 1-7
1.5 Stormwater Management Facility Maintenance…….. 1-8
1.6 Constructed Stormwater Management Facility Data Analysis…… 1-9
1.7 Summary…….. 1-14

Section 2: Erosion and Sediment Control Program
2.0 Permit Requirement…….. 2-1
2.1 Introduction…….. 2-1
2.2 Program Analysis—Plans Review…….…….. 2-2
2.3 Program Analysis—Inspection and Enforcement……..…….. 2-2
2.3.1 Grading and Building Permits Issued…….…. 2-2
2.3.2 Inspections, Complaints and Enforcement……..… 2-5
2.4 Program Analysis—Training Program…….…… 2-8
2.5 Summary……..……. 2-8

Section 3: Road Maintenance and Recycling Activities
3.0 Permit Requirements…… 3-1
3.1 Introduction…….. 3-1
3.2 County Property Management…….. 3-2
3.2.1 County Facility NPDES Permit Compliance……... 3-2
3.3 Storm Drain Cleaning Program……...……. 3-2
3.3.1 Storm Drain Cleaning Overview……..…….……. 3-2
3.3.2 Storm Drain Cleaning Data Analysis……..…….…….. 3-3

3.3.3 Storm Drain Data by Watershed……..…….…….. 3-6
3.3.4 Program Summary – Storm Drain Cleaning…….……... 3-8
3.4 Street Sweeping……...……..…….. 3-8
3.4.1 Street Sweeping Overview…….……. 3-8
3.4.2 Street Sweeping by Watershed……..…….. 3-10
3.4.3 Program Summary – Street Sweeping…….…… 3-12
3.5 Household Hazardous Waste (HHW)…….…….……. 3-12
3.6 Fertilizer, Pesticide, and Deicing Statistics…….. 3-15

Section 4: NPDES Education Program
4.0 Permit Requirements…… 4-1
4.1 Introduction…….…. 4-1
4.2 Program Description……... 4-3
4.2.1 Baltimore County DEPRM's Environmental Education Programs.
4.2.1.1 School Initiatives……. 4-3
4.2.1.2 Outreach to Homeowners, Citizen Groups, Businesses, and Landscape Managers……... 4-11
4.2.2 Program Use…….. 4-13
4.2.3 Program Accomplishments…….. 4-15
4.2.4 Secchi Disk Monitoring Program……. 4-22
4.2.5 The Stream Watch Program…….. 4-22
4.2.6 Watershed Association Restoration Planning and Implementation Grant Program……..……. 4-22
4.2.7 The Baltimore Watershed Agreement……...…… 4-23
4.2.8 Tree-Mendous Maryland Program in Baltimore County…….. 4-23
4.2.9 The Baltimore County Forest Conservatory District Board…….. 4-23
4.2.10 The Baltimore County Growing Home Campaign……...…… 4-25
4.2.11 Additional Educational Efforts…….. 4-26
4.3 Summary……..……. 4-26

Section 5: Illicit Connection Program
5.0 Permit Requirements…… 5-1
5.1 Introduction…….. 5-1
5.2 Program Status…….. 5-2
5.3 Analysis of Outfall Screenings……. 5-2
5.4 Illicit Connections Investigations and Corrections……... 5-7
5.5 Regional Illicit Connections Investigations and Complaint Database……. 5-12
5.6 Summary…….…….… 5-13

Section 6: Geographic Information System and Databases
6.0 Permit Requirements…… 6-1
6.1 Source Identification-Geographic Information System Data layers…..…… 6-2
6.1.1 Storm Drain System……..……. 6-2
6.1.2 Urban Best Management Practices.……... 6-2
6.1.3 Impervious Surfaces……..…… 6-2
6.1.4 Monitoring Locations.……...……...……. 6-3
6.1.5 Watershed Restoration…….…..…….…… 6-3
6.2 Databases……..…… 6-3
6.2.1 Chemical Data…..……..……...…….……...…. 6-3
6.2.2 Biological Data……..…….…… 6-3
6.2.3 Geomorphological Data…….…….…… 6-3
6.2.4 Illicit Discharge Detection and Elimination……... 6-4
6.2.5 Responsible Personnel Certificate Information…….. 6-4
6.2.6 Grading Permit Information……... 6-4

Section 7: Watershed Planning and Restoration
7.0 Permit Requirements…… 7-1
7.1 Introduction…….. 7-2
7.2 Status of Watershed Management Plans…….. 7-3
7.2.1 Water Quality Management Plans……... 7-3
7.2.2 Small Watershed Action Plans (SWAPs)…… 7-4
7.3 Obtaining Pollution Reduction Numbers……. 7-5
7.3.1 Stream Restorations……. 7-5
7.3.2 Shoreline Enhancement Projects……. 7-5
7.3.3 Stormwater Retrofits…….. 7-5
7.3.4 Community Reforestation Program……. 7-6
7.3.5 Activities of Volunteer Organizations……. 7-6
7.4 Capital Restoration Projects - Upper Western Shore Watersheds…… 7-7
7.4.1 Deer Creek…….. 7-7
7.4.2 Prettyboy Reservoir……. 7-7
7.4.3 Loch Raven Reservoir Watershed……... 7-9
7.4.4 Lower Gunpowder Falls Watershed…… 7-11
7.4.5 Little Gunpowder Falls Watershed……. 7-12
7.4.6 Bird River Watershed…….. 7-13
7.4.7 Gunpowder River Watershed…….. 7-14
7.4.8 Middle River Watershed…….. 7-15

7.5 Capital Restoration Projects - Patapsco/Back River Watersheds……. 7-16
7.5.1 Liberty Reservoir Watershed……... 7-16
7.5.2 Patapsco River Watershed……... 7-17
7.5.3 Gwynns Falls Watershed……. 7-18
7.5.4 Jones Falls Watershed……. 7-20
7.5.5 Back River Watershed……. 7-22
7.5.6 Baltimore Harbor Watershed……... 7-23
7.6 Community Reforestation Program…….. 7-24
7.7 Volunteer Organizations……. 7-26
7.8 Additional Restoration Efforts…….. 7-27
7.8.1 Growing Home Campaign……... 7-27
7.8.2 Tree-Mendous Maryland Program in Baltimore County…… 7-27
7.9 Pollution Reduction Tracking Database……... 7-28
7.10 Impervious Surface Calculation……... 7-29

Section 8: Discharge Characteristics and Assessment of Controls
8.0 Permit Requirements…… 8-1
8.1 Introduction……..…..…… 8-3
8.2 Scotts Level Branch Long-Term Monitoring……... 8-3
8.2.1 Monitoring Design…….…….…….. 8-5
8.2.1.1 Flow Monitoring…….… 8-5
8.2.1.2 Chemical Monitoring…….. 8-6
8.2.1.3 Geomorphological Monitoring……... 8-7
8.2.1.4 Biological Monitoring…… 8-9
8.3 Scotts Level Branch Long-Term Site Monitoring Results….…….…. 8-9
8.3.1 Flow Monitoring……..……. 8-9
8.3.2 Chemical Monitoring…… 8-12
8.3.2.1 Storm Event Monitoring Results…….…... 8-12
8.3.2.2 Baseflow Monitoring Results……. 8-35
8.3.2.3 Pollutant Load Calculations…… 8-36
8.3.3 Geomorphological Monitoring……. 8-32
8.3.4 Biological Monitoring Results…….. 8-44
8.4 Windlass Run Monitoring – Stormwater Assessment…….. 8-47
8.4.1 Stream Geomorphologic Assessment……...…… 8-48
8.4.2 Biological Monitoring…….. 8-59

Section 9: Watershed and Restoration Monitoring
9.0 Permit Requirements……..…….. 9-1
9.1 Introduction…….…….…… 9-1
9.2 Chemical Monitoring Program……...….. 9-2
9.2.1 Baseflow Monitoring…….. 9-2
9.2.2 Tidal Waters Monitoring Program……..…….…….. 9-12
9.3 Stream Geomorphological Monitoring……. 9-18
9.3.1 Stream Restoration Project Monitoring…….. 9-18
9.3.2 Stream Stability Assessments……. 9-19
9.3.3 Geomorphological Monitoring Summary…….. 9-20

9.4 Biological Monitoring…….. 9-20
9.4.1 Probabilistic Monitoring…….……... 9-20
9.4.2 Capital Improvements Projects Monitoring…….…….. 9-29
9.4.3 Reference Site Monitoring…….……. 9-34
9.4.4 Submerged Aquatic Vegetation Monitoring Program…….……... 9-37
9.5 Status of Brook Trout in the Prettyboy Reservoir Watershed…….. 9-40
9.5.1 Introduction…… 9-40
9.5.2 Methods…….. 9-40
9.5.3 Results and Discussion……... 9-41
9.5.4 References…….. 9-43
9.6 Stream Corridor Assessment…… 9-53
9.6.1 Introduction……... 9-53
9.6.2 Summary of Results……... 9-55
9.6.3 Summary of Erosion…….. 9-58
9.6.4 Summary of Trash Dumping……. 9-61
9.6.5 Summary of Inadequate Buffer……. 9-63
9.6.6 Summary of Unusual Conditions and Comments……. 9-65
9.6.7 Summary of Fish Barrier……... 9-67
9.6.8 Summary of Pipe Outfall……... 9-69
9.6.9 Summary of In or Near Stream Construction…… 9-71
9.6.10 Summary of Representative Sites…….. 9-73
9.6.11 Discussion…….. 9-75

Section 10: BMP Pollutant Load Reductions
10.0 Permit Requirements……..……. 10-1
10.1 Introduction…….…… 10-1
10.2 Pollutant Load Calculations……...……...……. 10-2
10.3 New Nutrient Reduction and Impervious Cover Addressed Tracking Added This Year….…….…… 10-5
10.4 Summary of Pollutant Reduction Programs…… 10-5
10.5 Progress in Meeting MS4 Impervious Restoration, TMDLs, and Maryland Tributary Strategies….…….…... 10-9
10.5.1 MS4 Impervious Restoration…….. 10-9
10.5.2 TMDL Progress……... 10-10
10.5.3 Maryland Tributary Strategies……. 10-11
10.6 Summary……... 10-12

Section 11: Permit Administration, Legal Authority, and Fiscal Analysis
11.0 Permit Requirements…...……... 11-1
11.1 Permit Administration……...…….. 11-1
11.2 Legal Authority……..…….……. 11-3
11.3 Fiscal Analysis……...…….. 11-3

List of Tables

1-1 Fee-in-lieu money received in 2008…… 1-3
1-2 Approved Stormwater Management Facilities by Watershed Through 2008……..…… 1-4
1-3 SWM Inspections 2008 …… 1-7
1-4 Stormwater Facility Maintenance Visits by Type 2008…… 1-8
1-5 SWM Pond Maintenance Activities for Calendar Year 2008……... 1-9
1-6 Constructed SWM Facility Drainage Area Land Use (Acres) by Watershed through Calendar Year 2008…….. 1-10
1-7 Pollutant Loads to Constructed SWM Facilities by Watershed…… 1-10
1-8 Percent Removal Efficiency of BMPs…….…… 1-11
1-9 Total Phosphorus Removal by SWM Facility Type and Watershed…… 1-12
1-10 Total Nitrogen Removal by SWM Facility Type and Watershed……. 1-12
1-11 Impervious Cover Addressed by All SWM and Advanced SWM…….…… 1-13

2-1 Number of Grading Permits and Acreage of Disturbance by Watershed.… 2-3
2-2 Number of Building Permits by Watershed Approved in 2008…… 2-4
2-3 Number of Grading and Building Permits by Year……..…… 2-5
2-4 Sediment Control Inspection Data for 2008..…… 2-7

3-1 NPDES Permit Compliance Status……... 3-2
3-2 Removal Rates of Vac-Con Inlet and Pipe Cleaning by Year…….…. 3-3
3-3 2008 Material Removed in Cubic Yards by Watershed…… 3-6
3-4 2008 Storm Drain Cleaning Program Pollutant Removal (Pounds) and Impervious Urban Acres Treated …… 3-8
3-5 Annual Street Sweeping Summary.……..…… 3-9
3-6 2008 Street Sweeping Program – Tons Removed from Watersheds…… 3-11
3-7 2008 Street Sweeping Program Pollutant Removal (Pounds) and Impervious Urban Acres Treated ……..…... 3-11
3-8 Household Hazardous Waste Recycled (2003-2008)……... 3-12
3-9 2008 County Agency Fertilizer, Pesticide, and Deicing Materials Used (in Pounds)…….. 3-16
3-10 Annual Fertilizer, Pesticide and Deicing Materials Used By County Agencies (in Pounds)…… 3-16

4-1 School and Community Environmental Education Projects Implemented in County watersheds by Baltimore County's Newly Recognized Public and Private MD Green Schools and Green Centers, 2008…….. 4-6
4-2 School and Community Environmental Education Projects Implemented in County watersheds by Baltimore County's Re-certifying Public and Private MD Green Schools, 2008…….. 4-7
4-3 Education Events Conducted for Residents of the County and Region by Watershed Audience, 2008……... 4-14
4-4 Education Events by Type of Audience*, 2008……..…….. 4-14
4-5 *Maryland Green Schools* by Jurisdiction 1999-2008…….……... 4-16
4-6 Number of Participants in MD Green School Program in Baltimore County, 2008……. 4-16
4-7 Community and Business Partnerships Supporting Baltimore County's Public Schools recognized as MD Green Schools, 2008…….……. 4-21
4-8 Presentations, Participants, and Materials, 1994-2008……. 4-21

5-1 Major Outfalls by Watershed and Priority Classification…….…… 5-3
5-2 Complaints Processed from January 1, 2008 through December 31, 2008.. 5-7

7-1 Status of Watershed Management Plans…….. 7-3
7-2 Watershed Management Plans Consultants and Costs…….. 7-4
7-3 Percent Removal Efficiency of BMPs……..…… 7-6
7-4 Prettyboy Reservoir Watershed – CIP Status……...……. 7-8
7-5 Loch Raven Reservoir Watershed – CIP Status……...……. 7-10
7-6 Lower Gunpowder Falls Watershed – CIP Status ……...……. 7-11
7-7 Little Gunpowder Falls Watershed – CIP Status ……...…….. 7-13
7-8 Bird River Watershed – CIP Status……... 7-14
7-9 Gunpowder River Watershed – CIP Status……... 7-15
7-10 Middle River Watershed – CIP Status…….. 7-15
7-11 Patapsco River Watershed – CIP Status…… 7-18
7-12 Gwynns Falls Watershed – CIP Status…….. 7-19
7-13 Jones Falls Watershed – CIP Status…….. 7-20
7-14 Back River Watershed – CIP Status…….. 7-23
7-15 Baltimore Harbor Watershed – CIP Status……... 7-24
7-16 Baltimore County Reforestation Projects by Calendar Year…… 7-25
7-17 Baltimore County Reforestation Projects by Watershed through 2008…… 7-26
7-18 Watershed Groups' Projects Resulting in Nutrient Reductions…… 7-26
7-19 Number of Trees Planted in the Upper Western Shore Basin……... 7-27
7-20 Number of Trees Planted in the Patapsco/Back River Basin…… 7-27
7-21 Baltimore County Impervious Area by Watershed – Changes Between 1997 and 2005……... 7-29

7-22 Baltimore County and Maryland State Highway Impervious Acreage……. 7-30
7-23 Impervious Acreage Addressed by Completed Capital Projects and Advanced Treatment SWM Facilities…….…….. 7-31
7-24 County Impervious Cover Addressed by the Current SWAPs……..... 7-31

8-1 Scotts Level Branch, Powder Mill Run, and Upper Gwynns Falls Information ……..……. 8-5
8-2 USGS Gage Information……...…… 8-5
8-3 Precipitation Data Analysis for Calendar 2008……...…….. 8-10
8-4 2008 Precipitation Amount, Intensity, and Duration by Category …….. 8-10
8-5 Seasonal Precipitation and Runoff Characteristics……..……. 8-12
8-6 Regression Equations Relationship Between Discharge (CFS) and Pollutant Concentrations……... 8-12
8-7 2008 Daily Baseflow Pollutant Loads for Scott's Level Branch Sites …… 8-35
8-8 Pollutant Load Characteristics for USGS gaged site (SL-01) Calendar Year 2008…….…. 8-37
8-9 Scotts Level Branch Cross Sections - Cut and Fill Amounts……... 8-39
8-10 Scotts Level Branch Stream Channel Changes Over Time……... 8-41
8-11 Pollutant Load Estimates- Comparison between Water Quality Monitoring and Geomorphology for Scotts Level Branch, 2006 - 2008….. 8-42
8-12 Powder Mill Run Cross Sections - Cut and Fill Amounts……... 8-43
8-13 Powder Mill Run, 2007-2008 and 2005-2008 Stream Channel Changes…. 8-43
8-14 Windlass Run Cross Sections - Cut and Fill Amounts……. 8-58
8-15 Windlass Run Stream Channel Changes Over Time…… 8-58

9-1 Baseflow Pollutant ANOVA and Duncan's Multiple Range Test Results... 9-5
9-2 Site Codes and the Associated Tidal Water body……. 9-14
9-3 ANOVA and Duncan's Multiple Range Test Results……... 9-14
9-4 Summary of Capital Improvements Projects Monitoring Reports Submitted for 2008…… 9-19
9-5 BIBI Metrics…….. 9-21
9-6 BIBI Score Distribution by Watershed (% by Category)…….. 9-24
9-7 Watershed Biological Condition Using Percent Stream Mile Method..…... 9-26
9-8 Watershed Biological Condition Using Average IBI Method…….. 9-27
9-9 Stream Restoration Biological Monitoring Site Locations….…….. 9-29
9-10 Taxonomic composition of MNBK-1, 2008……..……... 9-31
9-11 Benthic and fish taxa collected at WDVL-1 and WDVL-3, 2008.……... 9-33
9-12 Reference Site Locations…….…….……. 9-34
9-13 SAV Standards and Baltimore County SAV Monitoring Results (2006-2008)……..…….……... 9-38
9-14 Prettyboy Reservoir brook trout and thermal monitoring stations.……... 9-43
9-15 Prettyboy Reservoir brook trout population data.……. 9-44
9-16 Fish Index of Biotic Integrity (FIBI) and Physical Habitat Index (PHI) Scores ……... 9-45
9-17 Water Temperature Summary….…….. 9-45
9-18 Fish Community Composition……..…… 9-46

9-19 Land Use by Percentage…… 9-47
9-20 Brook Trout Redd Counts……. 9-47
9-21 Total Stream Miles and Stream Miles Surveyed, by Subwatershed……. 9-57
9-22 Summary of Results From Prettyboy Direct Drainage 3 Subwatershed…... 9-57
9-23 Summary of results from Prettyboy Direct Drainage 4 Subwatershed……. 9-57
9-24 Listing of Information by Site……... 9-75
9-25 Listing of Sites by Problem Category……... 9-78

10-1 Status of TMDLs and TMDL Reduction Requirements for Urban Stormwater…… 10-1
10-2 Nitrogen Per Acre Pollutant Rate, MDE Segment and CBP Segment …..... 10-3
10-3 Phosphorus Per Acre Pollutant Rate, MDE Segment and CBP Segment … 10-4
10-4 Watershed Nitrogen Loads (%)…..…… 10-4
10-5 Watershed Phosphorous Loads (%)……...……... 10-5
10-6 Pollutant Removal (Pounds) by Upper Western Shore Watersheds Attributed to BMP's…….. 10-6
10-7 Pollutant Removal (Pounds) by Patapsco/Back River Watersheds Attributed to BMPs…….….. 10-8
10-8 Impervious Cover Addressed by Water Quality Improvement Efforts to Date……... 10-10
10-9 Progress in Meeting Nutrient TMDLs Where Developed…… 10-10
10-10 Upper Western Shore Urban Tributary Strategy……... 10-12
10-11 Patapsco/Back River Urban Tributary Strategy…… 10-12
10-12 Tributary Strategy Urban Non-point Nutrient Load Reduction Process…... 10-12

11-1 Major NPDES Program Tasks and Responsible Baltimore County Agencies…… 11-2
11-2 NPDES Operating Budget……. 11-3
11-3 Capital Budget and Program……. 11-3
11-4 Baltimore County Environmental Capital Improvement Program- Fiscal Year 2008 & 2009…...…….. 11-4
11-5 Baltimore County Environmental Capital Improvement Program- Fiscal Year 2010 & 2011...…….. 11-4
11-6 Baltimore County Environmental Capital Improvement Program- Fiscal Years 2012 & 2013……...…… 11-5

List of Figures

1-1 Number of Approved SWM Facilities by Watershed— Through Calendar Year 2008……. 1-6
1-2 Acreage Served by Approved Private SWM Facilities by Watershed Through Calendar Year 2008…..……. 1-6
1-3 Acreage Served by Approved Public SWM Facilities by Watershed Through Calendar Year 2008…..…… 1-7

2-1 Acres of disturbance through approved grading permits by watershed for 2008……. 2-3
2-2 Number of building permits issued in 2008 by watershed…… 2-4
2-3 Approved Grading and Building Permits for the Period 1998 – 2008…… 2-5
2-4 The number of sediment control enforcement actions by month for the calendar year 2008……. 2-6
2-5 Number of sediment control inspections and the total number of inspections by month for the calendar year 2008…… 2-7

3-1 Summary Report for Inlets……..……. 3-4
3-2 Annual Inlet Debris Removal Rates…… 3-4
3-3 Summary Report for Pipes…….…….. 3-5
3-4 Annual Pipe Debris Removal Rates……...…….. 3-5
3-5 Miles of Street Swept, Tons of Material Removed and Tons/Miles Swept 3-10
3-6 Household Hazardous Wastes Recycling of Flammables, Gasoline, and Pesticides…….…… 3-14
3-7 Waste Oil and Anti-freeze Recycled from 1991 through 2008……... 3-15
3-8 Trends in Annual Fertilizer and Pesticide Used by County Agencies……. 3-17
3-9 Trends in Annual Deicing Material Used by County Agencies…….. 3-17

5-1 Major Outfall Prioritization……. 5-4
5-2 Major Outfall Screening Priority Distribution……...……. 5-5
5-3 Number of *quantitative* problems detected……. 5-6
5-4 Number of *qualitative* problems visually observed...…….. 5-7
5-5 Involvement of the Regional Programs in the Investigation of Illicit Connections……. 5-12

7-1 Number of trees obtained through the Tree-Mendous Maryland Program with technical assistance and free tree delivery by DEPRM between 1990 and 2008……... 7-28

8-1	Subwatersheds to be used in the Paired Watershed Monitoring Design.…	8-4
8-2	Scotts Level Branch Chemical Monitoring Locations.……	8-6
8-3	Scotts Level Branch Geomorphological and Biological Monitoring Site Locations……..	8-8
8-4	Powder Mill Run Geomorphological and Biological Monitoring Sites…..	8-9
8-5	Calendar year 2008 Daily Precipitation and Discharge……...	8-11
8-6	Total Suspended Solids (TSS) Data and Regressions for 2005-2009…….	8-13
8-7	Total Kjeldahl Nitrogen (TKN) Data and Regressions for 2005-2009…...	8-14
8-8	Nitrate/Nitrite (NO_2/NO_3) Data and Regressions for 2005-2009……	8-14
8-9	Total Nitrogen (TN) Data and Regressions for 2005-2009…….	8-15
8-10	Total Phosphorus (TP) Data and Regressions for 2005-2009…….	8-15
8-11	Total Copper (Cu) Data and Regressions for 2005-2009……	8-16
8-12	Total Lead (Pb) Data and Regressions for 2005-2009……	8-16
8-13	Total Zinc (Zn) Data and Regressions for 2005-2009……	8-17
8-14	Chloride (Cl) Data and Regressions for 2005-2009……	8-17
8-15	Sodium (Na) Data and Regressions for 2005-2009…….	8-18
8-16a	Event Mean Concentration for Total Suspended Solids (TSS) 2005-2006.	8-19
8-16b	Event Mean Concentration for Total Suspended Solids (TSS) 2007-2008.	8-19
8-16c	Event Mean Concentration for Total Suspended Solids (TSS) 2009……..	8-20
8-17a	Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2005-2006…….	8-20
8-17b	Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2007-2008…….	8-21
8-17c	Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2009……	8-21
8-18a	Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2005-2006……	8-22
8-18b	Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2007-2008……	8-22
8-18c	Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2009…….	8-23
8-19a	Event Mean Concentration for Total Nitrogen (TN) 2005-2006…….	8-23
8-19b	Event Mean Concentration for Total Nitrogen (TN) 2007-2008…….	8-24
8-19c	Event Mean Concentration for Total Nitrogen (TN) 2009……..	8-24
8-20a	Event Mean Concentration for Total Phosphorus (TP) 2005-2006…….	8-25
8-20b	Event Mean Concentration for Total Phosphorus (TP) 2007-2008…….	8-25
8-20c	Event Mean Concentration for Total Phosphorus (TP) 2009……..	8-26
8-21a	Event Mean Concentration for Total Copper 2005-2006……	8-26
8-21b	Event Mean Concentration for Total Copper 2007-2008……	8-27
8-21c	Event Mean Concentration for Total Copper 2009…….	8-27
8-22a	Event Mean Concentration for Total Lead 2005-2006……	8-28
8-22b	Event Mean Concentration for Total Lead 2007-2008……	8-28
8-22c	Event Mean Concentration for Total Lead 2009…….	8-29
8-23a	Event Mean Concentration for Total Zinc 2005-2006…….	8-29
8-23b	Event Mean Concentration for Total Zinc 2007-2008…….	8-30
8-23c	Event Mean Concentration for Total Zinc 2009……..	8-30
8-24a	Event Mean Concentration for Chloride 2005-2006……...	8-31
8-24b	Event Mean Concentration for Chloride 2007-2008……...	8-31
8-24c	Event Mean Concentration for Chloride 2009…….	8-32
8-25a	Event Mean Concentration for Sodium 2005-2006…….	8-32
8-25b	Event Mean Concentration for Sodium 2007-2008…….	8-33

8-25c	Event Mean Concentration for Sodium 2009……..	8-33
8-26	Concentration over Time for TSS, TP, TKN, NO2/NO3, Total Copper during storm event on 11/13/08……...	8-35
8-27	Scotts Level Branch Geomorphological Cross Section 1 Overlay showing net deposition especially on the right channel side between the 2007 and 2008 surveys.……..…….	8-39
8-28	(a) Scotts Level Branch and (b) Powder Mill Run IBI Scores ……...	8-45
8-29	(a) Scotts Level Branch and (b) Powder Mill Run PHI Scores …….….	8-46
8-30	Windlass Run Aerial Photograph Showing Monitoring Station Locations.	8-49
8-31	Orthophotograph of Windlass Run watershed, 1995.……..	8-51
8-32	Windlass Run watershed orthophotograph, 2002.……..……	8-52
8-33	Windlass Run orthophotograph, 2005…….	8-53
8-34	Windlass Run orthophotograph, 2007…….	8-54
8-35	Summary of cross-sectional changes in Windlass Run during entire study period……..	8-57
8-36	Windlass Run BIBI Scores…….	8-60
8-37	Windlass Run Physical Habitat Scores……	8-61
9-1	Patapsco/Back River Basin – Baseflow Monitoring Sites……...	9-3
9-2	Gunpowder Basin/Deer Creek – Baseflow Monitoring Sites……..	9-4
9-3	Frequency distributions by concentration for Total Copper and Dissolved Copper for the 2008 Patapsco/Back River Basin samples…….….	9-5
9-4	Duncan's Multiple Range Test results for COD, TN, Dissolved Copper, and Chlorides.…….…….……	9-7
9-5	Baseflow Dissolved Copper, Nitrate/Nitrite, Chloride, and Total Phosphorus for sampling years 2004, 2006, and 2008……	9-7
9-6	Baseflow Total Nitrogen Mean Concentrations for Monitoring Years 2007 (Patapsco/Back River Basin) and 2008 (Gunpowder Basin)..……	9-10
9-7	Baseflow Total Phosphorus Mean Concentrations for Monitoring Years 2007 (Patapsco/Back River Basin) and 2008 (Gunpowder Basin)……..	9-11
9-8	Tidal Waters Monitoring Site Locations…….	9-13
9-9	Pollutant Between Year Variation by Site……...	9-16
9-10	Probabilistic Biological Monitoring results for 2005 and 2006……..	9-22
9-11	Probabilistic Biological Monitoring results for 2007 and 2008……..	9-23
9-12	Means and one standard deviation of BIBI scores for Patapsco/Back River watersheds between 2003 and 2007…….…..	9-25
9-13	Means and one standard deviation of BIBI scores of Gunpowder Falls/Deer Creek watersheds between 2004 and 2008……...…….	9-25
9-14	Mean BIBI scores for (a) Patapsco/Back River and (b) Gunpowder/Deer Creek Sentinel Sites between 2003 and 2008……..……...	9-28
9-15	Minebank Run Biological Monitoring Stations.……..……	9-30
9-16	Biological index values at MNBK-1 from beginning of monitoring to present.……..……...	9-31
9-17	Woodvalley Biological Monitoring Station Locations.……...	9-32
9-18	Benthic and Fish IBI and Physical Habitat Index Values for (a) WDVL-1 (restored) and (b) WDVL-3 (control)……..	9-32
9-19	Box and Whisker Plot of Reference Site BIBI Values by Year……..	9-35

9-20	Box and Whisker Plot of Reference Site BIBI Values by Year……...	9-35
9-21	Mean and One Standard Deviation of PHI Scores for Reference Stations Since 2005..…….	9-36
9-22	BIBI and PHI values for WDVL-1 and Reference Sites……..	9-37
9-23	Baltimore County SAV Monitoring Program – Trends in % Coverage...	9-39
9-24	Locations of Prettyboy Reservoir Watershed Monitoring Sites……..…..	9-48
9-25	Maximum Air and Water Temperatures at Prettyboy Stations…….	9-49
9-26	Map of Prettyboy Subwatersheds…….	9-54
9-27	Map of the Streams Surveyed for the Two Subwatersheds……..	9-56
9-28	Potential Stream Problems by Subwatershed……...	9-58
9-29	Severity Distribution of Sites……	9-59
9-30	Map of Erosion Severity and Location…….	9-60
9-31	Severity Distribution of Sites……	9-61
9-32	Map of Trash Dumping Severity and Location……	9-62
9-33	Severity Distribution of Sites……	9-63
9-34	Map of Inadequate Buffer Severity and Location……	9-64
9-35	Severity Distribution of Sites……	9-65
9-36	Map of Unusual Condition/Comment Severity and Location……..	9-66
9-37	Severity Distribution of Sites……	9-67
9-38	Map of Fish Barrier Severity and Location……..……	9-68
9-39	Severity Distribution of Sites……	9-69
9-40	Map of Pipe Outfall Severity and Location……..……	9-70
9-41	Severity Distribution of Sites……	9-71
9-42	Map of In or Near Stream Construction Severity and Location……...	9-72
9-43	Map of Representative Site Locations……..	9-74

List of Exhibits

4-1 Baltimore County's *Maryland Green Schools and Green Centers*, 1999-2008……..…….. 4-28

11-1 Department of Environmental Protection and Resource Management Table of Organization for FY2009……. 11-5

11-2 Department of Environmental Protection and Resource Management Staff Organizational Chart Effective April 25, 2009……...…….. 11-8

List of Appendices

1-1 Public Stormwater Facility Maintenance by Type for Calendar Year 2008……..…… 1-15

2-1 List of Individuals Receiving Certification…… 2-9

4-1 Presentations, Distributions, and Events, by Watershed, 2008……..…… 4-29

4-2 Education Program: Recycling Presentations, 2008 Accomplished by Baltimore County Department of Public Works, Recycling Division…….. 4-37

9-1 Baseflow Monitoring Sites by Watershed.……...…… 9-83

9-2 Baseflow Water Quality Data by Site……...…… 9-84

9-3 Tidal Waters Chemical Monitoring Results…….…… 9-97

9-4 Results of 2008 Probabilistic Monitoring……...…….. 9-100

Document Overview

This Document Overview provides a brief summary of the contents of the eleven sections included in Baltimore County's NPDES 2009 Annual Report. The major changes in this year's report include changes in the pollutant load calculations (Section 10.2), pollutant load reduction calculations, tracking progress towards meeting Total Maximum Daily Loads (TMDLs) and the Maryland Tributary Strategies. Most of these changes occur in Section 10. In addition, revised impervious surface acreage is included in this year's report (see Section 7) based on updated 2005 aerial photography.

Section 1: Stormwater Management Program

Baltimore County implements a stormwater management program in accordance with the Annotated Code of Maryland, including implementation of the Maryland Stormwater Design Manual. This section of the report includes data on the number of plans reviewed and fees-in-lieu money received. There is information on the number of approved stormwater facilities and the type of facilities as well as the acreage of drainage area controlled by these facilities. Data is also provided on inspections of facilities and the number and types of maintenance activities. The pollutant load reductions that result from the stormwater management facilities are calculated, as well as the amount of impervious surface addressed from the drainage area of these facilities. This information fulfills section E.1 and E.2 of the NPDES permit.

Section 2: Sediment Control Program

Baltimore County implements a sediment control program in accordance with the Annotated Code of Maryland. This section of the report includes data on the number of plans reviewed and permits issued. Data is provided on the acreage of disturbed area and is categorized by watershed. Trends in the numbers of building and grading permits are examined. A summary of the number of inspections and enforcement actions is included. This section fulfills section E.4 of the NPDES permit.

Section 3: County Property Management, Road Maintenance and Recycling Activities

The activities accounted for in this section of the report are implemented by both the Department of Public Works (DPW) and the Department of Environmental Protection and Resource Management (DEPRM). Activities accounted for include; the Stormdrain Cleaning Program, the Street Sweeping Program, and hazardous waste recycling programs. This section includes a summary of the County Property Management as it relates to acquiring Industrial Stormwater General permits and preparation of Pollution Prevention Plans. Also reported in this section is data on the use of fertilizer, pesticide and deicing materials. This fulfills the NPDES permit requirement for section E.5 and E.6.

Section 4: Education Program

Baltimore County implements and maintains a public education and outreach program to reduce stormwater pollutants. Information provided in this section includes DEPRM's partnerships with other State programs, County level programs, as well as all interested local watershed groups. Baltimore County continues to lead the State in the number of State Green School awards, has developed the award winning Growing Home Campaign

and implements a highly successful Tree-mendous Maryland program. DEPRM continues to expand its outreach to local school administrative staff through workshops. This program fulfills the requirements of section E.7 of the NPDES permit.

Section 5: Illicit Connections Program

This section of the NPDES report summarizes the detection, investigation, and remediation of illicit connections to the County's storm drain system. Data is provided on routine screenings and complaint investigations. Outfall screenings are presented by distribution priority and quantitative and qualitative problems. Details on complaint investigation results are separately listed. This information meets the requirements in section E.4 of the County's NPDES permit.

Section 6: Geographic Information System and Databases

This section describes the Geographic Information System (GIS) information and databases submitted with the report, as required by permit condition Part III C and Part IV A.

Section 7: Watershed Planning and Restoration Program

The Watershed Management Program continues to systematically assess the water quality within all of its urban watersheds. The data provided in this section satisfies, in part, section F and G requirements of the NPDES permit. A status is provided on watershed plans and the development of small watershed action plans. Documentation of capital restoration projects constructed by DEPRM is provided for each watershed. This year's report has included a nutrient reduction estimate from shoreline erosion control projects. This reduction is theoretically determined based on how much sediment is prevented from entering a waterway (see Section 7.3.2). Summary tables include the costs of each project and the projected pollutant reduction. The County's Community Reforestation Program and the restoration activities from local watershed groups provide additional pollution reduction benefits. Pollution reduction projections for these activities are included for the first time in this year's report. Also included is an accounting of the amount of impervious surfaces addressed by DEPRM's capital restoration projects. Baltimore County is required to address 10% of its impervious surfaces during this five-year permit period. Section 7 also includes updates on the status of TMDL development for the various watersheds. This information meets the requirements in section F of the County's NPDES permit.

Section 8: Discharge Characterization and Assessment of Controls

This section describes the Scotts Level Branch monitoring plan and provides an analysis of the chemical, biological and geomorphological data. The section also presents the data derived from Windlass Run.

The Scotts Level Brach long-term monitoring site has been paired with sites in Upper Gwynns Falls and Powder Mill Run in a paired watershed design. The intent of this paired watershed design is to determine restoration effectiveness on a subwatershed scale in the realms of chemical load reduction, improvement in the biological community, and changes in stream erosion rates. The design will also determine the relative proportion of chemical pollutant load attributed to watershed wash off and stream erosion.

The ongoing Windlass Run monitoring to determine the effectiveness of the *2000 Maryland Stormwater Design Manual* is presented in this section this year. Additionally a progression of development in Windlass Run from 1995-2007 from which orthophotographs were available has been included in this section. Previously, it had been accorded its own section. This section meets the reporting requirements for section H in the NPDES permit.

Section 9: Watershed and Restoration Monitoring

This section combines analysis of the chemical, biological, and geomorphological data collected exclusive of the Scotts Level Branch and Windlass Run monitoring sites. In addition, a section on Submerged Aquatic Vegetation (SAV) data collected by the County has been included. The section summarizes chemical data collected through the County baseflow and tidal water-monitoring program. It also summarizes the results from the stream restoration geomorphological monitoring program. Included are the results of the Stream Stability Assessments conducted during the reporting year. The portion of the report on the biological data includes results from the County Probabilistic Monitoring Program, stream restoration biological monitoring, and reference site monitoring. The SAV data is compared to the new Water Quality Standards for SAV coverage. Also included in this section are the Stream Corridor Assessment and the status of wild Brook Trout in the Prettyboy Reservoir watershed. The data provided in this section satisfies, in part, section F and G requirements of the NPDES permit.

Section 10: BMP Pollutant Load Reduction

Information provided in this section will meet the requirements of the NPDES Permit Part IV. section A.1.e. The section summarizes pollutant load reductions and the amount of impervious cover addressed due to implementation of management programs. Much of the information is already detailed in the sections on the specific management programs (e.g. Stormwater Management, Road Maintenance, and Watershed Restoration). Summary tables are provided on progress made in meeting TMDL reduction requirements and Tributary Strategy goals.

There are a number of programs for which pollutant load reductions are not calculated or are only partially calculated e.g. Education and Illicit Connections. This is due to the lack of information on the load reduction to allocate to those activities. The determination of pollutant load reduction due to education activities and from the illicit connection program will be a difficult undertaking.

Section 11: Permit Administration, Legal Authority, and Fiscal Analysis

This section includes the financial information regarding the County's capital, operating and maintenance budgets related to compliance with the NPDES permit. Data is provided pertaining to DEPRM's organization and budgets. It also includes the county organization to address the NPDES permit requirements and an update on any legal authority changes. This portion of the report meets the requirements of sections A, B, and I in the NPDES permit.

1.0 Permit Requirements

E.1. Stormwater Management

An acceptable stormwater management program shall be maintained in accordance with the Environment Article, Title 4, Subtitle 2, Annotated Code of Maryland. At a minimum, Baltimore County shall:

a. Implement the stormwater management design policies, principles, methods, and practices found in the *2000 Maryland Stormwater Design Manual* or other innovative stormwater management technologies approved by MDE;

b. Track progress toward implementing the *2000 Maryland Stormwater Design Manual* or other innovative stormwater management technologies approved by MDE and report annually the modifications needed to address any programmatic problems; and

c. Maintain programmatic and implementation information according to the requirement established as part of MDE's triennial stormwater program review.

E.2. Stormwater Management BMP Inspections

a. Within 6 months of this permit being issued, Baltimore County shall designate sufficient staff and resources to ensure that maintenance inspections are performed for all stormwater management BMPs in the County. At a minimum, the County shall:

i. identify the specific individual(s) responsible for BMP maintenance inspections;

ii. develop and implement specific written procedures for conducting routine maintenance inspections, preparing inspection reports, enforcing requirements, and following up to ensure that specified maintenance is performed for all BMPs in Baltimore County;

iii. perform routine maintenance inspections on all stormwater management BMPs in Baltimore County by June 15, 2007; and

iv. submit annually copies of all BMP maintenance inspection reports and a current database of all stormwater management BMPs in Baltimore County with each facility's maintenance status clearly described.

b. In its first report, Baltimore County shall report the progress toward completing the BMP maintenance inspections specified in Part III E.2.a. above. Based on Baltimore County's progress toward inspecting all BMPs, MDE will approve a maintenance inspection frequency for the remainder of this permit.

1.1 Introduction

The Stormwater Management Program addresses the impacts on stormwater quantity and quality resulting from new development after the construction phase is complete. These impacts are mainly associated with the increase in impervious area due to the installation of roadways and buildings. Baltimore County has been delegated authority by the State of Maryland to enforce stormwater management regulations. The Stormwater Management Program is located within the DEPRM – Stormwater Engineering Section. DEPRM currently implements the requirements of the 2000 Maryland Stormwater Design Manual to new and redevelopment activities. The Stormwater Management Act of 2007 will be incorporated into the regulations and review process when all State approvals have been completed. This program is periodically reviewed by the Maryland Department of the Environment (MDE) and has consistently passed the review requirements.

The Program contains several components, including:

- review of stormwater management facilities plans,
- review of variance and associated fee-in-lieu requests,
- as built inspections, and
- periodic inspections.

The three-year inspection and maintenance of publicly owned facilities is conducted by the operations program, located within the DEPRM Capital Program and Operations Section. Their staff consists of 6 field crews and members and a supervisor. The Stormwater Engineering Section inspects privately owned facilities. Their staff consists of a supervisor and two inspectors.

1.2 Plan, and Variance and Fee-in-lieu Reviews

1.2.1 Plan Reviews

During the calendar year 2008 one thousand three hundred and forty-eight (1,348) plans were reviewed for stormwater management. Of these, two hundred and fifty-three (253) were approved, one thousand and ninety-five (1,095) were denied and eighty-six (86) were pending at the end of the year. Most plans are not approved on the first submittal, and these numbers reflect multiple plan submittals for the same project.

1.2.2 Variance and Fee-in-lieu Reviews

A variance in accordance with Council Bill 51-01 may be approved for a project when exceptional circumstances are applicable to the site. A variance is only granted when the result is more beneficial for the watershed and it is accompanied by a fee-in-lieu. This option is only acceptable to Baltimore County if it is proven to be infeasible to provide SWM on site and a suitable outfall has been identified for the project. The fee-in-lieu money is used by DEPRM's Capital Program and Operations section for water quality restoration projects. Table 1-1 indicates the fee-in-lieu money received by watershed for the calendar year 2008.

Table 1-1: Fee-in-lieu money received in 2008

Watershed	# of Projects	Fee-in-lieu
Upper Western Shore		
Deer Creek	0	$0
Prettyboy Reservoir	4	$27,812
Loch Raven Reservoir	18	$83,200
Lower Gunpowder	8	$40,490
Little Gunpowder Falls	1	$10,400
Bird River	3	$12,900
Gunpowder River	3	$21,156
Middle River	1	$1,568
Upper Western Shore Total	**37**	**$197,526**
Patapsco/Back River		
Liberty Reservoir	1	$1,608
Patapsco	9	$55,590
Gwynns Falls	6	$17,877
Jones Falls	12	$41,777
Back River	11	$77,560
Baltimore Harbor	0	$0
Patapsco/Back River Total	**39**	**$194,412**
County Totals	**76**	**$391,938**

1.3 Approved Stormwater Management Facility Analysis

The database of approved stormwater management facilities indicates that 3,334 facilities have been approved through the end of 2008. Of the 3,334 approved facilities 2,388 have been built (933 public and 1,455 private). Table 1-2 lists approved facilities, but not necessarily built, by watershed, type and ownership. The last two sections of the table include both the total approved facilities by watershed and the number of built facilities by watershed.

The 3,334 approved facilities listed in Table 1-2 will, if built, serve 35,386 acres of urban land. Sixty-two (62%) percent of all approved facilities are privately owned and operated. The private facilities represent forty-five (45%) percent of the drainage area served by stormwater management facilities. The 2,388 built facilities serve 29,075 acres of urban land, with forty-four (44%) percent of the drainage area served by private facilities.

Stormwater management facilities classified as detention ponds provide minimal water quality. The database indicates that there are approved plans for 591 dry detention pond facilities serving 12,732 acres of urban land. There are 257 in public ownership and these represent 7,700 acres of the drainage area. These facilities present an opportunity for conversion in the future to other facility types with greater pollutant removal potential. An assessment of the existing stormwater management facilities and possibilities for conversion is a component of each watershed management plan. Conversions are typically cost effective only for facilities with greater than ten acres of drainage. Preparation of Small Watershed Action Plans (see Section 7) will result in assessing each built stormwater management facility for conversion possibilities.

Table 1-2: Approved Stormwater Management Facilities by Watershed Through 2008

Watershed	Detention Ponds (DP)				Extended Detention (ED, EDSD, EDSW)			
	Private		Public		Private		Public	
	N	D.A.	N	D.A.	N	D.A.	N	D.A.
Upper Western Shore								
Deer Creek	0	0	0	0	0	0	0	0
Prettyboy Res.	0	0	0	0	0	0	5	36
Loch Raven Res.	65	1,298	33	1,166	65	745	55	1,273
Lower Gunpowder	14	154	39	1,140	27	190	56	717
Little Gunpowder	2	3	0	0	5	16	9	107
Bird River	36	528	29	730	53	396	59	666
Gunpowder River	1	14	3	115	1	2	3	9
Middle River	5	78	3	138	9	24	3	22
UWS Totals	**123**	**2,075**	**107**	**3,289**	**160**	**1373**	**190**	**2,830**
Patapsco/Back River								
Liberty Res.	0	0	1	8	9	59	10	186
Patapsco River	34	473	38	1,369	54	565	60	581
Gwynns Falls	78	1,129	69	2,079	135	1,425	127	1,831
Jones Falls	33	815	22	724	62	729	20	432
Back River	59	396	18	145	62	420	38	365
Baltimore Harbor	7	144	2	86	8	65	1	14
Patapsco/Back R. Tot	**211**	**2,957**	**150**	**4,411**	**330**	**3,263**	**256**	**3,409**
County Totals	**334**	**5,032**	**257**	**7,700**	**490**	**4,636**	**446**	**6,239**

Watershed	Retention Pond (WP & SM)				Infiltration Basins, Trenches, Dry Wells, Porous Paving (DW, PP, IT, TTWQE & IB)			
	Private		Public		Private		Public	
	N	D.A.	N	D.A.	N	D.A.	N	D.A.
Upper Western Shore								
Deer Creek	0	0	0	0	0	0	0	0
Prettyboy Res.	0	0	0	0	1	13	0	0
Loch Raven Res.	11	293	8	128	54	182	15	120
Lower Gunpowder	2	300	5	96	5	11	6	53
Little Gunpowder	1	50	1	7	4	57	2	33
Bird River	22	513	12	440	17	40	10	50
Gunpowder River	11	99	4	55	3	20	6	4
Middle River	16	247	9	172	11	14	4	8
UWS Totals	**63**	**1502**	**39**	**898**	**95**	**337**	**43**	**268**
Patapsco/Back River								
Liberty Res.	1	22	0	0	10	23	1	2
Patapsco River	12	286	11	142	45	62	13	217
Gwynns Falls	16	290	6	167	48	67	23	47
Jones Falls	6	882	2	31	23	45	5	24
Back River	15	174	9	862	14	17	2	8
Baltimore Harbor	9	93	7	294	10	16	1	2
Patapsco/Back R. Tot	**59**	**1747**	**35**	**1496**	**150**	**230**	**45**	**300**
County Totals	**122**	**3,249**	**74**	**2,394**	**245**	**567**	**88**	**568**

Table 1-2: Approved Stormwater Management Facilities by Watershed Through 2008 (continued)

Watershed	Sand Filter and Bioretention (SF)				Underground Storage & Oil/Grit Separator (UGS, OGS, SC)			
	Private		Public		Private		Public	
	N	D.A.	N	D.A.	N	D.A.	N	D.A.
Upper Western Shore								
Deer Creek	0	0	0	0	0	0	0	0
Prettyboy Res.	0	0	5	43	0	0	0	0
Loch Raven Res.	101	273	73	653	77	189	1	25
Lower Gunpowder	23	70	22	121	17	45	1	2
Little Gunpowder	10	16	4	34	2	1	0	0
Bird River	50	104	57	334	24	56	4	13
Gunpowder River	8	16	2	10	0	0	0	0
Middle River	28	53	9	85	5	7	2	2
UWS Totals	**220**	**532**	**172**	**1280**	**125**	**298**	**8**	**42**
Patapsco/Back River								
Liberty Res.	13	20	21	126	4	2	0	0
Patapsco River	62	142	40	296	37	141	7	17
Gwynns Falls	109	309	59	336	107	294	5	32
Jones Falls	74	165	28	154	57	181	8	107
Back River	66	129	34	144	42	99	2	13
Baltimore Harbor	9	28	4	3	9	11	4	3
Patapsco/Back R. Tot	**333**	**793**	**186**	**1059**	**256**	**728**	**26**	**172**
County Totals	**553**	**1,325**	**358**	**2,339**	**381**	**1,026**	**34**	**214**

Watershed	Total Approved SWM				Total Constructed SWM			
	Private		Public		Private		Public	
	N	D.A.	N	D.A.	N	D.A.	N	D.A.
Upper Western Shore								
Deer Creek	0	0	0	0	0	0	0	0
Prettyboy Res.	2	0	11	92	0	0	9	62
Loch Raven Res.	347	2,933	202	3,423	252	2,474	149	2,813
Lower Gunpowder	90	778	130	2,139	69	705	102	1,876
Little Gunpowder	23	142	18	190	12	124	13	120
Bird River	192	1,651	172	2,243	143	1,317	116	1,837
Gunpowder River	24	151	19	193	14	78	15	189
Middle River	77	448	29	489	40	298	24	385
UWS Totals	**755**	**6,103**	**581**	**8,769**	**530**	**4,996**	**428**	**7,282**
Patapsco/Back River								
Liberty Res.	35	125	36	322	29	114	15	148
Patapsco River	241	1,658	168	2,632	163	1,168	120	2,254
Gwynns Falls	473	3,501	291	4,506	348	2,876	225	4,061
Jones Falls	246	2,780	87	1,476	177	2,404	60	1,284
Back River	251	1,227	103	1,530	172	920	78	1,007
Baltimore Harbor	52	358	15	399	36	287	7	274
Patapsco/Back R. Tot	**1298**	**9,649**	**700**	**10,865**	**925**	**7,769**	**505**	**9,028**
County Totals	**2,053**	**15,752**	**1,281**	**19,634**	**1,455**	**12,765**	**933**	**16,310**

Figure 1-1 displays the number of approved facilities, both private and public, by watershed. The Gwynns Falls watershed continues to have the greatest total number of existing and newly approved facilities. The large number of facilities in the Gwynns

Falls watershed can be attributed to the fact that the Owings Mills growth area was built mostly after SWM regulations were in place. Many older communities, developed prior to regulatory authority, do not have any SWM facilities. Deer Creek, Prettyboy Reservoir, Liberty Reservoir, the Little Gunpowder Falls and the Gunpowder River watersheds have only a few facilities, which is reflective of fewer development projects and the small size of those watersheds. This pattern has not changed from past reports.

Figure 1-2 displays acreage to be served by approved private stormwater management facilities by watershed, and Figure 1-3 displays the same information for public facilities.

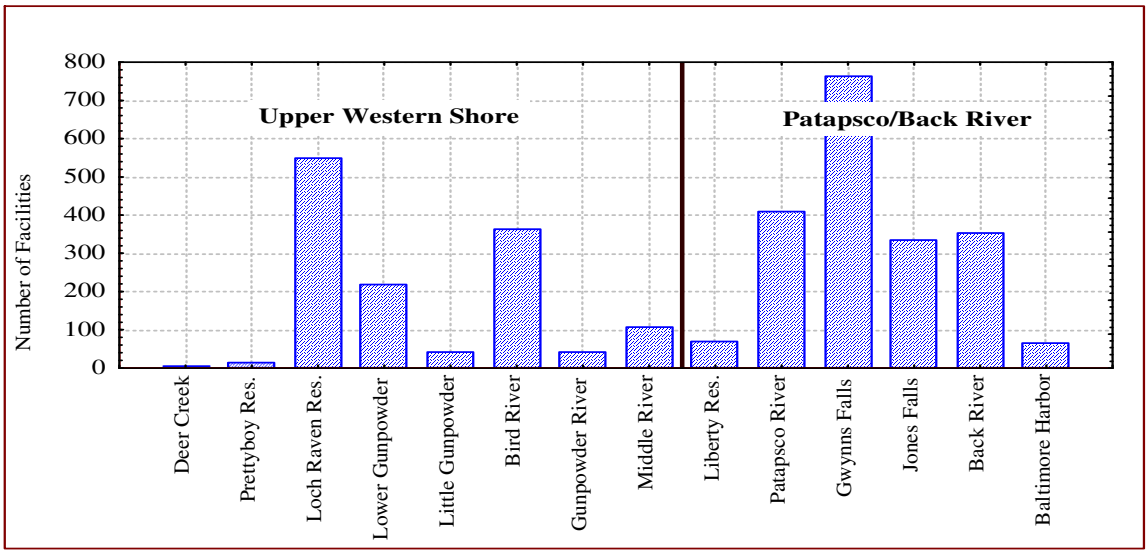


Figure 1-1: Number of Approved SWM Facilities by Watershed – Through Calendar Year 2008.

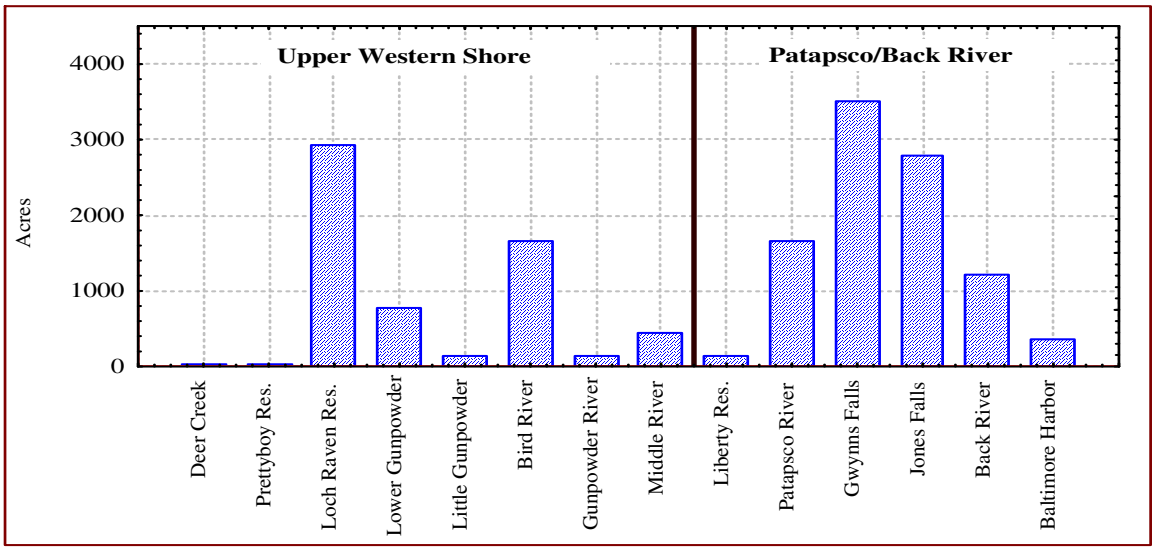


Figure 1-2: Acreage Served by Approved Private SWM Facilities by Watershed Through Calendar Year 2008.

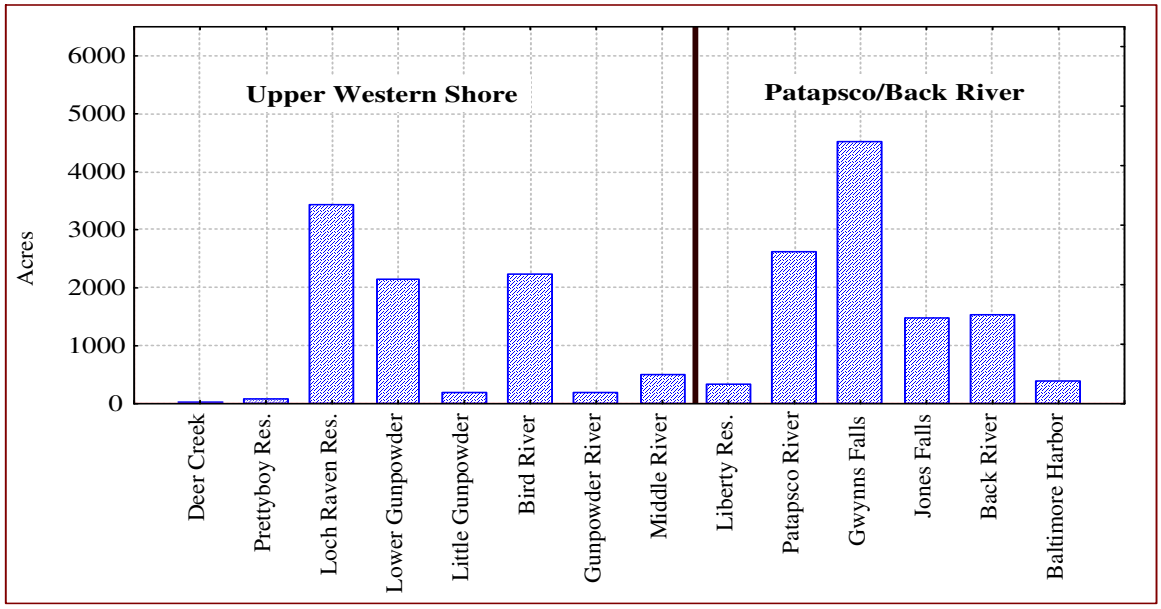


Figure 1-3: Acreage Served by Approved Public SWM Facilities by Watershed Through Calendar Year 2008.

1.4 Inspections

Inspections of stormwater management facilities are conducted by the Stormwater Engineering Section for private facilities and by the Capital Programs and Operations Section for public facilities. The Stormwater Engineering Section added two Engineering Associates III to conduct three-year inspections of private stormwater facilities in 2005. In addition, an existing Engineering Associate IV was reassigned as a supervisor to the private facility three-year inspection program. An Engineer III was added in 2008 to the Stormwater Engineering Section to provide added staff for review of stormwater management designs for new development and redevelopment.

Table 1-3 presents the SWM facility inspections conducted by DEPRM during the calendar year 2008.

Table 1-3: SWM Inspections 2008

	As Built	One year	Three year	Totals
Private Stormwater Facilities	195	113	316	**624**
Public Stormwater Facilities	139	70	125	**334**
Totals	**334**	**183**	**441**	**958**

All as-built inspections and one-year inspections are completed by engineers in the Stormwater Engineering Section. A total of three hundred and thirty-four (334) as-built inspections were completed in calendar year 2008. A total of one hundred and eighty-three (183) one-year inspections were completed. Approval of the one-year maintenance inspection initiates the three-year maintenance inspection cycle. The Stormwater Engineering Section also completes three-year inspections for the facilities in private ownership. A total of three hundred and sixteen (316) three-year inspections of private stormwater facilities were conducted.

The three-year inspection of publicly owned facilities is completed by the Capital Program and Operations Section. A total of one hundred and twenty-five (125) three-year inspections were completed for public facilities. This results in a total of four hundred

and forty-one (441) three-year inspections of all stormwater management facilities by DEPRM for the calendar year 2008. This represents 19% of the built facilities in Baltimore County and indicates that the program is below last year's inspection totals and not achieving its goal to inspect all built facilities every three years.

1.5 Stormwater Management Facility Maintenance

The Baltimore County Department of Environmental Protection and Resource Management has an operations crew in the Capital Program and Operations Section. This crew consists of six environmental maintenance specialists and one supervisor. The crews are divided geographically into central, eastern and western districts. A database has been developed to track all routine maintenance and responses to complaints. Table 1-4 summarizes the number of maintenance visits due to complaints versus routine maintenance. There were one hundred and fifty seven (157) routine maintenance assessments and ninety-five (95) complaint driven site assessments during the calendar year 2008.

Table 1-4: Stormwater Facility Maintenance Visits by Type 2008

Watershed	# of Routine Maintenance Visits	# of Complaint Maintenance Visits
Loch Raven Reservoir	13	6
Lower Gunpowder	39	14
Little Gunpowder	3	2
Bird River	20	7
Gunpowder River	7	1
Middle River	4	3
Liberty Reservoir	0	1
Patapsco River	10	15
Gwynns Falls	26	35
Jones Falls	19	2
Back River	16	8
Baltimore Harbor	0	2
Total	**157**	**95**

A summary of the maintenance activities for the time period by watershed and drainage basin is presented in Table 1-5. One hundred and eighty-eight (188) facilities were maintained during the reporting time period. The total number of site visits was two hundred and fifty-two (252), indicating that some facilities required several visits. The most frequent activities are debris removal, fence trimming, cleaning of the riser, and cleaning the low flow channel. Appendix 1-1 contains the SWM maintenance data for the time period of January 1, 2008 through December 31, 2008. The data are arranged by watershed, with facility ID number, and by type of maintenance activity.

Table 1-5: SWM Pond Maintenance Activities for Calendar Year 2008

Watershed	# Ponds Maintained	Total # inspections	Repair Fence	Secure Gate	Clean Riser	Clean Low Flow	Remove Debris	Trim Fence	Cleared Berm	Tar- Riser
Upper Western Shore										
Prettyboy	0	0	0	0	0	0	0	0	0	0
Loch Raven	16	19	5	10	11	12	12	11	4	0
Lower Gunpowder	35	53	20	18	15	12	15	20	7	0
Little Gunpowder	4	5	0	4	3	4	3	3	0	0
Bird River	15	26	19	6	3	1	8	10	0	0
Gunpowder River	6	8	2	1	3	4	4	2	0	0
Middle River	5	7	2	0	1	1	3	1	1	0
Upper West Shore. Total	**81**	**118**	**48**	**39**	**36**	**34**	**45**	**47**	**12**	**0**
Patapsco/Back River										
Liberty	1	1	1	1	1	1	0	1	0	0
Patapsco	20	25	10	9	20	17	18	15	17	1
Gwynns Falls	54	61	15	33	48	54	54	46	39	0
Jones Falls	20	21	8	12	16	20	17	12	5	1
Back River	10	24	19	6	3	1	8	10	0	0
Baltimore Harbor	2	2	1	1	0	0	0	2	0	0
Patapsco/Back River Total	**107**	**134**	**54**	**62**	**88**	**93**	**97**	**86**	**61**	**2**
County Totals	**188**	**252**	**102**	**101**	**124**	**127**	**142**	**133**	**73**	**2**

1.6 Constructed Stormwater Management Facility Data Analysis

An analysis of the databases related to stormwater management facilities indicated that a total of 2,388 facilities have been built to date. The 2,388 built facilities have a combined drainage area of 29,075 acres. The drainage areas of 1,990 built facilities were delineated and digitized into the County GIS. The drainage area for the 1,990 facilities that have been delineated is 25,644 acres or approximately 88% of the area (29,075 ac.) served by the built stormwater facilities. The remaining 389 built facilities have a combined drainage area of 3,431 acres (12% of the area served by stormwater management). As new facilities are built their drainage areas will also be added to the GIS data layer. Overall, built stormwater management facilities serve 19% of the designated urban acreage (151,038 acres). The total urban acreage is based on the Maryland Department of Planning 2002 land use data.

The drainage areas were overlaid on the Maryland Department of Planning 2002 land use data to determine the specific land use draining to each facility. Table 1-6 presents a summary of the land use served by built SWM facilities by watershed. It should be noted that the date of the creation of the MDP GIS data layer might precede the building of a number of the stormwater management facilities. This fact will result in some error in the determination of land use draining to those facilities.

Table 1-6: Constructed SWM Facility Drainage Area Land Use (Acres) through Calendar-Year 2008

Watershed	Pervious Urban	Impervious Urban	Low Density Residential	Agriculture	Forest and Wetlands	Bare Ground	Total
Upper Western Shore							
PR	0.2	4.6	22.3	4.2	14.0	0.0	45.3
LR	1,747.1	1,318.5	1,165.5	240.1	606.6	1.9	5,079.7
GU	992.4	478.3	325.3	121.7	182.3	0.0	2100.0
LG	6.0	12.7	49.4	24.6	5.3	0.0	98.0
BI	1,261.3	722.8	60.5	250.5	468.4	0.0	2,763.5
GR	103.2	55.8	0.0	0.1	68.8	0.0	227.9
MR	192.4	125.6	0.3	0.0	116.9	0.0	435.2
Total	**4,302.6**	**2,718.3**	**1,623.3**	**641.2**	**1462.3**	**1.9**	**10,749.6**
Patapsco/Back River							
LI	75.3	36.4	47.2	12.6	9.7	0.0	181.2
PA	1,449.5	887.8	118.7	53.3	261.9	0.9	2,772.1
GW	3,231.2	2,118.8	416.0	127.0	443.6	8.5	6,345.1
JF	1,288.4	780.4	847.2	58.1	384.7	31.9	3,390.7
BR	721.5	745.5	271.6	2.6	154.3	14.7	1910.2
BH	171.0	120.7	0.7	0.0	23.1	0.0	315.5.0
P/B	**6,936.9**	**4,689.6**	**1701.4**	**253.6**	**1277.3**	**56.0**	**14,914.8**
County	**11,239.4**	**7,047.8**	**3,324.7**	**894.8**	**2,739.6**	**57.9**	**25,644.2**

LR = Loch Raven Reservoir PR = Prettyboy Reservoir GU = Lower Gunpowder
LG = Little Gunpowder Falls BI = Bird River GR = Gunpowder River
PA = Patapsco River LI = Liberty Reservoir GW = Gwynns Falls
JF = Jones Falls MR = Middle River BH = Baltimore Harbor
BR = Back River

The pollutant loads were determined by the methodology described in Section 10 for each of the 1,990 facilities that are currently built with drainage area digitized (an additional 398 facilities that have been built do not have their drainage areas digitized at this time). Table 1-7 presents the loads Total Phosphorus and Total Nitrogen delivered to storm water management facilities. The table is organized into watersheds and the two Tributary Strategy groups. A separate load is calculated for the Upper Western Shore and the Patapsco/Back River basins.

Table 1-7: Pollutant Loads to Constructed SWM Facilities by Watershed

Watershed	(#) TP	(#) TN
Upper Western Shore		
Prettyboy Res.	53.1	461
Loch Raven Res.	7,005.9	58,521
Lower Gunpowder	3,080.2	25,013
Little Gunpowder	404.1	3,298
Bird River	3,551.6	30,572
Gunpowder River	265.2	2,167
Middle River	504.6	4,192
Total	**14,864.7**	**124,224**
Patapsco/Back River		
Liberty Res.	237.5	1,897
Patapsco	3,675.6	29,752
Gwynns Falls	9,004.6	74,826

Jones Falls	4,957.0	39,408
Back River	2,675.7	22,146
Baltimore Harbor	453.4	3,710
Total	**21,003.8**	**171,739**
County Total	**35,868.5**	**295,963**

The type of stormwater management facility has an influence on the percentage of a pollutant removed. Through a series of meetings conducted by the Chesapeake Bay Program – Urban Stormwater Workgroup a consensus was reached on the pollutant removal efficiencies by categories of practice for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). A copy of the resulting *Draft Recommendation for Storm Water Best Management Practice Categories and Pollutant Removal Efficiencies* document was included with Baltimore County's 2004 NPDES report. Table 1-8 reflects the pollutant removal efficiencies based on the consensus document. An additional change based on the *Draft Recommendation for Storm Water Best Management Practice Categories and Pollutant Removal Efficiencies* document is the type of facility to include in each practice category. The type of practice included in each category is indicated, along with the associated NPDES practice code, below Table 1-8. As shown in the table, there is a wide range of pollutant removal efficiencies by facility type as well as for pollutant type. Where there is a lack of data for a type of facility the removal efficiency for a particular pollutant was assumed to be zero. This will result in a conservative estimate of the actual amounts of pollutants removed.

Table 1-8: Percent Removal Efficiency of BMPs

BMP	Pollutants		
	TSS	TP	TN
Detention Facilities	10	10	5
Extended Detention Facilities	60	20	30
Wet Ponds	80	50	50
Infiltration Practices	90	70	50
Filtration Practices	85	60	40

Detention Facilities = Detention Pond and Hydrodynamic Devices (DP, OGS, and UGS)
Extended Detention Facilities = Extended Detention Ponds (EDSD, EDSW, ED)
Wet Ponds and Wetlands = Wet Pond and Shallow Marsh (WP and SM)
Infiltration Practices = Infiltration Trench and Infiltration Basins (IB, IT and ITWQC), Porous Paving (PP), and Dry Wells (DW)
Filtration Practices = Sand filters and Bioretention Facilities (SF, BIO)

The results of the analysis are displayed in Tables 1-9 (Total Phosphorus) and 1-10 (Total Nitrogen)

Table 1-9: Total Phosphorus Removal by SWM Facility Type and Watershed

Watershed	Total # To SWM	Pounds of Removal by Facility Type					Total Removed	
		DP	EDP	WP	INF.	FIL.	#	%
Upper Western Shore Watersheds								
Prettyboy Res.	53.1	0	4.4	0	14.2	6.4	25.0	47
Loch Raven Res.	7,005.9	329.4	463.9	214.4	235.4	376.7	1,619.8	23
Lower Gunpowder	3,080.2	139.0	202.6	245.0	83.7	40.3	710.6	23
Little Gunpowder	404.1	0.7	33.9	51.2	82.1	5.1	173.0	43
Bird River	3,551.6	141.3	185.5	420.8	118.1	108.3	974.0	27
Gunpowder River	265.2	14.0	4.4	48.8	0.8	2.7	70.7	27
Middle River	504.6	21.2	9.2	102.0	6.2	20.3	158.9	31
Totals	**14,864.7**	**645.6**	**903.9**	**1082.2**	**540.5**	**559.8**	**3,732.0**	**25**
Patapsco/Back River Watersheds								
Liberty Res.	237.5	0.2	28.6	16.1	26.5	13.6	85.0	36
Patapsco	3,675.6	205.4	184.6	201.6	126.0	69.0	786.6	21
Gwynns Falls	9,004.6	406.7	797.0	255.8	108.3	177.4	1,744.8	19
Jones Falls	4,957.0	241.5	283.9	443.2	52.7	98.2	1,119.5	23
Back River	2,675.7	72.5	137.4	420.2	10.1	147.8	788.0	29
Baltimore Harbor	453.4	34.0	7.1	27.7	9.9	4.7	83.4	18
Totals	**21,003.8**	**960.3**	**1438.6**	**1364.6**	**333.5**	**510.7**	**4,607.3**	**22**
County Total	**35,868.5**	**1,605.5**	**2,342.5**	**2,446.8**	**874.0**	**1,070.5**	**8,339.3**	**23**

Table 1-10: Total Nitrogen Removal by SWM Facility Type and Watershed

Watershed	Total # To SWM	Pounds of Removal by Facility Type					Total Removed	
		DP	EDP	WP	INF.	FIL.	#	%
Upper Western Shore Watersheds								
Prettyboy Res.	461	0	50	0	75	59	184	40
Loch Raven Res.	58,521	1,356	5,926	1,769	1,470	2,074	12,595	22
Lower Gunpowder	25,013	551	2,433	2,165	510	213	5,872	23
Little Gunpowder	3,298	3	424	390	464	48	1,329	40
Bird River	30,572	562	2,511	3,875	741	691	8,380	27
Gunpowder River	2,167	55	52	406	15	19	547	29
Middle River	4,192	85	116	829	44	143	1,217	29
Totals	**124,224**	**2,612**	**11,512**	**9,434**	**3,319**	**3,247**	**30,124**	**24**
Patapsco/Back River Watersheds								
Liberty Res.	1,897	1	321	123	152	102	699	37
Patapsco	29,752	819	2,288	1,547	874	363	5,891	20
Gwynns Falls	74,826	1,655	10,044	2,220	637	1,015	15,569	21
Jones Falls	39,408	975	3,365	3,443	290	2,074	10,147	26
Back River	22,146	305	2,085	3,466	70	807	6,733	30
Baltimore Harbor	3,710	134	111	243	53	25	566	15
Totals	**171,739**	**3,889**	**18,214**	**11,042**	**2076**	**4,386**	**39,605**	**23**
County Total	**295,963**	**6,499**	**27,726**	**20,476**	**5,395**	**7,633**	**69,729**	**24**

While the load reductions are conservative numbers, it is apparent from an inspection of Table 1-9 and Table 1-10 (phosphorus and nitrogen loads) that the County has not achieved a 40% reduction of these two constituents for existing development served by stormwater management facilities. This calculation does not include the nitrogen and phosphorus loads from development without stormwater controls.

In order to account for the impervious area served by state-of-the-art stormwater management, an analysis of the impervious area served by stormwater management facilities was performed. The drainage areas for facilities that are considered to have higher pollutant removal efficiencies and to have little or no conversion potential were overlaid on the Baltimore County impervious cover data layer. The facility types included in this analysis are wet ponds, shallow marsh, extended detention facilities, sand filters, bioretention, and infiltration facilities. Dry ponds and underground facilities were not included. The former were excluded due to low pollution removal efficiencies and the latter due to the impossibility of conversion to a type of facility that has higher pollution removal efficiency. The impervious cover layer for Baltimore County does not include sidewalks and driveways. It does include all roadways and parking lots, as well as all buildings based on aerial photography obtained in the 2005. This is the first year that the 2005 impervious cover data has been used. Previously, the impervious cover was based on aerials obtained in the mid 1990s (see Section 7 for the new analysis of existing impervious cover). The results of the analysis of impervious cover served by storm water management are presented in Table 1-11. The 4,005 acres of impervious cover addressed by advanced stormwater management represents 11% of the Baltimore County impervious cover (minus State and Federally owned impervious cover).

Table 1-11: Impervious Cover Addressed by All SWM and Advanced SWM

Watershed	Watershed Impervious Acres	Baltimore County Impervious Acres	Impervious Acres Cover by All SWM	Impervious Acres Cover by Advanced SWM	% Covered by All SWM	% Covered by Advanced SWM
Upper Western Shore						
Deer Creek	193.4	165.5	0.0	0.0	0.0	0.0
Prettyboy	528.2	506.5	4.6	4.6	0.9	0.9
Loch Raven	7,203.9	6,560.0	1,317.6	615.4	20.1	9.4
Lower Gunpowder	2,474.4	2,281.5	470.9	256.8	20.6	11.3
Little Gunpowder	702.4	611.9	30.5	27.8	5.0	4.5
Bird River	2,836.4	2,552.7	713.2	414.5	27.9	16.2
Gunpowder River	436.5	396.0	55.8	27.7	14.1	7.0
Middle River	1,442.2	1,162.3	125.2	82.5	10.8	7.1
UWS Totals	**15,817.4**	**14,236.4**	**2,717.8**	**1429.3**	**19.1**	**10.0**
Patapsco/Back River						
Liberty	685.5	561.6	34.9	33.2	6.2	5.9
Patapsco	4,574.2	3,852.9	917.0	395.2	23.8	10.3
Gwynns Falls	6,989.6	6,261.9	2,140.8	1,209.3	34.2	19.3
Jones Falls	3,890.3	3,422.6	775.4	371.9	22.7	10.9
Back River	5,846.4	5,297.6	755.0	518.0	14.3	9.8
Baltimore Harbor	3,124.8	2,812.8	120.7	48.1	4.3	1.7
P/B Totals	**25,110.8**	**22,209.4**	**4,743.8**	**2,575.7**	**21.4**	**11.6**
County Total	**40,928.2**	**36,445.8**	**7,461.6**	**4,005.0**	**20.5**	**11.0**

1.7 Summary

Baltimore County operates a comprehensive stormwater management program. DEPRM has always taken a firm stand on requiring water quality treatment even when quantity management was not required. With the implementation of the new stormwater regulations DEPRM continues to require all projects to explore and implement methods for water quality treatment. DEPRM now has the option to accept a fee-in-lieu payment if an exhaustive search has resulted in no practicable opportunities.

The operation of the public stormwater management facility maintenance program within DEPRM's Capital Program and Operations Section has continued to inspect and maintain publicly owned facilities. This group has compiled an extensive database of inspections and maintenance operations for the County's publicly owned stormwater facilities. These inspections, and the resulting actions, are improving the overall pollutant reduction efficiency of all public stormwater facilities.

Constructed stormwater management facilities serve ~19% of the total urban land, 151,038 acres (84,814 P/B and 66,223 UWS), in Baltimore County. For the areas served by these facilities a significant amount of pollutants are removed annually. Facilities designed and constructed for water quantity management represent an opportunity for water quality improvement through conversion to water quality facilities that will be explored through the Small Watershed Action Plan planning process (Section 7). However, many of the facilities either have no conversion potential (underground facilities) or are already designed to provide advanced water quality treatment. Those facilities designed for water quality are serving 4,005 acres of impervious cover of the County's 36,446 acres of impervious area.

Appendix 1-1: Public Stormwater Facility Maintenance by Type for Calendar Year 2008

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
02/04/2008	Back River	164	X							
08/20/2008	Back River	164	X			X	X	X		
09/29/2008	Back River	164	X							
02/06/2008	Back River	170			X			X		
09/16/2008	Back River	170						X		
09/29/2008	Back River	170	X							
07/09/2008	Back River	381	X							
05/15/2008	Back River	554		X				X		
06/16/2008	Back River	554		X	X		X	X		
01/03/2008	Back River	1380	X							
02/04/2008	Back River	1380	X							
04/28/2008	Back River	1380	X							
08/18/2008	Back River	1380	X	X				X		
11/25/2008	Back River	1380	X							
03/25/2008	Back River	1547	X	X			X	X		
04/24/2008	Back River	1547	X							
11/24/2008	Back River	1547	X				X			
04/28/2008	Back River	1983	X							
06/18/2008	Back River	1983	X				X	X		
11/24/2008	Back River	1983	X				X			
03/26/2008	Back River	1984	X	X						
06/16/2008	Back River	2915	X	X	X		X	X		
07/14/2008	Back River	2915	X							
12/09/2008	Back River	3031					X	X		
08/20/2008	Baltimore Harbor	1420						X		
07/31/2008	Baltimore Harbor	1421	X	X				X		
08/10/2008	Bird River	493								
09/30/2008	Bird River	493								
12/01/2008	Bird River	493				X				
12/11/2008	Bird River	493				X	X			
12/22/2008	Bird River	493				X	X			
01/10/2008	Bird River	610	X							
07/02/2008	Bird River	874	X							
11/18/2008	Bird River	977		X	X	X	X	X		
11/18/2008	Bird River	979		X	X	X	X	X		
03/05/2008	Bird River	1010			X	X	X		X	
01/15/2008	Bird River	1038			X			X		
10/21/2008	Bird River	1038			X	X		X		
01/15/2008	Bird River	1039	X	X	X	X		X		
09/24/2008	Bird River	1039			X		X	X		
12/12/2008	Bird River	1039	X							
01/15/2008	Bird River	1040	X	X	X		X	X		
09/24/2008	Bird River	1040			X		X	X		

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
12/12/2008	Bird River	1040	X							
01/15/2008	Bird River	1041	X	X	X	X	X	X		
09/25/2008	Bird River	1041	X							
12/12/2008	Bird River	1041	X							
07/01/2008	Bird River	1260	X	X	X		X			
08/19/2008	Bird River	1260								
01/29/2008	Bird River	1270			X					
01/29/2008	Bird River	1271		X	X			X	X	
01/29/2008	Bird River	1272		X	X			X	X	
03/18/2008	Bird River	1799		X	X			X		
09/29/2008	Gunpowder River	1167	X							
11/12/2008	Gunpowder River	1167	X	X	X			X		
09/22/2008	Gunpowder River	1307			X	X	X			
09/22/2008	Gunpowder River	1308				X	X			
09/22/2008	Gunpowder River	1309				X	X			
12/09/2008	Gunpowder River	3032			X		X	X		
08/19/2008	Gunpowder River	3436								
12/01/2008	Gunpowder River	3436				X				
08/13/2008	Gwynns Falls	26		X	X	X	X	X		
01/15/2008	Gwynns Falls	28			X	X	X		X	
01/28/2008	Gwynns Falls	33		X	X	X	X	X		
06/26/2008	Gwynns Falls	42			X	X	X		X	
07/01/2008	Gwynns Falls	42		X		X	X	X		
09/23/2008	Gwynns Falls	42		X						
02/05/2008	Gwynns Falls	47		X	X	X	X	X		
06/12/2008	Gwynns Falls	93			X	X	X		X	
07/23/2008	Gwynns Falls	110		X	X	X	X	X		
10/15/2008	Gwynns Falls	226	X	X	X	X	X	X	X	
10/08/2008	Gwynns Falls	227	X	X	X	X	X	X	X	
11/26/2008	Gwynns Falls	231	X		X	X	X	X	X	
08/12/2008	Gwynns Falls	238	X	X	X	X	X	X	X	
03/11/2008	Gwynns Falls	242	X		X	X	X	X	X	
08/14/2008	Gwynns Falls	274		X	X	X	X	X		
04/21/2008	Gwynns Falls	365								
09/18/2008	Gwynns Falls	441		X	X	X	X	X	X	
09/19/2008	Gwynns Falls	442			X	X			X	
09/24/2008	Gwynns Falls	442		X	X	X	X	X	X	
06/18/2008	Gwynns Falls	450		X	X	X	X	X	X	
01/10/2008	Gwynns Falls	451			X	X	X	X	X	
08/27/2008	Gwynns Falls	651					X	X	X	
12/15/2008	Gwynns Falls	746		X	X	X	X	X	X	
02/08/2008	Gwynns Falls	842					X			
02/11/2008	Gwynns Falls	842				X	X	X	X	
06/16/2008	Gwynns Falls	849		X	X	X	X	X		

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
07/08/2008	Gwynns Falls	925		X	X	X	X	X		
12/03/2008	Gwynns Falls	925	X	X	X	X	X	X	X	
12/04/2008	Gwynns Falls	925		X	X	X	X	X	X	
08/22/2008	Gwynns Falls	967		X	X	X	X	X		
06/20/2008	Gwynns Falls	993		X	X	X	X	X	X	
02/07/2008	Gwynns Falls	997			X	X	X	X	X	
03/04/2008	Gwynns Falls	1053		X	X	X	X			
10/23/2008	Gwynns Falls	1054	X		X	X	X	X	X	
10/20/2008	Gwynns Falls	1055	X	X	X	X	X	X	X	
11/24/2008	Gwynns Falls	1066			X	X	X	X	X	
03/21/2008	Gwynns Falls	1073					X			
07/29/2008	Gwynns Falls	1109			X	X	X	X	X	
12/04/2008	Gwynns Falls	1115		X	X	X	X	X	X	
09/02/2008	Gwynns Falls	1144	X	X	X	X	X	X	X	
09/03/2008	Gwynns Falls	1145	X	X		X	X	X	X	
10/03/2008	Gwynns Falls	1146		X	X	X	X	X	X	
05/06/2008	Gwynns Falls	1194			X	X	X	X	X	
04/08/2008	Gwynns Falls	1432	X	X	X	X	X	X	X	
05/28/2008	Gwynns Falls	1601	X		X	X	X	X	X	
06/05/2008	Gwynns Falls	1602			X					
07/30/2008	Gwynns Falls	1708			X	X	X		X	
03/12/2008	Gwynns Falls	1709		X	X	X	X	X	X	
07/28/2008	Gwynns Falls	1716			X	X	X	X	X	
01/31/2008	Gwynns Falls	1730		X	X	X	X	X	X	
01/15/2008	Gwynns Falls	1731			X	X	X	X	X	
02/05/2008	Gwynns Falls	1732			X	X	X	X	X	
03/27/2008	Gwynns Falls	1815	X	X		X	X			
07/02/2008	Gwynns Falls	2016		X	X	X		X		
08/15/2008	Gwynns Falls	2016				X				
07/02/2008	Gwynns Falls	2198	X				X	X	X	
09/16/2008	Gwynns Falls	2203	X			X	X	X	X	
09/17/2008	Gwynns Falls	2204			X	X	X			
02/29/2008	Gwynns Falls	3055		X	X	X	X	X		
07/10/2008	Gwynns Falls	3269		X	X	X		X		
12/03/2008	Gwynns Falls	3501				X	X			
12/29/2008	Jones Falls	49			X	X	X		X	
02/08/2008	Jones Falls	63			X	X	X	X	X	
09/10/2008	Jones Falls	111	X	X	X	X	X	X		
09/11/2008	Jones Falls	112		X		X	X	X		
09/11/2008	Jones Falls	113		X		X	X	X		
08/19/2008	Jones Falls	145								
02/27/2008	Jones Falls	147		X	X	X	X	X		
05/30/2008	Jones Falls	200			X	X	X			
05/02/2008	Jones Falls	912		X	X	X		X	X	

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
03/18/2008	Jones Falls	913		X		X	X			
12/30/2008	Jones Falls	913		X	X	X	X	X	X	
01/09/2008	Jones Falls	1015	X	X	X	X	X	X	X	
08/05/2008	Jones Falls	1632			X	X				
02/27/2008	Jones Falls	1667	X			X	X	X		
02/19/2008	Jones Falls	1797	X		X	X				
01/16/2008	Jones Falls	1807	X		X	X	X			
02/20/2008	Jones Falls	1808	X	X	X	X	X			
02/19/2008	Jones Falls	1809	X	X	X	X	X	X		
01/22/2008	Jones Falls	3307	X		X	X	X			X
07/11/2008	Jones Falls	3570		X	X	X	X	X		
07/11/2008	Jones Falls	3571		X	X	X	X	X		
12/02/2008	Liberty	1456	X	X	X	X		X		
11/03/2008	Little Gunpowder	1970		X						
05/05/2008	Little Gunpowder	2225		X	X	X	X	X		
05/07/2008	Little Gunpowder	2226		X	X	X	X	X		
08/11/2008	Little Gunpowder	2226		X		X		X		
11/19/2008	Little Gunpowder	4255			X	X	X			
06/18/2008	Loch Raven	61			X	X			X	
03/06/2008	Loch Raven	78		X	X		X			
03/11/2008	Loch Raven	85			X	X	X	X		
01/02/2008	Loch Raven	86		X						
01/02/2008	Loch Raven	118	X	X	X	X	X	X	X	
03/14/2008	Loch Raven	156	X	X		X		X	X	
03/13/2008	Loch Raven	180		X	X		X	X		
10/15/2008	Loch Raven	382	X			X	X	X		
09/23/2008	Loch Raven	699		X	X			X		
09/23/2008	Loch Raven	707			X			X		
09/23/2008	Loch Raven	707					X	X		
05/15/2008	Loch Raven	1457		X	X	X	X	X		
06/05/2008	Loch Raven	1457	X							
12/22/2008	Loch Raven	1599	X	X	X	X	X	X	X	
07/07/2008	Loch Raven	1676		X	X	X				
02/27/2008	Loch Raven	2232				X	X			
02/27/2008	Loch Raven	2233				X	X			
03/03/2008	Loch Raven	2879		X	X	X	X	X		
05/30/2008	Loch Raven	2879				X	X			
03/18/2008	Lower Gunpowder	216	X	X	X		X	X		
10/29/2008	Lower Gunpowder	279		X	X	X	X	X		
10/29/2008	Lower Gunpowder	279		X	X	X	X	X		
11/17/2008	Lower Gunpowder	339		X	X					
11/13/2008	Lower Gunpowder	340	X							
09/17/2008	Lower Gunpowder	344								
10/02/2008	Lower Gunpowder	344			X					

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
01/16/2008	Lower Gunpowder	345		X						
09/17/2008	Lower Gunpowder	345								
07/17/2008	Lower Gunpowder	354		X				X		
01/03/2008	Lower Gunpowder	393	X							
07/30/2008	Lower Gunpowder	406	X		X	X	X	X	X	
11/05/2008	Lower Gunpowder	452		X	X		X	X		
11/05/2008	Lower Gunpowder	453			X	X				
01/16/2008	Lower Gunpowder	525	X							
02/14/2008	Lower Gunpowder	525	X							
12/22/2008	Lower Gunpowder	525								
01/29/2008	Lower Gunpowder	557			X			X	X	
02/05/2008	Lower Gunpowder	557	X							
09/16/2008	Lower Gunpowder	557			X			X		
12/03/2008	Lower Gunpowder	729					X			
12/22/2008	Lower Gunpowder	729				X				
09/17/2008	Lower Gunpowder	741						X		
07/08/2008	Lower Gunpowder	811			X	X				
09/16/2008	Lower Gunpowder	815						X		
07/10/2008	Lower Gunpowder	845		X				X		
08/19/2008	Lower Gunpowder	845				X				
10/22/2008	Lower Gunpowder	845					X			
12/01/2008	Lower Gunpowder	845				X				
11/17/2008	Lower Gunpowder	846							X	
05/21/2008	Lower Gunpowder	954				X				
08/19/2008	Lower Gunpowder	1003	X	X	X		X	X		
12/11/2008	Lower Gunpowder	1003	X							
02/04/2008	Lower Gunpowder	1406	X							
06/11/2008	Lower Gunpowder	1406							X	
09/29/2008	Lower Gunpowder	1406	X							
12/22/2008	Lower Gunpowder	1406	X							
09/29/2008	Lower Gunpowder	1407	X							
12/22/2008	Lower Gunpowder	1407	X							
09/29/2008	Lower Gunpowder	1408	X							
12/22/2008	Lower Gunpowder	1408	X							
12/11/2008	Lower Gunpowder	1473				X				
11/19/2008	Lower Gunpowder	1534		X	X			X	X	
11/19/2008	Lower Gunpowder	1535		X		X		X		
12/03/2008	Lower Gunpowder	1535					X		X	
12/09/2008	Lower Gunpowder	1634	X	X						
12/09/2008	Lower Gunpowder	1635		X			X	X		
04/28/2008	Lower Gunpowder	1746	X							
12/15/2008	Lower Gunpowder	1789		X			X	X	X	
12/15/2008	Lower Gunpowder	1790	X	X			X	X		
12/15/2008	Lower Gunpowder	1791		X			X	X		

Date	Watershed	Pond #	Repaired Fence	Secured Gate	Cleaned Riser	Cleaned Low Flow	Removed Debris	Trimmed Fence	Cleared Berm	Tar Riser
11/17/2008	Lower Gunpowder	2032	X	X	X	X	X	X		
11/17/2008	Lower Gunpowder	3390		X	X		X	X		
04/08/2008	Middle River	950	X							
07/09/2008	Middle River	950	X							
12/01/2008	Middle River	1253				X				
12/02/2008	Middle River	1253			X		X		X	
10/23/2008	Middle River	1256					X			
10/23/2008	Middle River	2938					X			
09/18/2008	Middle River	4208						X		
08/06/2008	Patapsco	202			X	X		X	X	
11/17/2008	Patapsco	233	X		X	X	X	X	X	
11/20/2008	Patapsco	341			X	X	X		X	
08/25/2008	Patapsco	415		X	X	X	X	X	X	
06/04/2008	Patapsco	417		X	X		X	X	X	
02/06/2008	Patapsco	454			X	X	X			X
04/22/2008	Patapsco	454					X			
07/21/2008	Patapsco	781	X	X	X	X	X	X	X	
07/22/2008	Patapsco	782	X		X	X	X	X	X	
07/09/2008	Patapsco	994			X	X	X	X	X	
07/09/2008	Patapsco	995			X	X	X	X	X	
08/19/2008	Patapsco	995	X							
09/13/2008	Patapsco	1204			X	X	X	X		
12/08/2008	Patapsco	1335		X	X	X	X	X	X	
08/05/2008	Patapsco	1430			X	X			X	
08/04/2008	Patapsco	1431		X	X	X	X		X	
08/04/2008	Patapsco	1560								
12/09/2008	Patapsco	1560		X	X	X	X	X	X	
09/05/2008	Patapsco	1700	X	X	X	X	X	X	X	
11/06/2008	Patapsco	1759	X	X	X	X	X	X	X	
05/08/2008	Patapsco	2228			X	X	X	X	X	
08/07/2008	Patapsco	2228	X	X	X			X		
06/23/2008	Patapsco	3558	X		X		X		X	
01/03/2008	Patapsco	3575	X							
04/28/2008	Patapsco	3575	X							

2.0 Permit Requirement

E.3. Erosion and Sediment Control

An acceptable erosion and sediment control program shall be maintained in accordance with the Environment Article, Title 4, Subtitle 1, Annotated Code of Maryland. At a minimum, Baltimore County shall:

a. Address needed program improvements identified during MDE's evaluation of Baltimore County's application for the delegation of erosion and sediment control enforcement authority;

b. At least three times per year, conduct "responsible personnel" certification classes to educate construction site operators regarding erosion and sediment control compliance. Program activity shall be recorded on MDE's "green card" database and submitted with the Baltimore County annual report; and

c. Report quarterly information regarding earth disturbances exceeding one acre or more. Quarters shall be based on calendar year and submittals shall be made within 30 days following each quarter. The information shall be specific to the permitting activity for the preceding three months.

2.1 Introduction

The Erosion and Sediment Control Program is implemented by DEPRM's Inspection and Enforcement Section. This program is periodically reviewed by the Maryland Department of the Environment (MDE) and has consistently met the review requirements. MDE is currently reviewing new erosion and sediment control standards in accordance with guidance provided by EPA. Baltimore County will update its program as necessary to stay in compliance with State regulatory changes. The Erosion and Sediment Control Program contains several components:

- review of building and grading permit applications
- field inspection and enforcement of grading and sediment control regulations
- citizen complaint investigation, and
- training program for certification of responsible personnel.

Baltimore County has been given the authority to enforce sediment control regulations by the State of Maryland. The main function of the Erosion and Sediment Control Program is to reduce pollutant loads from new development and redevelopment during the construction phase. This goal is achieved using sediment control best management practices (BMPs) as specified in the sediment and erosion control plan for each development site. Sediment control plans are required for any construction activity disturbing an area greater than 5,000 square feet. The standard plan for Sediment and Erosion Control is used for residential construction activity disturbing less than 30,000 sq. ft. and for all other construction activity disturbing less than 20,000 sq. ft.

2.2 Program Analysis - Plans Review

Currently, Sediment and Erosion Control Plans are reviewed for adequacy by the Baltimore County Soil Conservation District while DEPRM's Stormwater Management Section coordinates the approval process. The Sediment and Erosion Control Plans are also reviewed by DEPRM's Environmental Impact Review Section to ensure that there is no encroachment on the forest buffers or forest conservation areas that are protected by County regulations.

Each Sediment and Erosion Control Plan is required to have an associated Grading Plan indicating the final topographic contours of the development site. The Grading Plans are reviewed by DEPRM and the Baltimore County Soil Conservation District.

2.3 Program Analysis - Inspection and Enforcement

The Inspection and Enforcement Section maintains records of issued grading permits, conducts routine inspections of active construction sites, and issues correction notices, violation notices, and stop work orders to enforce compliance of sediment and erosion control and grading plans. Prior to the issuance of grading permits, a pre-construction meeting is held at the site. This meeting is attended, at a minimum, by the DEPRM inspector and the construction site foreman. The foreman must be certified through the "responsible personnel in erosion and sediment control" training program which is described in section 2.4. The meeting covers the sequence of operations for the grading involved with the overall site development. This meeting is intended to forestall any future problems.

2.3.1 Grading and Building Permits Issued

Grading permits and building permits are reviewed by DEPRM. Grading Permits are required for any disturbance over 5,000 square feet or for grade changes in existing neighborhoods.

Baltimore County building permits are required for any new construction, additions, or alterations. This Department reviews building permits, to ensure that the final drainage patterns will not impact adjacent properties and that the onsite drainage will direct stormwater away from building structures and to stormwater management facilities. These permits are also reviewed to ensure that they are in compliance with other environmental regulations, such as, Critical Area requirements and Forest Buffer requirements.

During the calendar year 2008, two hundred and seventeen (217) grading permits were issued. This represents a slight increase in the number of grading permits from the previous year and slight decrease in the number of acres disturbed from 698 to 669.5 acres. This is the lowest acreage since reporting began in 1998. The number of grading permits approved and the acreage of disturbance are displayed by watershed in Table 2-1 and Figure 2-1. Approximately 76 acres representing 11% of the total acreage of disturbance occurred in the drainage areas of the three drinking water reservoir watersheds Prettyboy Reservoir (1.8 acres), Loch Raven (70.8 acres), and Liberty (3.7 acres). This disturbed acreage is a decrease from last year. These watersheds comprise ~47 % of the drainage area in Baltimore County. Baltimore County has been promoting redevelopment of its older communities. This renaissance has finally come to fruition and is apparent by these permit numbers. The watersheds with the greater number of permits are the ones within growth areas or contain older existing communities.

Table 2-1: Number of Grading Permits and Acreage of Disturbance by Watershed for 2008.

Watershed	Number of Permits	Acreage of Disturbance
Upper Western Shore		
Deer Creek	0	0.0
Prettyboy Reservoir	2	1.8
Loch Raven Reservoir	30	70.8
Lower Gunpowder Falls	17	68.0
Little Gunpowder Falls	1	6.0
Bird River	23	158.7
Gunpowder River	2	4.8
Middle River	13	17.6
UWS Totals	**88**	**327.7**
Patapsco/Back River		
Liberty Reservoir	4	3.7
Patapsco River	34	73.6
Gwynns Falls	42	156.1
Jones Falls	16	32.8
Back River	26	35.6
Baltimore Harbor	7	40.0
Patapsco/Back R. Totals	**129**	**341.8**
County Totals	**217**	**669.5**

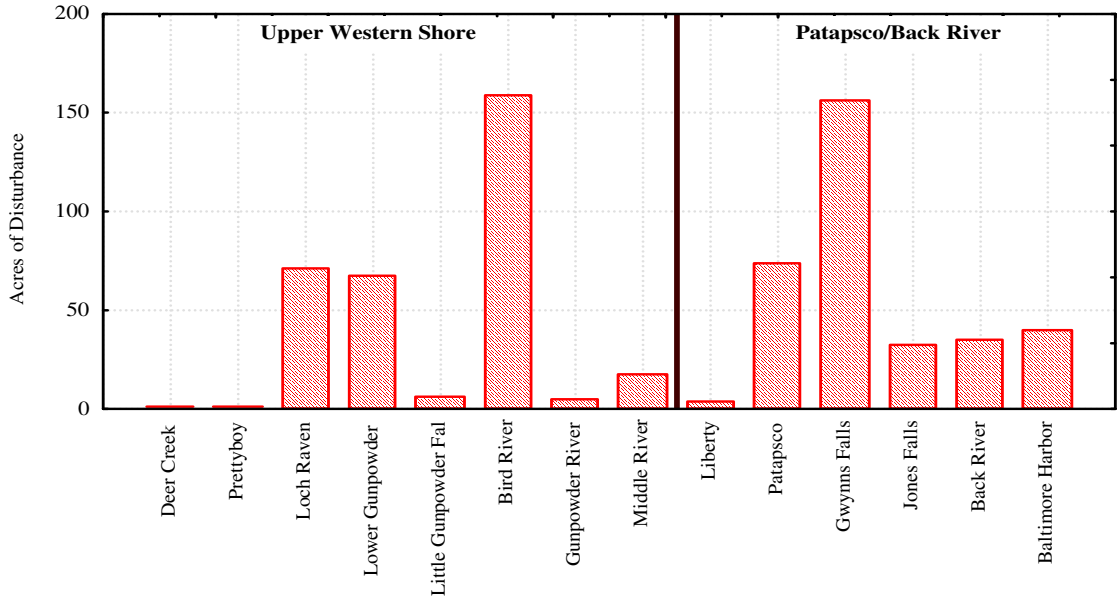


Figure 2-1: Acres of disturbance through approved grading permits by watershed for 2008.

During the calendar year 2008, 824 new residential building permits were issued. The distribution of building permits by watershed is displayed in Table 2-2 and Figure 2-2.

As indicated above, Baltimore County has been advocating redevelopment of its older communities. For calendar year 2008, a greater number of permits are located in watersheds with existing infrastructure.

Table 2-2: Number of Building Permits by Watershed Approved in 2008.

Watershed	Number of Permits
Upper Western Shore	
Deer Creek	1
Prettyboy Reservoir	10
Loch Raven Reservoir	87
Lower Gunpowder Falls	58
Little Gunpowder Falls	13
Bird River	179
Gunpowder River	18
Middle River	33
Upper Western Shore Totals	**399**
Patapsco/Back River	
Liberty Reservoir	14
Patapsco River	67
Gwynns Falls	63
Jones Falls	91
Back River	175
Baltimore Harbor	15
Patapsco/Back River Totals	**425**
County Totals	**824**

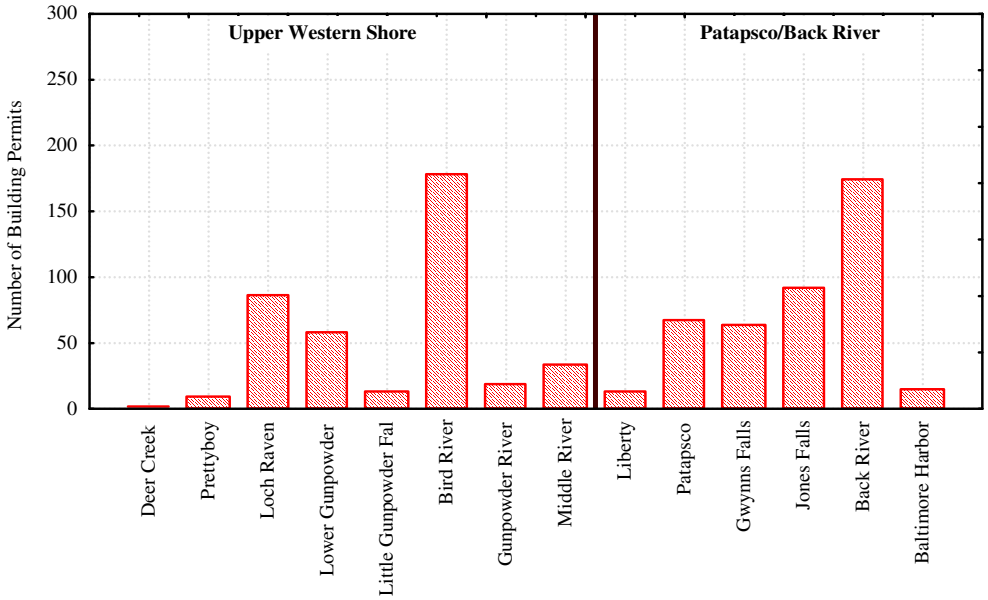


Figure 2-2: Number of building permits issued in 2008 by watershed.

Displayed in Table 2-3 and Figure 2-3 are the trends in building and grading permits, as well as acres of disturbance for an eleven-year period. It shows a peak in 1999 followed by a gradual downward trend and then a greater downward trend these past two years.

Table 2-3: Number of Grading and Building Permits by Year

Year	Grading Permits	Acres of Disturbance	Building Permits
1998	256	1,173	2,705
1999	364	1,115*	2,747
2000	256	1,081	2,419
2001	232	1,209	1,869
2002	216	1,093	1,915
2003	258	916	1,708
2004	249	905	1,731
2005	217	1,083	2,085
2006	230	1,147	1,713
2007	212	698	1,191
2008	217	670	824

*Excluding a single permit for 6,060 acres of disturbance associated with the Colonial Pipeline maintenance project.

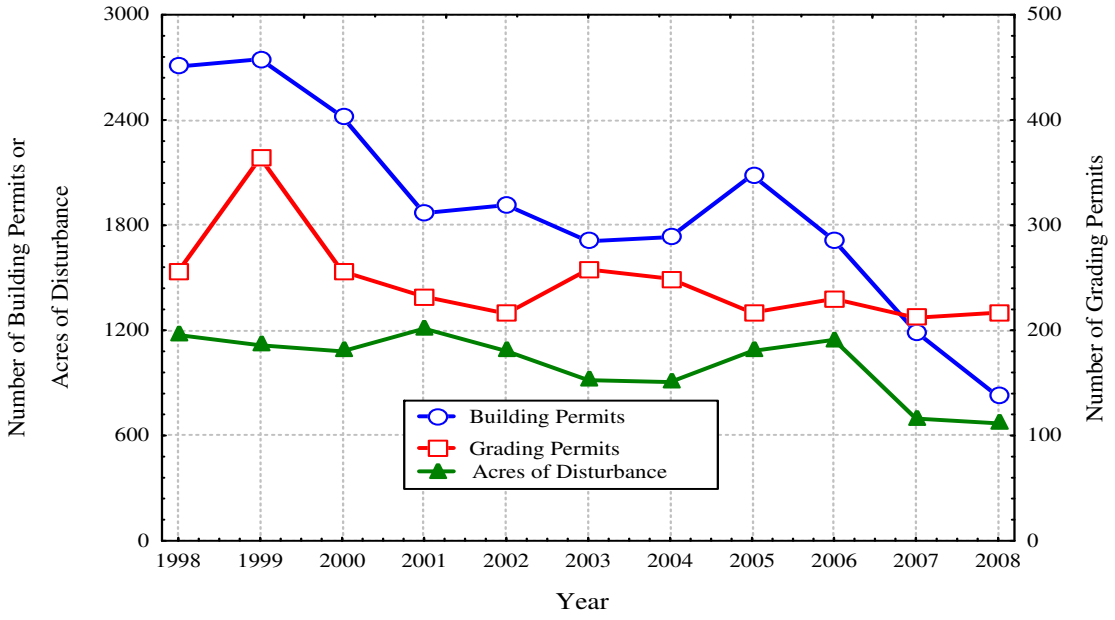


Figure 2-3: Approved Grading and Building Permits for the Period 1998 – 2008.

2.3.2 Inspections, Complaints and Enforcement

After construction begins, an inspector inspects the site an average of once every two weeks during the active constructive phase. Table 2-4 displays the number of inspections by month and type for the calendar year 2008. These inspections are also shown in Figures 2-4 and 2-5. The data are broken down into two categories, enforcement actions and inspections.

In 2008, 1,344 enforcement actions were logged (Table 2-4, last column and Figure 2-4), and 11,628 inspections were logged (Table 2-4, seventh column and Figure 2-5). These numbers are down from two years ago, but are relatively the same in comparison with the activities in 2007.

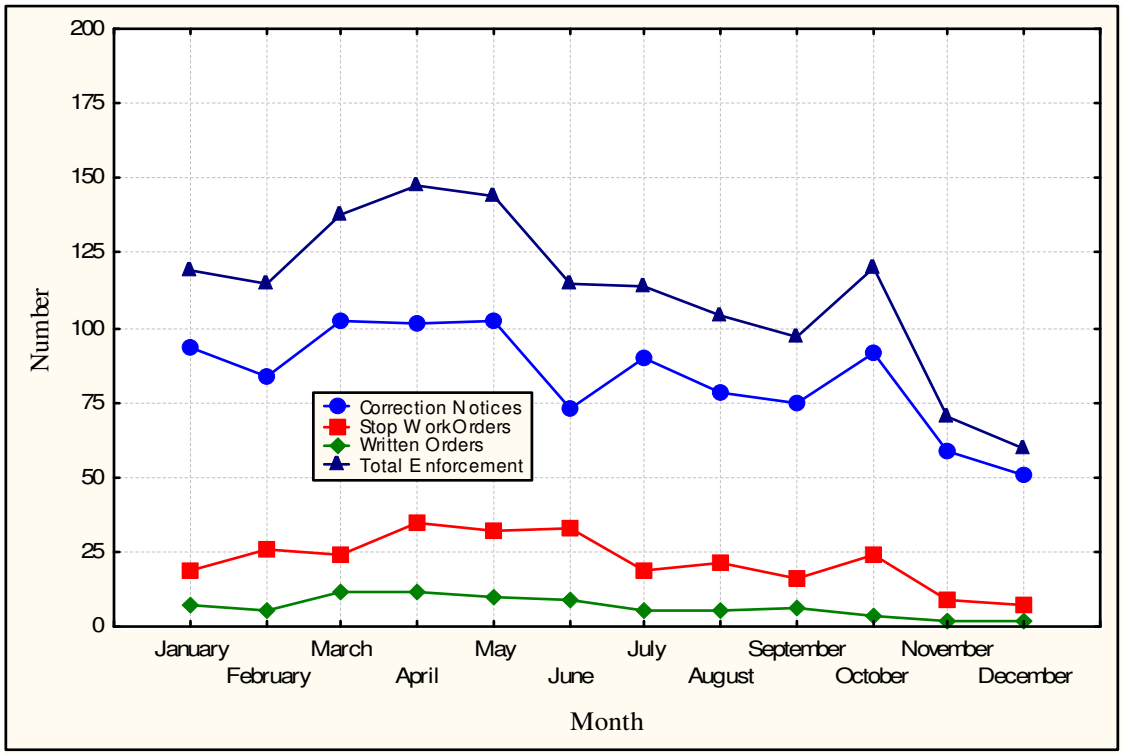


Figure 2-4: The number of sediment control enforcement actions by month for the calendar year 2008.

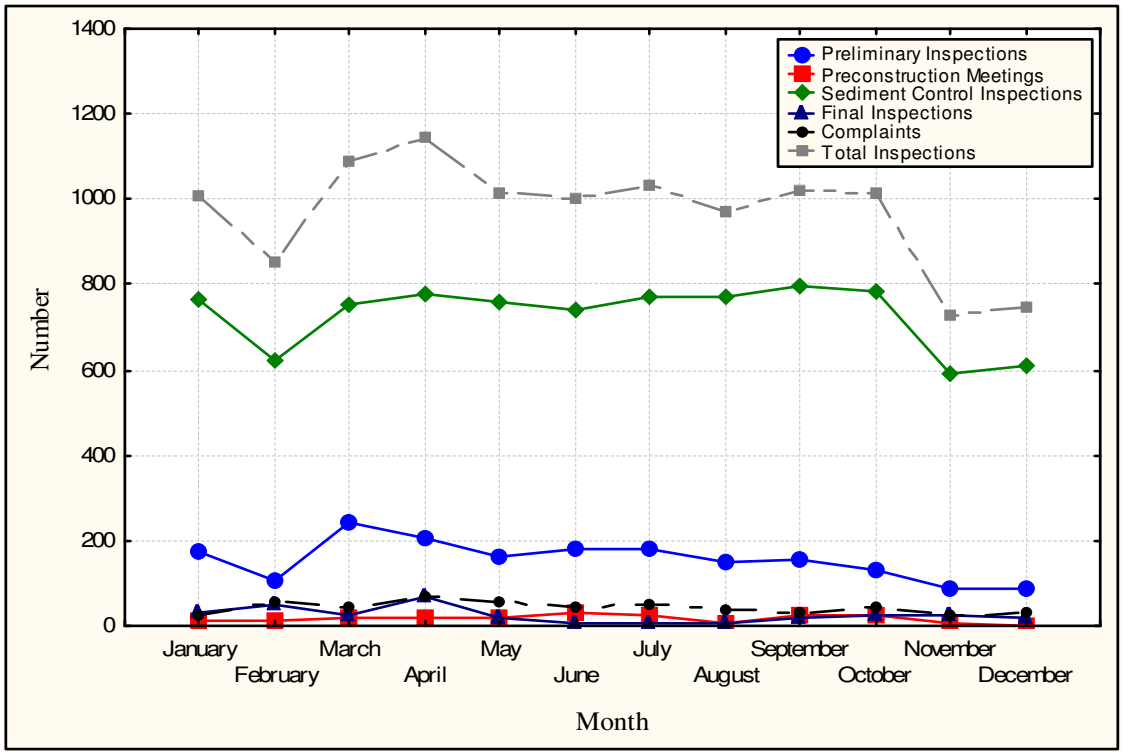


Figure 2-5: Number of sediment control inspections and the total number of inspections by month for the calendar year 2008.

Table 2-4: Sediment Control Inspection Data for 2008

Month	Prelim.	Pre Constr.	S.C. Inspt.	Final Inspt.	Complaint	Total Inspt.	Correct. Notice	Stop Work Order	Written Orders	Totals Enforce
January	177	11	763	34	25	1,010	93	19	7	119
February	103	15	625	48	59	850	84	26	5	115
March	245	21	751	26	45	1,088	102	24	12	138
April	208	18	777	70	69	1,142	101	35	12	148
May	162	19	758	20	55	1,014	102	32	10	144
June	179	31	741	7	45	1,003	73	33	9	115
July	178	23	771	8	53	1,033	90	19	5	114
August	148	8	773	7	36	972	78	21	5	104
September	155	22	796	16	33	1,022	75	16	6	97
October	133	28	784	25	44	1,014	92	24	4	120
November	89	5	591	22	24	731	59	9	2	70
December	90	2	612	16	29	749	51	7	2	60
Totals	**1,867**	**203**	**8,742**	**299**	**517**	**11,628**	**1,000**	**265**	**79**	**1,344**

Sediment controls are only seventy to ninety percent effective when they are properly installed and maintained. Therefore a successful sediment control inspection and enforcement program is essential for achieving maximum effectiveness.

2.4 Program Analysis - Training Program

Two (2) Responsible Personnel Certification training sessions were held in 2008: February 6, and February 20. Ninety one (91) people attended these sessions. A list of individuals receiving certification is presented in Appendix 2-1. The training program is offered to construction site operators in Baltimore County on an as-needed basis. Baltimore County maintains an interest list on file and offers the certification class when enrollment requests justify the need.

2.5 Summary

A decrease in new building permit applications for 2008 allowed more man hours to be devoted toward sediment control inspections of existing active projects.

Baltimore County will apply in the fall of this year requesting continued delegation of erosion and sediment control enforcement authority beyond June 30, 2010.

Appendix 2-1: List of Individuals Receiving Certification

LASTNAME:	FIRSTNAME:	DATE:	CERTNUM:
ANDERS	CHRISTOPHER M.	02/20/2008	37058
ANDERSON	MARCUS D.	02/20/2008	37059
APLIN, JR.	JOSEPH M.	02/20/2008	37060
BARNHART	JOHN J.	02/06/2008	31033
BITTINGER	DAVID L.	02/20/2008	35411
BLEVINS	JAMES W.	02/06/2008	31034
BOYD, JR.	BILL S.	02/20/2008	35412
BROOKS	JEREMY S.	02/06/2008	31035
BROOKS	BARRY L.	02/06/2008	31036
BROWN	STEWART A.	02/06/2008	31037
BUNTING	DARYL M.	02/20/2008	35413
CANAVAN	CHAD E.	02/06/2008	31038
CANNON	SARAH J.	02/06/2008	31039
CLARK	ARTHUR H.	02/20/2008	35414
COATES	GLENN A.	02/20/2008	40935
COOPER	JEFF S.	02/06/2008	31040
CREEKMORE	ROBERT S.	02/20/2008	35416
CROUSE	NORMAN L.	02/06/2008	31042
CRUISE	KATHLEEN C.	02/06/2008	31041
DIETZ	MATTHEW D.	02/06/2008	31043
DIETZ	MICHAEL W.	02/06/2008	31044
DORSCH	JON E.	02/06/2008	31045
ELTZ, JR.	DAVID L.	02/20/2008	35417
FERGUSON	ADAM F.	02/06/2008	31046
FRANK	JOSHUA V.	02/20/2008	35418
GRIFFIN	MICHAEL E.	02/06/2008	31047
HAILEY	ROWLAND K.	02/20/2008	35419
HALL	JOHN A.	02/20/2008	35420
HART	DANIEL G.	02/06/2008	31048
HEARD	SATINA M.	02/06/2008	31049
HENSS	MIKE B.	02/20/2008	35421
HYMAN	RICHARD S.	02/20/2008	35422
JONES	TERRY L.	02/06/2008	31053
JONES	JASON L.	02/06/2008	31052
JONES	CHRIS M.	02/06/2008	31051
JONES	BUCK C.	02/06/2008	31050
KERR	JOHN T.	02/06/2008	31054
KYLER	JOHN L.	02/20/2008	35423
LANGFORD	DALE L.	02/20/2008	35424
LEASHER	TRACEY S.	02/06/2008	32411
LIPINSKI, II	WILLIAM A.	02/06/2008	34060
LIPINSKI, III	EDWARD E.	02/06/2008	32413
LIPINSKI, JR.	EDWARD E.	02/06/2008	32414
MALCOMB	DAVID D.	02/20/2008	35425
MARTIN	BILL E.	02/20/2008	35426
MCCABE, JR.	WILLIAM T.	02/20/2008	35427

LASTNAME:	FIRSTNAME:	DATE:	CERTNUM:
MILLER	JASON C.	02/06/2008	32415
MILLER	TY A.	02/06/2008	32416
MURTAGH	CHRIS J.	02/06/2008	32417
NOVOTNY	TIMOTHY J.	02/20/2008	35428
OETTEL	BUD H.	02/06/2008	32418
OLDEWURTEL	DAVID W.	02/20/2008	35429
ORWICK	DAVID M.	02/20/2008	35430
PICKETT	DAMON D.	02/20/2008	35431
POINSETT	DAVID R.	02/20/2008	35432
PORTER	JERRY R.	02/06/2008	32419
PREVATT	WALLACE R.	02/20/2008	35433
PRIDGEN	PHILLIP M.	02/20/2008	35434
RAAF	THOMAS W.	02/06/2008	32420
RITTER	DAVID J.	02/06/2008	32421
ROBINSON	MICHAEL J.	02/20/2008	35435
RUARK	MICHAEL J.	02/20/2008	40921
RUDOLPH	ANDREW R.	02/06/2008	32422
RYDER	SEAN W.	02/06/2008	32423
SCHMIDT	STEVEN C.	02/06/2008	32424
SCHWARTZ	CHRIS J.	02/06/2008	32425
SCRIVNOR	GLENN J.	02/20/2008	40922
SEDGEWICK	AARON W.	02/20/2008	40923
SHARPE	HANIF W.	02/20/2008	40924
SHELTON	WILLIAM	02/06/2008	32426
SHOWERS	JEFF K.	02/06/2008	32427
SHUMAKER	DANIEL L.	02/06/2008	32428
SIMMS	EDWARD G.	02/06/2008	32429
SKINNER	AMANI M.	02/20/2008	40925
SLIGH	DANIEL P.	02/20/2008	40926
SPRIGGS	KIRK	02/20/2008	40927
STAUBS, JR.	ARNOLD B.	02/20/2008	40928
STEWART	KEITH B.	02/06/2008	32430
STONE	NANNETTE M.	02/06/2008	32431
STULTZ	JERRY A.	02/06/2008	32432
TAYLOR	AMANDA M.	02/20/2008	40929
THOMAS	JOE A.	02/20/2008	40930
THOMPSON	PAUL W.	02/06/2008	32433
VENTURINA	JOS A.	02/06/2008	32434
VIEGLINS	JURIS X.	02/06/2008	32435
VOJIK	MARY E.	02/20/2008	40931
WALKER	WILLIAM R.	02/20/2008	40932
WEIFORD	WILLIAM D.	02/20/2008	40933
WOLF	RYAN T.	02/06/2008	34057
YOOS	JEFFREY M.	02/06/2008	34058
ZAMFIRACHE	RADU L.	02/06/2008	34059

3.0 Permit Requirements

E.5. County Property Management

Baltimore County shall identify all County–owned facilities requiring NPDES stormwater general permit coverage and submit Notices of Intent (NOI) to MDE for each. The status of pollution prevention plan development and implementation shall be submitted annually.

E.6. Road Maintenance

A plan to reduce pollutants associated with road maintenance activities shall be developed and implemented. At a minimum, an annual progress report shall be submitted that documents the following activities:

a. Street sweeping;

b. Inlet cleaning;

c. Reducing the use of pesticides, herbicides, fertilizers, and other pollutants associated with roadside vegetative management practices through the use of integrated pest management (IPM); and

d. Controlling the overuse of winter weather deicing materials through continual testing and improvement of materials, equipment calibration, employee training, and effective decision-making.

3.1 Introduction

Baltimore County has established several programs to control the amount of pollution that reaches the stream systems and landfills: a Storm Drain Cleaning Program, a Street Sweeping Program, and a Hazardous Waste Collection Program. Baltimore County DEPRM has also identified those county owned sites that require a NPDES stormwater general permit and is assisting them in preparing Pollution Prevention Plans. These include good house keeping and best management practices to prevent contaminants from leaving the site during rainstorms or a spill.

Both the Storm Drain Cleaning Program and the Street Sweeping Program are the responsibility of the Baltimore County Department of Public Works (DPW). Within the Department of Public Works, the Bureau of Utilities handles the Storm Drain Cleaning program. The Storm Drain Cleaning Program was originally created to remove the sediment from the storm drain systems in the watersheds of dredged tidal creeks, thereby increasing the longevity of the original dredging. The Program has since been expanded to clean the County's entire storm drain system, including the drain inlets, connecting pipes and outfalls. Debris, sediment, and pollutants can also be taken off the streets before they enter the storm drain system. This is accomplished with the Street Sweeping Program that is managed by the Bureau of Highways.

The Hazardous Waste Collection Program is the responsibility of the Baltimore County DEPRM Environmental Health Section. Citizens can come and drop off unwanted household chemicals, paints, pesticides, medicines, mercury thermometers, fluorescent bulbs, rechargeable batteries, computers and home electronics, ammunition and automotive fluids for recycling or proper

disposal. These items are accepted at the Eastern Landfill from April until November. There are also two collection events in the fall and spring at additional locations.

3.2 County Property Management

Over the last few years, three meetings of the Baltimore County NPDES Management Committee were held. The first meeting in December 2005 presented the requirements of the renewed NPDES permit to the Management Committee, including the requirement that certain County owned facilities acquire an NPDES Industrial Stormwater General Permit. A NPDES Management Committee meeting in February 2006 covered how to fill out the Notice of Intent (NOI) and the elements of the pollution prevention plan. A third meeting in May covered in more detail the elements of a Pollution Prevention Plan and used a highway shop to demonstrate how to conduct a site assessment and the types of controls that should be considered in the pollution prevention plan. A sample Pollution Prevention Plan in draft form is included on the enclosed CD.

3.2.1 County Facility NPDES Permit Compliance

Baltimore County DEPRM has been assisting other County Departments to gain compliance with NPDES general stormwater permit requirements. Table 3-1 shows the status of County Facilities that we have started assisting. DEPRM is still identifying all County –owned facilities requiring NPDES stormwater general permit coverage. DEPRM estimates approximately 30 facilities may be included. As facilities are identified, we will assist them in submitting a Notice of Intent (NOI) to MDE and assist in the preparation of a Pollution Prevention Plan.

Table 3-1: NPDES Permit Compliance Status

County Department	Facility Name	Notice of Intent (NOI)	Pollution Prevention Plan (PPP)
Community College of Baltimore County	Catonsville, Essex, and Dundalk Campuses	Yes	Yes
Department of Public Works Highways	All 11 Shops	Yes	Clark's Lane and Middleton Shops
Baltimore County Public Schools	All 12 Bus Lots	Yes	No

3.3 Storm Drain Cleaning Program

3.3.1 Storm Drain Cleaning Overview

The Baltimore County storm drain system consists of approximately 2,040,000 linear feet (388 miles) of storm drainpipe, 14,400 inlets, and 3,460 outfalls. In order to keep the entire system clean of trash, debris, and sediment, the Department of Public Works maintains three storm drain cleaning vehicles and employs three crews of two men each on a daily basis to clean the storm drains and pipes. Removing the material from the storm drain system reduces street flooding, a potential safety hazard, and aids in the detection of illicit connections.

Each time a crew cleans an inlet or pipe the amount of debris removed is recorded on a data sheet that typically contains all cleaning records for that particular location. Completed data sheets are sent to the Department of Environmental Protection and Resource Management

(DEPRM), where the data is entered into a database. The database facilitates reporting for NPDES purposes.

3.3.2 Storm Drain Cleaning Data Analysis

The data entered into the database are analyzed for a number of measures, including the amount of material removed per inlet, the amount of material removed per linear foot of pipe cleaned, total amount of material removed by watershed, and the amount of pollutants removed as a result of the program.

Inlet data are reported as the average annual cubic feet of material removed per inlet, and pipe data are reported in cubic feet of material removed per linear foot of pipe. The removal rates for 1993 to 2008 are presented in Table 3-2. Figure 3-1 shows a yearly comparison of the number of inlets cleaned and the total volume of material removed. Figure 3-2 shows the mean volume of debris removed per inlet. Figure 3-3 shows a yearly comparison of the length of pipe cleaned and the amount of material removed, and Figure 3-4 shows the mean volume of debris removed per linear foot of pipe.

Table 3-2: Removal Rates of Inlet and Pipe Cleaning by Year

Year	Inlet Vol. Cu. Yd.	# Inlets	Vol. / Inlet Cu. Yd	Pipe Vol. Cu. Yd.	Length in feet	Vol. / Ft. Cu. Yd.
1993	760	8,955	0.08	1,186	68,830	.0172
1994	769	2,615	0.29	347	21,193	.0164
1995	642	1,532	0.42	306	14,491	.0211
1996	1,536	1,347	1.14	1,558	67,676	.0230
1997	1,731	1,485	1.17	2,822	119,900	.0235
1998	2,059	1,178	1.75	988	93,918	.0105
1999	662	462	1.43	446	38,451	.0116
2000	689	580	1.19	672	89,145	.0075
2001	902	746	1.21	585	46,319	.0126
2002	919	602	1.53	409	34,384	.0118
2003	660	428	1.54	519	30,374	.0171
2004	898	653	1.37	1,169	54,795	.0213
2005	1,385	888	1.56	1,001	53,069	.0189
2006	950	659	1.44	538	30,891	.0174
2007	429	223	1.92	179	10,257	.0175
2008	664	377	1.76	238	16,572	.0144
Totals	**15,638**	**22,730**		**12,957**	**790,265**	

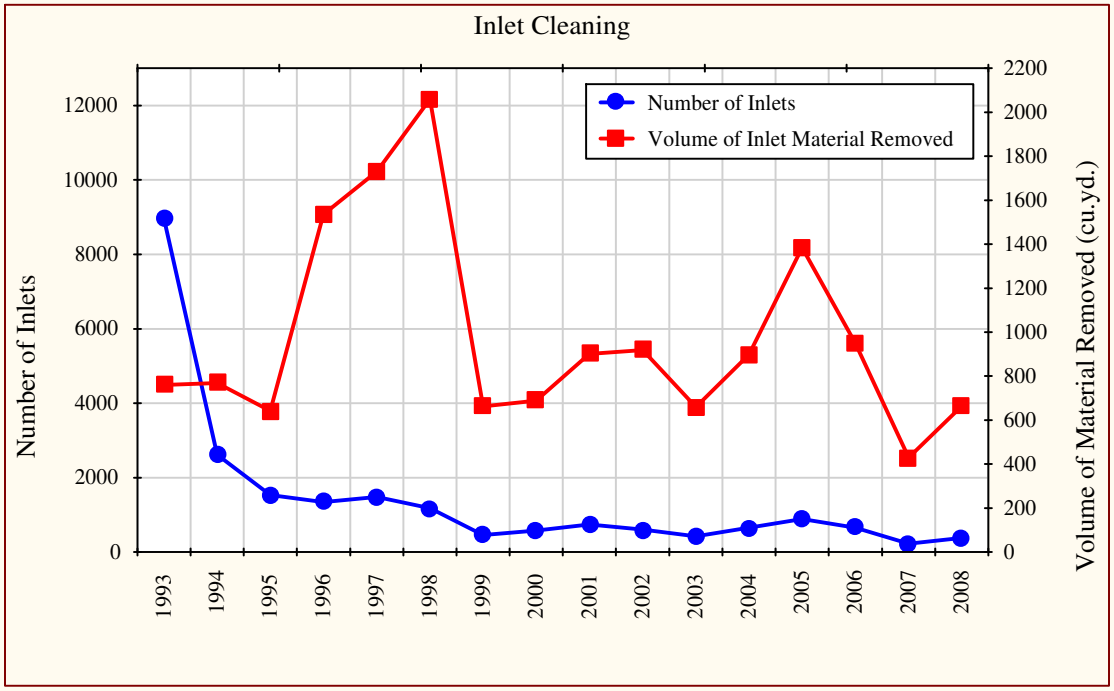


Figure 3-1: Summary Report for Inlets

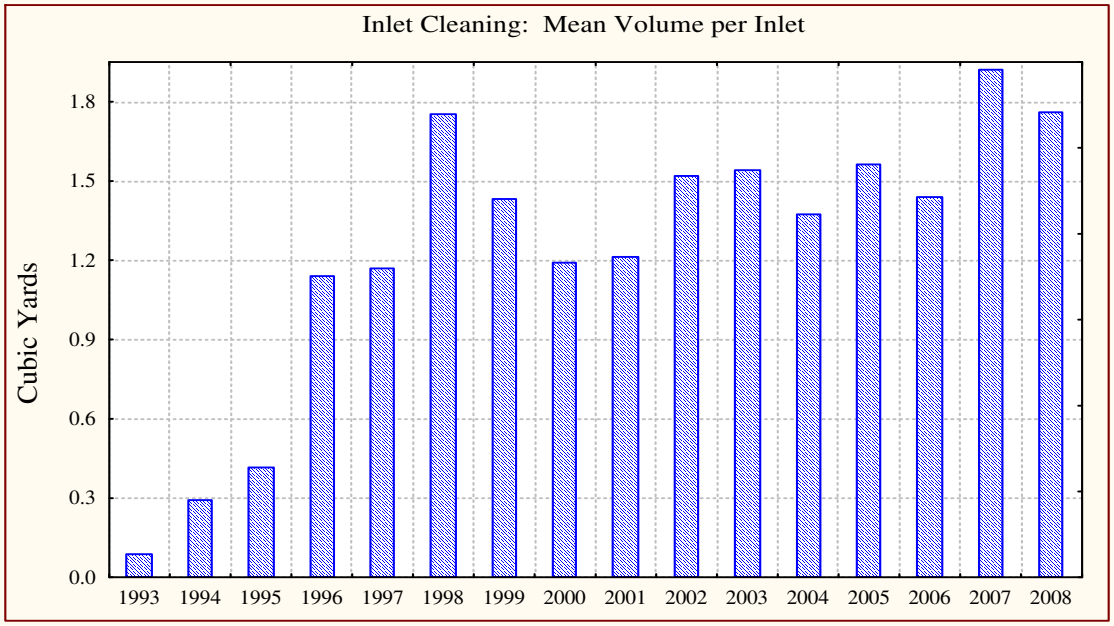


Figure 3-2: Annual Inlet Debris Removal Rates

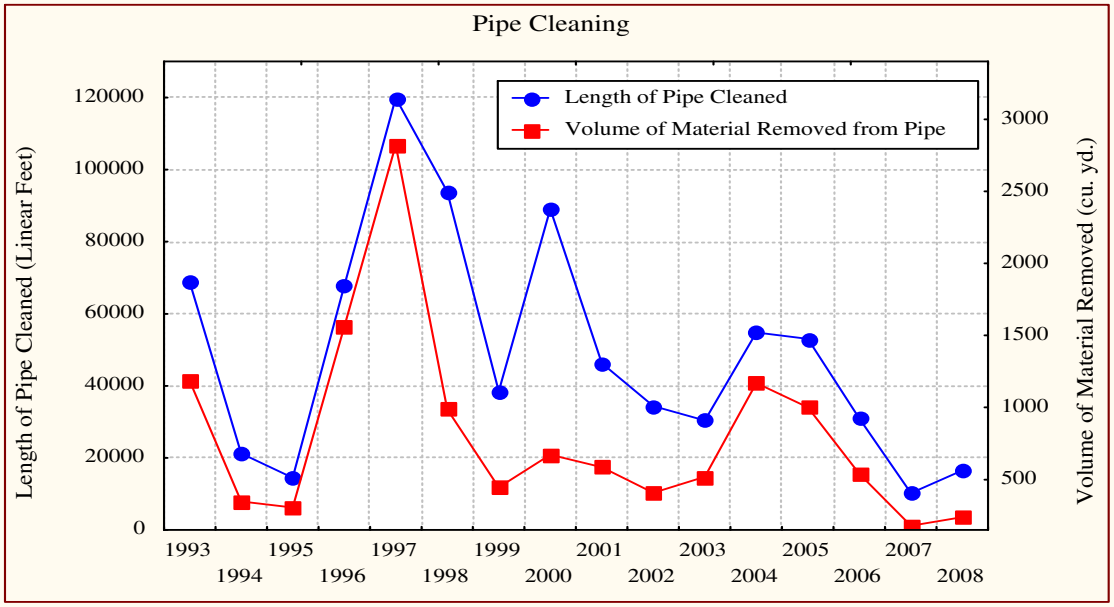


Figure 3-3: Summary Report for Pipes

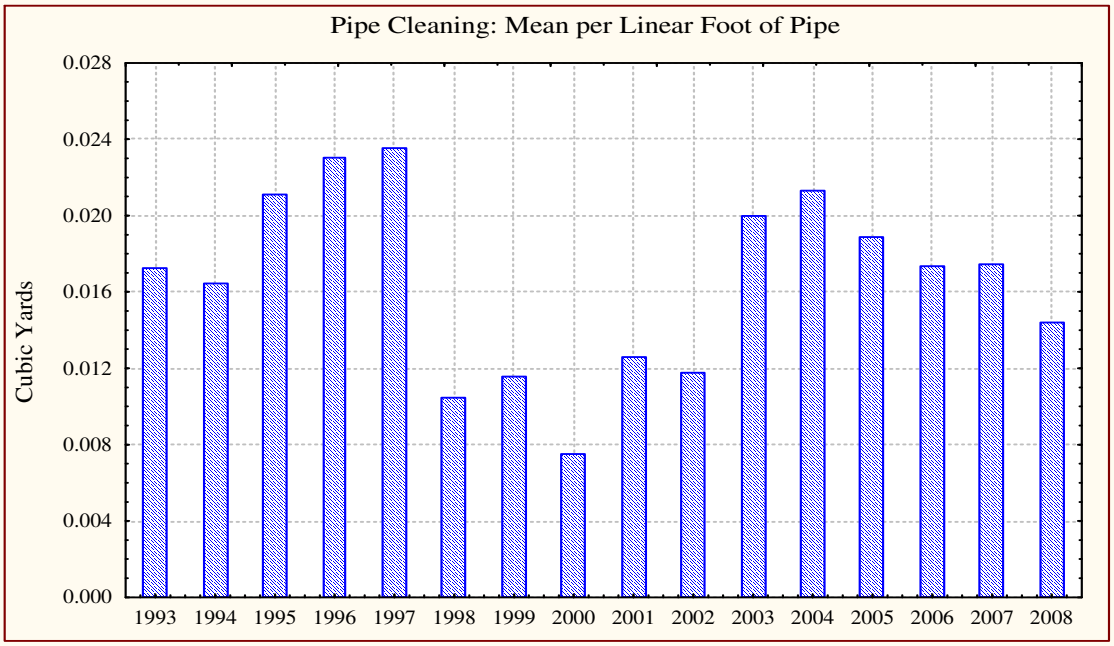


Figure 3-4: Annual Pipe Debris Removal Rates

While the number of inlets cleaned has remained fairly steady since 1998, the volume removed per inlet has been more variable. For the period from 1993 through 1998, the average number of inlets cleaned was ~2,850 per year in contrast to ~562 per year in the 1999-2008 time period. The average amount of material removed per inlet increased from ~0.8 cubic yards per inlet to ~1.5 cubic yards per inlet for the same two time periods. In the early years of the program (1993-1995), all inlets within the County were cleaned, some with little or no accumulation of material. This resulted in low volumes of material removed per inlet cleaned. This method was changed after 1995. The current method does not include routinely cleaning storm drains; they are cleaned based on comments or complaints received. During the winter months (Nov - Mar),

they respond only to emergencies due to the temperature. Therefore the numbers of pipes and inlets cleaned out after 1995 varies each year.

The volume of material removed from inlets grew beginning in 1993 and peaked in 1998, at over 2,000 cubic yards of material removed (Figure 3-1). The total amount of material removed was lower for the years 1999 through 2003. There was an upward trend in 2004 and 2005 that has rebounded again for 2008.

The largest amount of material removed from pipes was in 1997. This was also the greatest length of pipe cleaned (see Figure 3-2). The average length of pipe cleaned in the time period 1993 through 1998 was ~64,500 linear feet compared to ~39,000 linear feet in the 1999 through 2008 time period. The volume removed per linear foot decreased from .019 cubic yards to .015 cubic yards for those two time periods. This is in contrast with the cleaning of inlets that showed an increase in the removal rate per inlet for the latter time period.

It should also be noted that drought conditions from 1999 through 2002 might have resulted in less material being washed into the storm drain system. That material was likely removed by street sweeping. Conversely, the increase in removal rates in the 2003 to 2005 was probably due to above normal levels of precipitation.

3.3.3 Storm Drain Cleaning Data by Watershed

The Storm Drain Cleaning data for 2008, showing the total number of inlets and lengths of pipe cleaned for each of Baltimore County's fourteen (14) major watersheds, are displayed in Table 3-3.

Table 3-3: 2008 Material Removed in Cubic Yards by Watershed

Watershed	Inlets Cleaned	Inlet Volume Cleaned (Cu. yd.)	Length of Pipe Cleaned (Ft.)	Pipe Volume Cleaned (Cu. yd.)	Total Volume (Cu. yd.)
Deer Creek	1	1.3	95	2.0	3.3
Prettyboy Reservoir	0	0	0	0	0
Loch Raven Reservoir	19	26.6	1030	19.0	45.6
Lower Gunpowder River	27	81.1	1120	18.7	99.8
Little Gunpowder Falls	2	2.4	170	5.9	8.3
Bird River	10	13.8	550	4.0	17.8
Gunpowder River	7	4.3	225	2.1	6.4
Middle River	4	.8	310	2.4	3.2
UWS Totals	**70**	**130.3**	**3,500**	**54.1**	**184.4**
Patapsco/Back River					
Liberty Reservoir	1	.2	45	0	0.2
Patapsco River	40	77.2	1455	16.1	93.3
Gwynns Falls	115	232.3	4746	77.6	309.9
Jones Falls	37	67.8	2283	31.6	99.4
Back River	82	108.6	3253	40.9	149.5
Baltimore Harbor	32	47.5	1290	17.4	64.9
Pat./Back R. Totals	**307**	**533.6**	**13,072**	**183.6**	**717.2**
County Totals	**377**	**663.9**	**16,572**	**237.7**	**901.6**

Over 79% of the material removed from the storm drain system was removed from the heavily urbanized Patapsco/Back River Basin with Gwynns Falls and Baltimore Harbor having the highest amounts removed.

In the fall of 2005, a study was initiated on the pollutant removal effectiveness of street sweeping and storm drain cleaning. This study was funded by the Chesapeake Bay Program and led by the Center for Watershed Protection and UMBC. Both Baltimore County and Baltimore City were partners in this research effort. Baltimore County specifically looked at the storm drain cleaning portion of the study by measuring monthly accumulation rates for 100 inlets in coastal plain commercial/industrial and residential and piedmont commercial/industrial and residential. Baltimore County conducting sampling and chemical analysis of the material from a subset of the inlets. The results from this study are used to estimate pollutant load reductions from street sweeping and storm drain cleaning activities.

The composition of 16 inlets sampled in spring and fall of 2006 was divided into three categories; sediment, leaves (organic matter), and trash. The weight and volume of each component was determined for each inlet sampled. In the spring, sediment accounted for 63.5%, leaves 28.8% and trash 7.7% of the material accumulated in the inlets. In the fall, sediment accounted for 61.3%, leaves 31.0%, and trash 7.7% of the material accumulated in the inlets. An ANOVA based on a 2 x 2 x 2 factorial design (land use, physiographic province, sampling round) was conducted. This analysis found no significant differences between the design factors. The average bulk density for the spring was 330.7 pounds/cubic yard of material and for the fall 331.4 pounds/cubic yard of material. The following formula was used to determine kilograms of material per cubic yard:

331 pounds/cubic yard x 0.45 kilograms/pound = 148.95 kilograms/cubic yard

The derived kilograms/cubic yard was then multiplied by the total cubic yards of material removed from each watershed in 2008 to determine the total kilograms of material removed. These results were then multiplied by the average concentrations for each pollutant to determine the milligrams of pollutant removed. The concentrations used were 1,825.92 mg/kg total nitrogen and 707.95 mg/kg total phosphorus. Finally, the milligrams of pollutant were back calculated for pounds of pollutant removed.

The amount of each pollutant removed and urban impervious area treated from each major watershed in the county during 2008 is shown in Table 3-4. Impervious Urban Area Treated was calculated by taking the pounds of pollutant removed and dividing it by the Chesapeake Bay Program per acre pollutant loading rate for impervious urban area. The pollutants removed from the Patapsco/Back River Basin watersheds were nearly 5 times the amounts removed from the Upper Western Shore watersheds.

Table 3-4: 2008 Storm Drain Cleaning Program Pollutant Removal (Pounds) and Impervious Urban Acres Treated

Watershed	TN	Impervious Urban Acres Treated for TN	TP	Impervious Urban Acres Treated for TP	TSS
Upper Western Shore					
Deer Creek	2.0	0.2	0.8	1.6	1,092
Prettyboy Reservoir	0.0	0.0	0.0	0.0	0
Loch Raven Reservoir	27.3	3.4	10.6	20.8	15,094
Lower Gunpowder River	59.8	7.4	23.2	45.5	33,034
Little Gunpowder Falls	5.0	0.6	1.9	3.7	2,747
Bird River	10.7	1.3	4.1	8.0	5,892
Gunpowder River	3.8	0.5	1.5	2.9	2,118
Middle River	1.9	0.2	0.7	1.4	1,059
UWS Totals	**110.6**	**13.7**	**42.9**	**83.9**	**61,036**
Patapsco/Back River					
Liberty Reservoir	0.1	0.0	0.0	0.0	66
Patapsco River	56.0	6.9	21.7	42.5	30,882
Gwynns Falls	185.8	23.1	72.1	141.4	102,577
Jones Falls	59.6	7.4	23.1	45.3	32,901
Back River	89.7	11.1	34.8	68.2	49,485
Baltimore Harbor	38.9	4.8	15.1	29.6	21,482
Patapsco/Back R. Tot	**430.1**	**53.4**	**166.8**	**327.1**	**237,393**
County Totals	**540.7**	**66.8**	**209.7**	**411.0**	**298,429**

3.3.4 Program Summary – Storm Drain Cleaning

In sixteen years, the storm drain-cleaning program has removed ~28,600 cubic yards of material from the Baltimore County storm drain system. At 331 pounds per cubic yard, that amounts to approximately 9.5 million pounds. Without intervention, this material would have eventually entered our waterways.

3.4 Street Sweeping

3.4.1 Street Sweeping Overview

Removing materials such as trash, sediment, and debris, from public streets also results in a reduction of the pollutant load (toxins and nutrients) that could have entered waterways. Baltimore County removes these materials by utilizing a street sweeping program managed by the Bureau of Highways. Seven employees operate seven sweepers on a daily basis, following prescribed routes.

The data on how many street miles are swept and tonnage collected is recorded by the Department of Public Works and submitted to DEPRM on an annual basis. Table 3-5 shows this data for each of the past eighteen years. The removal rates or productivity is also expressed in a tons-per-mile ratio for each year in the table. Approximately ½ ton of material was collected each mile from 1991 through 1995, with a spike to 0.88 in 1994. In 1994, during a particularly severe winter, the county experienced a salt shortage and found it necessary to utilize slag to provide traction on the icy roads. Subsequently, the material removed per mile spiked to the highest-ever that year. In 1996, the one half ton per mile average began to decrease, reaching its lowest point of 0.112 tons/mile in 1998. The decreasing trend began in 1996 and leveled off in 1998 through 2001 at approximately 0.11 tons/mile and staying at that level through 2001. Since then the efficiency has been stable at about 0.30 tons/mile.

Table 3-5: Annual Street Sweeping Summary

Year	Miles Swept	Tons Collected	Tons/Mile
1991	7,566	3,792	0.50
1992	6,663	3,161	0.47
1993	6,300	3,108	0.49
1994	8,532	7,473	0.88
1995	5,333	2,990	0.56
1996	8,605	2,990	0.35
1997	14,785	3,177	0.21
1998	24,863	2,792	0.11
1999	24,968	2,880	0.12
2000	21,949	2,491	0.11
2001	12,147	1,395	0.12
2002	7,800	2,364	0.30
2003	8,640	2,592	0.30
2004	6,617	1,985	0.29
2005	6,126	1,838	0.30
2006	6,306	1,892	0.30
2007	5,133	1,540	0.30
2008	4,110	1,233	0.30
Totals	**186,443**	**49,693**	**18 yr avg. = 0.33**

Figure 3-5 provides graphic displays of the information contained in Table 3-5.

Even with the fluctuations in productivity, tonnage removed each year has been relatively consistent as shown in Figure 3-5. However, the mileage needed to collect each ton of sediment increased greatly from 1997 through 2000 while the productivity continued a decline that began in 1996. Although experiencing a slight decrease in 2000, mileage began significantly decreasing in 2001 and returned to the approximate mileage recorded early in the program. Although the tonnage remained relatively steady, the mileage declined enough to raise the productivity to about two-thirds of the rate in the first five years of the program.

The decline in productivity does not necessarily indicate a serious problem. It may simply indicate that the bulk of sediment and debris accumulated over many years was removed during the early years of the program, as might be expected. Absent any major sediment influx (e.g. more cinders used for snow removal), street sweeping efficiency may have reached a maintenance level where it is simply keeping up with the average annual loading. Optimizing the program's performance may now depend mostly on fine-tuning the interrelated activities, for example a route analysis could lead prioritizing and redefining the sweeping routes, and concentrating efforts more on the commercial areas.

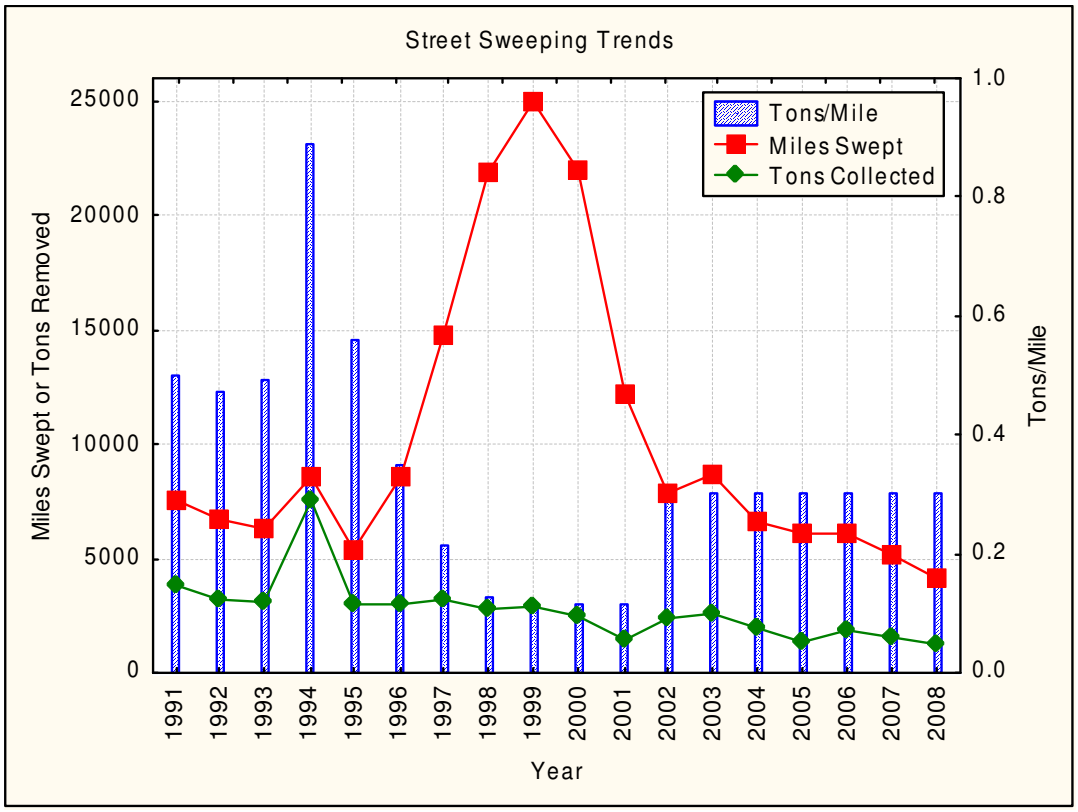


Figure 3-5: Miles of Street Swept, Tons of Material Removed and Tons/Mile Swept

3.4.2 Street Sweeping by Watershed

Utilizing the same methodology used to calculate Storm Drain Cleaning Program pollutant removal rates, the reduction in pollutant loading attributable to the Street Sweeping Program was also quantified. The tonnage of material removed is reported on a countywide basis. In order to determine the material removed by watershed, it is assumed that the pollutant loading per pound of debris did not vary among watersheds or land uses. The street sweeping routes were digitized into a GIS map and then overlaid with the watershed boundaries to determine the proportion of swept miles per watershed. The tonnage of swept material per watershed was then determined by multiplying the total tonnage by the proportion of miles in each watershed. The results are displayed in Table 3-6. The breakdown into watersheds is based on the actual miles available for sweeping, without regard to the number of repeat visits.

Table 3-6: 2008 Street Sweeping Program – Tons Removed from Watersheds

Watershed	Route Miles (1 circuit)	Percent of Total Miles	Tons Removed
Upper Western Shore Watersheds			
Deer Creek	0.0	0.0	0.0
Prettyboy Reservoir	0.0	0.0	0.0
Loch Raven Reservoir	142.8	11.5	141.8
Lower Gunpowder Falls	78.8	6.4	78.9
Little Gunpowder Falls	17.0	1.4	17.3
Bird River	72.6	5.9	72.7
Gunpowder River	7.7	0.6	7.4
Middle River	27.2	2.2	27.1
Totals for UWS	**346.1**	**28%**	**345.2**
Patapsco/Back River Watersheds			
Liberty Reservoir	6.9	0.6	7.4
Patapsco River	170.0	13.8	170.2
Gwynns Falls	321.4	26.0	320.6
Jones Falls	68.3	5.5	67.8
Back River	229.0	18.5	228.1
Baltimore Harbor	93.8	7.6	93.7
Totals for Pat/Back R.	**889.4**	**72%**	**887.8**
Totals	**1,235.5**	**100%**	**1,233**

Unlike the Storm Drain Cleaning Program program, the exact location where the material is collected is not known. A basic assumption was made that material swept from the county's streets was the same, as far as pollutants are concerned, to the material that washes off the streets and into its storm drains. Using the pollutant concentrations from the Street Sweeping- Inlet Cleaning study, the distribution of pounds of pollutants removed and Impervious Urban Acres Treated in 2008 from each of the major watersheds in the County was calculated and is shown in Table 3-7. Impervious Urban Area Treated was calculated by taking the pounds of pollutant removed and dividing it by the Chesapeake Bay Program per acre pollutant loading rate for impervious urban area.

Table 3-7: 2008 Street Sweeping Program Pollutant Removal (Pounds) and Impervious Urban Acres Treated

Watershed TN	TN	Impervious Urban Acres Treated for TN	TP	Impervious Urban Acres Treated for TP
Upper Western Shore				
Deer Creek	0.0	0	0.0	0
Prettyboy Reservoir	0.0	0	0.0	0
Loch Raven Reservoir	517.9	64	200.8	394
Lower Gunpowder River	288.2	36	111.7	219
Little Gunpowder Falls	63.2	8	24.5	48
Bird River	265.5	33	103.0	202
Gunpowder River	27.0	3	10.5	21
Middle River	99.0	12	38.4	75
UWS Totals	**1,260.8**	**156**	**488.9**	**959**
Patapsco/Back River				
Liberty	27.0	3	10.5	21
Patapsco River	621.6	77	241.0	473
Gwynns Falls	1,171.0	145	454.0	890
Jones Falls	247.6	31	96.0	188
Back River	833.1	103	323.0	633

Baltimore Harbor	342.2	43	132.7	260
Patapsco/Back R Totals	**3,242.7**	**402**	**1,257.3**	**2,465**
Annual County Totals	**4,503.5**	**558**	**1,746.2**	**3,424**

3.4.3 Program Summary - Street Sweeping

From 1991 to 2008, the Street Sweeping program removed almost forty-nine thousand three hundred tons of debris from Baltimore County streets (Table 3-5). Without this program, this debris would have entered waterways.

The Street Sweeping program appears to have reached a maintenance level and now needs to be evaluated to determine where the most significant amounts of sediments are consistently collected. The number of times each route is swept each year, the land use, and other variables need to be factored into the program to increase its efficiency.

Both the Storm Drain Cleaning and Street Sweeping programs make a contribution to the County's overall goal of reducing sediment and other pollutants, including toxics and nutrients that enter the waters of the State. The tonnage collected by the street sweepers and storm drain cleaning trucks is not just pollutant-laden sediment, but includes significant amounts of paper, plastic, glass, wood, aluminum cans, and metal objects. During rainy weather the lighter, more floatable debris gets washed into the storm drains to be removed by the Storm Drain Cleaning program instead of by the street sweepers.

3.5 Household Hazardous Wastes (HHW)

Household Hazardous Wastes are specifically exempted from the Maryland State Recycling Act. The Household Hazardous Waste Recycling Program was initiated by Baltimore County DEPRM in response to numerous requests from County citizens and elected officials concerned with disposal of hazardous wastes from their own homes.

Baltimore County citizens can drop off household hazardous waste materials for recycling or proper disposal at a permanent processing facility located at the Eastern Sanitary Landfill Solid Waste Management Facility. This facility is operated by DEPRM, in cooperation with the Department of Public Works (DPW), Monday through Saturday, from April through November. Materials dropped off for processing include unwanted household chemicals, such as paints, flammable cleaning solvents, automotive fluids, pesticides, pool chemicals, acids, mercury thermometers, gasoline, corrosive material, etc. Table 3-8 provides a listing of material collected and amounts since 2003. DEPRM holds two one-day collection events annually, in the spring and fall, at different locations around Baltimore County.

Table 3-8: Household Hazardous Waste Recycled (2003-2008)

Material Type	2003	2004	2005	2006	2007	2008	Total*
Total Liquids (gal)							
Flammables	3,685	9,570	8,910	9,130	7,495	5,885	64,310
Ammonia	5	2	7	22	5	****	81
Corrosive	495	**	**	**	**	**	2,860
PCBs	0	0	0	0	0	**	165
Gasoline	2,393	2,914	2,043	2,727	2,202	2,884	23,204
Motor oil	93,251	100,735	93,277	85,565	86,055	75,676	921,460
Antifreeze	5,815	5,874	5,378	4,214	6,808	5,926	53,289
Paint (Latex)	5,815	14,480	16,060	12,685	12,445	11,555	91,061

Material Type	2003	2004	2005	2006	2007	2008	Total*
(liquid) totals	111,459	133,575	125,675	114,343	115,010	1,150,545	2,205,049
Total Solids (lbs.)							
Corrosive	**	5,250	5,744	8,860	8,740	8,698	37,292
Pesticides	8,930	14,140	16,150	13,630	18,256	13,685	75,861
Batteries (auto)	280,000	294,300	160,920	358,040	219,640	91,840	1,124,740
Batteries (rechargeable)	***	***	***	***	578	6,372	6,950
Cylinders (propane)	79,480	38,980	29,720	42,420	28,660	23,820	163,600
Mercury	168	125	50	40	112	22	349
Reactives	10	40	15	19	15	18	107
Toxics	40	360	105	14	199	257	1,030
Oxidizers	459	1,240	1,985	1,422.5	1,664	1,747	8,059
Freon	***	***	***	***	923	0	923
PCBs	**	**	**	**	**	5	5
(solids) totals	369,091	354,505	214,714	424,446	278,787	146,459	1,418,911
Total Solids (number of items)							
Fluorescent Light bulbs	***	***	***	***	2,564	7,945	10,509
Ammunition (rounds)	***	***	***	***	1,011	400	1,411
(solids) totals	***	***	***	***	3,575	8,345	11,920

Table 3-8 (cont.): Household Hazardous Waste Recycled (2003-2008)
* Includes 1998-2002, which are not shown on table.
** Changed from reporting in gallons to pounds
*** Not recorded for these years
**** County employees take ammonia away for re-use as soon as it comes in, so a number is not generated for amount collected.

Motor oil remains the most abundant and frequently recycled household hazardous waste. Motor oil and antifreeze are recycled throughout the County at drop-off facilities operated by the Baltimore County Department of Public Works (DPW), in cooperation with the Maryland Environmental Service (MES). Statistics for recycled motor oil and anti-freeze for all participating collection facilities have been reported since 1991. DEPRM provided assistance in establishing the motor oil and antifreeze recycling program at the DPW facilities. County drop-off sites include landfills, transfer stations, two rural DPW Highways shops. The Bowley's Quarters Marina also is a collection site for this program.

The various industries that reuse the materials, recycled oils and metals in particular, pay the market-based price for them. Because people that recycle essentially donate the material, the current rates generate sufficient revenue to pay the administrative costs of the program, which is facilitated by Maryland Environmental Service (MES). Individual commercial facilities that do not participate in the program, such as garages, gasoline stations, and tire and auto centers, are not included. They are typically paid directly by scheduled collectors.

Figure 3-6 displays the estimated statistics for recycled combustibles, gasoline and pesticides. After three years of steady increases, the amount of recycled gasoline has remained relatively steady in a range of 2,000 to 3,000 gallons per year. The amount of pesticides recycled declined in 2003 and 2008, however, for the former this could be due to the cancellation of the fall

collection event caused by hurricane Isabel. Similar reductions in toxic materials, corrosives, latex and solvent-based paints were also attributed to the cancellation of the same event. The 2007 collection resulted in an increase in pesticides collected to its highest level, 18,256 pounds.

Flammables increased again after 2003, when amounts had declined significantly. These decreases were also the result, at least in part, to the cancellation of the fall event due to hurricane Isabel. Paint sludge is now bulked together into the same drums with other combustible material and labeled as flammable. The greatest volume of flammables, 9,570 gallons, was recycled in 2004. Figure 3-6 shows in 2008 gasoline volume collected rose, while pesticides and flammable amounts decreased.

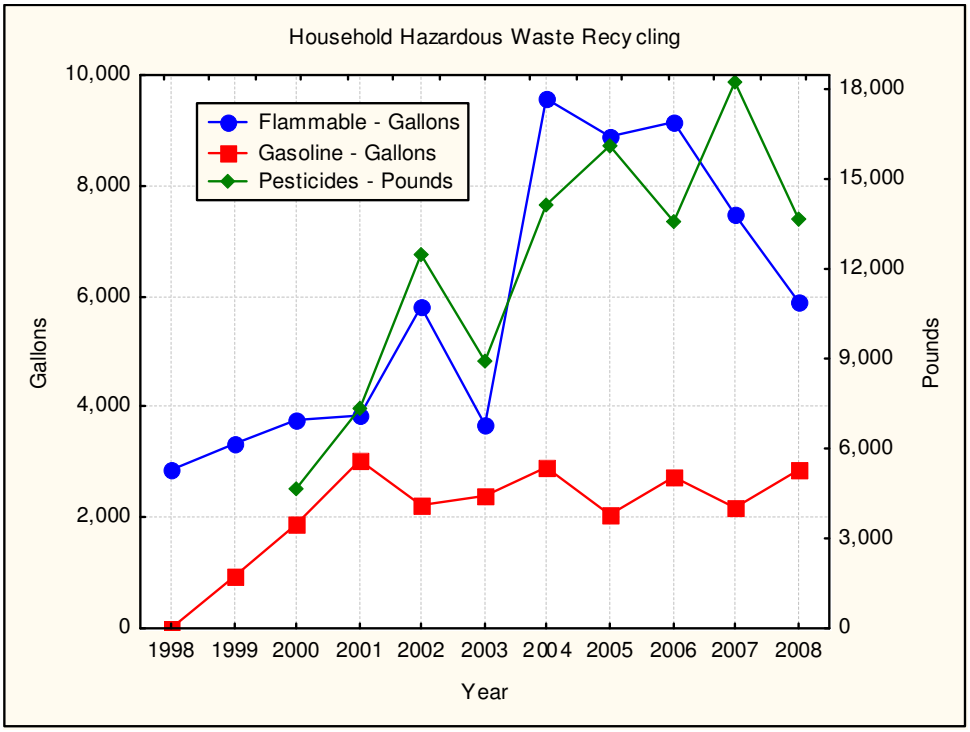


Figure 3-6. Household Hazardous Waste Recycling of Flammables, Gasoline, and Pesticides.

Mercury was added to the list of solid wastes in 2001, showing a steady increase from 20 pounds in 2002 to a peak of 168 pounds in 2003. A decrease to 22 pounds this year has occurred after last years peak of 112 pounds. There are mercury TMDLs for the Prettyboy, Liberty and Loch Raven Reservoirs and this program helps to meet that criteria.

Oil and antifreeze recycling is reported through Maryland Environmental Service, local government, and private facility partnership efforts and records date back to 1991. Additional unreported recycling of oil and anti-freeze occurs through a network of 65 private sector collection centers across the County, most of which are neighborhood gas/service stations. As can be seen in Figure 3-7 the recycling of motor oil has been near 100,000 gallons since 1998, decreasing to the lowest level last year at 75,676. A total of over 1.5 million gallons of motor oil has been collected for recycling since 1991. The annual volume of recycled anti-freeze, as shown in Figure 3-7, is typically between 5,000 to 6,000 gallons. The exception to this was 2006, which decreased to 4,214. Over 86,000 gallons of anti-freeze have been recycled in Baltimore County since 1991.

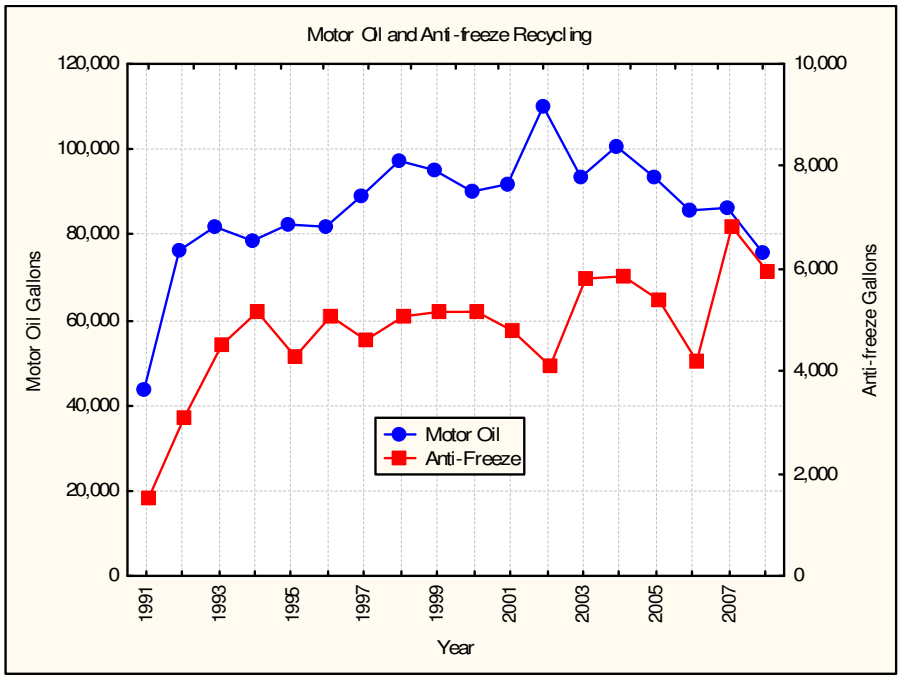


Figure 3-7. Waste Oil and Anti-freeze Recycled from 1991 through 2008

As evidenced by the continued citizen participation, DEPRM's recycling program for Household Hazardous Wastes continues to be a successful program. The contribution to reducing nonpoint source pollution remains significant.

3.6 Fertilizer, Pesticide, and Deicing Statistics

Members of the Baltimore County NPDES Management Committee have submitted statistics for usage of fertilizers, pesticides and deicing materials. Quantities of fertilizers and pesticides are reported in pounds, tons, gallons, and ounces. All results have been converted to pounds for this report. Fluid measure is assumed to have a density of 7.0 pounds per gallon. The statistics for 2008 by individual agencies are presented in Table 3-9. The amounts used by the entire County are presented in Table 3-10.

Among the County agencies that fertilize and use pesticides, golf courses are consistently the biggest users of these materials. Deicing materials are also used throughout County agencies. Logically, because of its responsibility to clear roads, the DPW– Bureau of Highways remains the biggest user of deicing materials. In 2008, the Bureau of Highways accounted for 99.6% of the deicer material used.

Table 3-9: 2008 County Agency Fertilizer, Pesticide and Deicing Materials Use (in Pounds) N/A stands for not available.

Agency	Fertilizer	Pesticide	Deicing
Golf Courses:			
Diamond Ridge	26,857	6,185	0
Greystone	4,082	69	50
Gunpowder Falls	11,650	3,379	0
Rocky Point	26,500	13,124	0
Longview	N/A	N/A	N/A
Woodlands	39,277	6,759	0
Golf Course Totals	**108,366**	**29,516**	**50**
Catonsville Comm. Coll.	N/A	N/A	N/A
Essex Comm. Coll.	N/A	N/A	N/A
Dundalk Comm. Coll.	N/A	N/A	N/A
County Public Schools	1,350	0	132,320
Bureau of Utilities	19	0	7,500
Bureau of Highways	0	2,100	65,200,000
Recreation and Parks	3,700	442.7	116,600
Non-Golf Course Totals	**5,069**	**2,542.7**	**65,456,420**
Totals Pounds =	**113,435**	**32,058.7**	**65,456,470**

Table 3-10 shows the annual usage of fertilizer, pesticides and deicing material from 1999 through 2008. The 58 inches of snow in the calendar year 2003 resulted in the highest salt usage recorded. The amount of deicing materials used depends not only on snowfall but also the number of events. Figure 3-8 shows the data Fertilizer and Pesticide Trends and Figure 3-9 shows the data for Deicing Material and Snowfall.

Table 3-10: Annual Fertilizer, Pesticide and Deicing Materials Used By County Agencies (in Pounds)

Calendar Year	Fertilizer	Pesticide	Deicing Mat.	Snowfall (in.)	Number of Winter Weather Events
1999	275,400	34,320	83,978,000	12.4	8
2000	213,114	21,028	94,467,750	27.2	7
2001	221,609	21,509	48,566,400	7.4	5
2002	200,060	21,229	100,437,859	12.0	7
2003	191,726	22,137	205,164,341	58.0	8
2004	227,309	34,762	147,537,040	8.7	5
2005	133,881	20,899	185,118,740	24.5	7
2006	166,870	29,607	23,888,950	13.1	1
2007	131,191	26,362	156,690,026	14.4	11
2008	113,435	32,059	65,456,420	4.3	15
Totals	**1,874,595**	**263,912**	**1,111,305,526**		

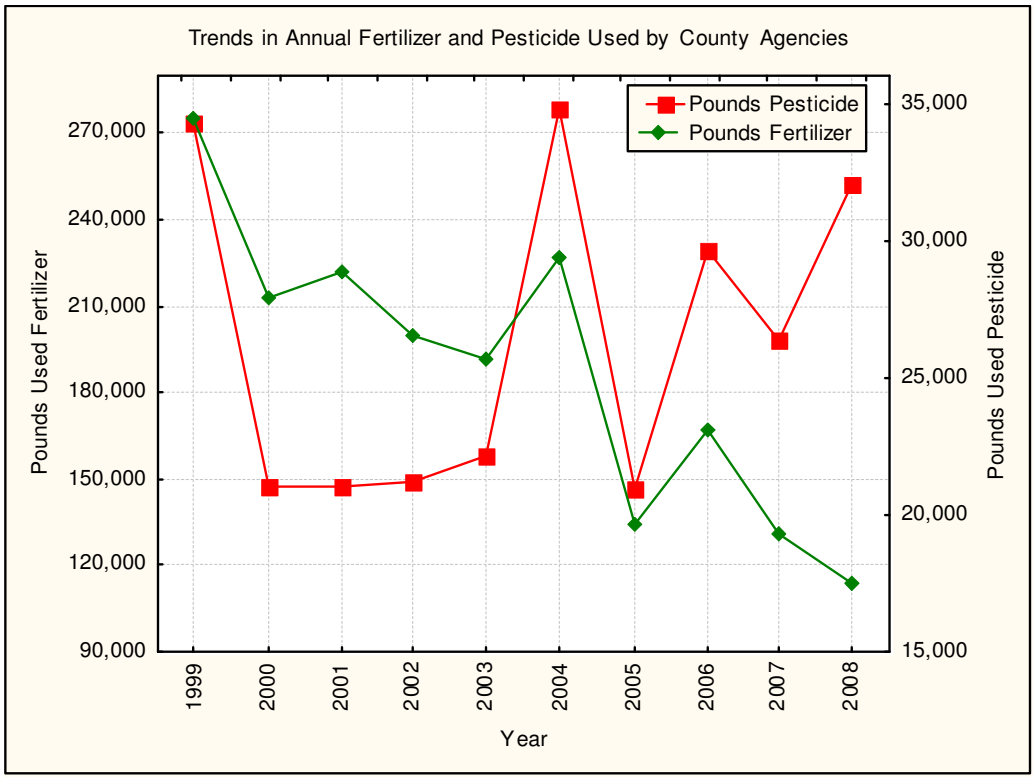


Figure 3-8: Trends in Annual Fertilizer and Pesticide Used by County Agencies

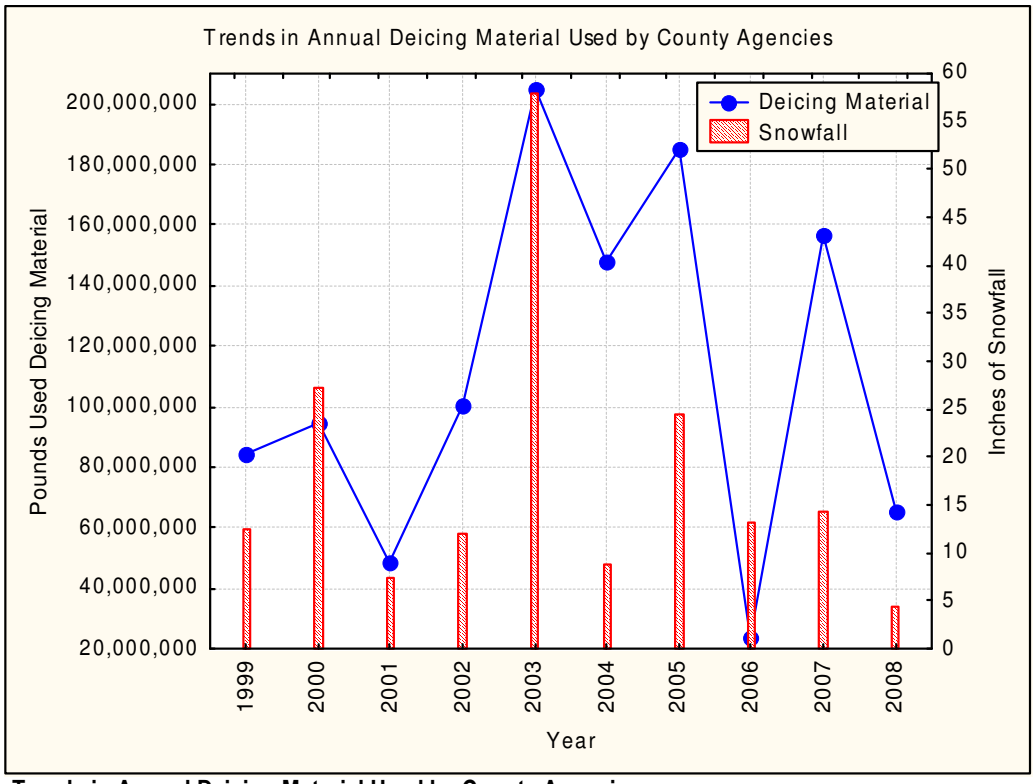


Figure 3-9: Trends in Annual Deicing Material Used by County Agencies

4.0 Permit Requirements

E.7. Public Education

A public education and outreach program shall be implemented to reduce stormwater pollutants. As part of this program, Baltimore County shall develop material and make it available for distribution to the public by watershed associations and at community events. These efforts are to be documented and summarized in the County's annual reports. At a minimum, Baltimore County shall:

a. Establish and publicize a compliance hotline for the public reporting of suspected illicit discharges, illegal dumping, and spills.

b. Provide information regarding the following water quality issues to the general public:

   i. Water conservation;
   ii. Stormwater management facility maintenance;
   iii. Erosion and sediment control;
   iv. Household hazardous waste;
   v. Lawn care and landscape management (e.g., the proper use of herbicides, pesticides, and fertilizers, ice and snow removal, cash for clippers," etc.);
   vi. Litter control, recycling, and composting;
   vii. Car care, mass transit, and alternative transportation;
   viii. Pet waste management.

c. Provide information regarding the following water quality issues to the regulated community:

   i. NPDES permitting requirements;
   ii. Pollution prevention plan development;
   iii. Proper housekeeping; and
   iv. Spill prevention and response.

4.1 Introduction

Baltimore County DEPRM has designated *environmental education (EE), outreach, action,* and *stewardship through community partnerships,* as high priorities in its suite of services to citizens. The County's integrated watershed approach to resource management and its intention to work with and support local citizen watershed organizations offer many opportunities for effective community partnerships involving a broad constituency of individual citizens, families, schools, organizations, faith communities, and businesses. Baltimore County DEPRM's *Let's Be Partners* and *Getting Greener Schools* environmental education and outreach programs provide the coordination and focus for these efforts to reach, inform, and work with all segments of the Baltimore County community.

As in past years, each component of the *Let's Be Partners/Getting Greener Schools* program carried the pollution prevention message. Special attention was given to the direct connection

between how one handles household and commercial toxic materials, pesticides, herbicides, fertilizers, landscape maintenance, cleaning procedures, pet waste, and impacts on water quality in local streams, drinking water reservoirs, and the Chesapeake Bay.

Emphasis was placed on cost-effective prevention over pollution regulation, structural controls, and cleanup. Recognizing the multiple benefits gained from implementation of proven conservation landscaping techniques and design components (erosion control, cleaner healthier water, increased biological diversity, energy saving, education and stewardship opportunities, scenic values, habitat restoration, recreation, etc), a strong emphasis was placed on encouraging and facilitating the restoration of natural native vegetation on public and private lands. In 2008, new school and community partnerships were created to enhance public awareness, education and outreach. New partnerships with other county agencies, especially Baltimore County Public Works-Recycling Division, were developed to expand outreach to new audiences.

Increasingly, since 1995, this environmental education program has assisted individual citizens, families, students, teachers, school administrative staff and facilities managers, businesses, homeowners and apartment dwellers, and faith communities and other local organizations in all the county's watersheds. Initiatives in 2008 identified and targeted specific populations, expanded cooperation with local watershed organizations, and developed new local and regional partnerships to better facilitate work in watershed communities.

As a result of the *Baltimore Watershed Agreement* first signed by Baltimore County and Baltimore City in October 2002, re-negotiated and signed on December 14th, 2006, an increasing number of Baltimore County's environmental education initiatives have extended across political boundaries into watersheds shared with Baltimore City. Goals and objectives addressing five topic areas were set in 2007 and Phase 1 Action Plans was completed in February 2009. Offices of Sustainability in both Baltimore County and City are identifying and assessing environmental education needs and existing programs.

As part of its successful *Maryland Green School* program initiative: *Getting Greener Schools,* Baltimore County continued to use *The Maryland Green School Awards Program* to provide a framework for integrating environmental learning and community involvement in local schools. DEPRM maintained its statewide leadership in this initiative and expanded its effort to target schools in the 2008-09 school year and beyond. The department's workshops and site-based support for teachers provided local and regional resources to enhance staff development opportunities and increase the environmental awareness and interest of local school principals, teachers, and facilities managers. Baltimore County's 42 recognized *Maryland Green Schools* and *Green Centers* provided important models for environmental awareness and community stewardship.

Long term partnerships with established local *Green Schools,* recognized *Maryland Green Centers* and other organizations and agencies such as the *Maryland Association for Environmental and Outdoor Education (MAEOE), the Herring Run Watershed Association (HRWA), The Irvine Nature Center, The Gunpowder Valley Conservancy,* and the *Jones Falls Watershed Association (JFWA)* brought expertise, technical support, volunteers and stakeholders to assist schools and citizens as they explored water quality issues, identified stewardship opportunities, and made plans. *Small Watershed Action Plans* (SWAP) involved citizens and stakeholders in identification of activities and projects that improve local water quality.

To underscore its commitment to promote meaningful environmental education, DEPRM maintained a Board position in The Maryland Association for Environmental and Outdoor Education (MAEOE) and county staff provided leadership at the state level by serving as chair of the *MD Green School* committee.

In 2008, DEPRM's environmental education activities were accomplished by one part-time staff person working approximately 33 hours/week. Other DEPRM staff members, staff from other County agencies, student interns, citizen volunteers, and program partners provided additional material and staffing support.

The *Let's Be Partners/Getting Greener Schools* education program, as well as other ongoing outreach efforts initiated by DEPRM, and all supporting materials developed or used in the program to date have been fully described and exhibited in previous NPDES Annual Reports 1995-2007. The following section reports on education and outreach accomplishments in 2008.

4.2 Program Description

4.2.1 Baltimore County DEPRM's Environmental Education Programs

"Let's Be Partners...Water Pollution: What We Can Do To Reduce and Prevent It"
"Getting Greener Schools" The MD Green School Program in Baltimore County

New or Expanded Program Components: To increase effectiveness and deliver the pollution prevention message to a wider audience, the following initiatives were developed or expanded:

4.2.1.1 School Initiatives

Support for all schools: To provide for professional development and enhance opportunities for high quality, effective, authentic environmental education and community stewardship at public and private schools Pre K-12 in Baltimore County, DEPRM provided the following:

Professional development for formal and non-formal environmental educators: In 2008, Baltimore County supported over 60 sessions and presentations at training workshops and conferences for staff development held in Baltimore County and in the region. Topics included *The MD Green Schools Program*, *Envirothon*, school yard landscape design for water quality enhancement, schoolyard habitat restoration, schoolyard maintenance protocols, conservation landscaping components, invasive species removal, and developing partnerships for stewardship. In cooperation with BCPS Office of Science, site-based assistance and training was also provided for teachers in use of technical equipment, enhancement of field skills, identifying and strengthening curriculum connections, and developing lesson plans and timelines. Emphasis was placed on using the environment as a context for learning across all grade levels and disciplines. Teacher training was accomplished at statewide workshops and conferences including the Archdiocese of Baltimore Parochial school Teacher Conference 2008, the Grounds for Teaching Series, and The MD Association for Environmental and Outdoor Education (MAEOE).

The following workshops and events targeting educational staff are currently being planned for 2009-10:

- With Irvine Nature Center: Habitat Stewards Fall 2009.
- With BCPS: Schoolyard Habitat for elementary, middle and high schools, Green Schools curriculum development summer 2009; AP Environmental Science.

- With MAEOE: 2009 conference workshops and short sessions, mentoring for prospective Green Schools, pre-application review sessions, displays.
- With MAEOE: The 2009 Association of Independent Maryland Schools (AIMS) Conference for private schools; special topic workshops.
- With BCPS: MAEOE conference sessions and workshops, and a conference track for principals and administrative staff;
- With MAEOE: training sessions for nature centers and outdoor schools in 2009-10.
- With teachers at the Forbush School at Sheppard Pratt in Towson: a MD Green Schools Program workshop for the annual MD Association for Non-Public Special Education Facilities (MANSEF) 2009.
- With MAEOE: a workshop for prospective Maryland Green Centers in 2009.
- DEPRM Watershed Management staff: A presentation to the Association of Mid-Atlantic Aquatic Biologists, April 2009.
- DEPRM staff: A *MD Green Schools* train-the-trainers workshop for Project Learning Tree Program facilitators, January 2009.
- With the Archdiocese of Baltimore: a MD Green School workshop for the 2009 Catholic classroom teachers.
- With the Chesapeake Bay Foundation and MAEOE: MD Green School Workshop for teachers, August 2009.

Planning, assessment tools, and materials: DEPRM provided over 100 enhanced aerial photographs for site analysis of school properties and the surrounding neighborhood and copies of the DNR's *Check-up for Schools* for school and schoolyard assessments. Over 200 copies of the USFW publication *Native Plants for Wildlife and Conservation Landscaping* were made available to schools and organizations as a reference guide for planning school and community habitat restoration projects. DEPRM also provided *Plant Invaders of Mid-Atlantic Natural Areas* for distribution to schools and communities interested in (1) identifying troublesome plants and (2) using environmentally sound prevention and control methods, and (3) identifying appropriate native plants for installation following removal of invasive plants. Other fact sheets and brochures were made available upon request.

Presentations, demonstrations, and demonstration sites: PowerPoint, interactive events, and demonstration programs were conducted for teachers, students, and principals for the purpose of highlighting opportunities and inviting discussion. To promote more sustainable landscape improvements on school properties and enhance water quality in local streams, DEPRM developed PowerPoint presentations highlighting the process of identifying opportunities to act, how to establish partnerships to assist in accomplishing projects, and how to engage school administrations and facility managers. Additional topics such as Integrated Pest Management (IPM), BayScaping with Native Plants, Schoolyard Habitat Restoration, Controlling Invasive Plants, Water Quality Monitoring, Exploring Environmental Careers, and other titles were also made available. For schools interested in adopting the *MD Green School* model, staff provided information and guidance for school administration, faculty, PTA, and students. Information was

provided to potential program partners for schools, such as local colleges and universities, garden clubs, scout troops, watershed organizations, faith communities, and businesses. These programs served as models for other counties and states in the region.

Information about the *Green Schools/Green Center* program: DEPRM conducted programs to introduce the *MD Green School/Green Center* model, provide professional development, find community partners, help with preparing applications, and provide assistance in *MD Green School* projects and activities. DEPRM assisted with facilities communication concerning planned schoolyard habitat and stormwater management projects on school properties. Staff assisted potential *Maryland Green Centers* with applications and many local schools as they began implementing sustainable practices, documenting their accomplishments and preparing to apply for *MD Green School* status. Website access to program information was maintained on the county site and with a link to www.maeoe.org.

Books, materials: DEPRM provided technical assistance, projects lists, plant lists, enhanced aerial photography of school properties and their watersheds, planting guides, site-assessment tools, Green School applications/information, posters, videos, and books. All materials obtained or developed to assist schools are made available upon request and at no charge.

Networking: DEPRM provided assistance in locating programs and resources, contacts for planting stock, mulch, funding, technical support, partnerships, and other assistance.

Recognition: DEPRM provided recognition for schools and individuals that were involved in responsible environmental actions and who served as models in their community. In 2008, the recognitions included *MD Green School* and *Green Center* awards, Towson Gardens Day awards, Green Renaissance awards for the County's Green Schools and Green Centers, County Executive Proclamations, and in cooperation with DNR, Governor's Citations. A poster-sized map identifying and highlighting all the *MD Green Schools* in Baltimore County was provided for exhibit in the DEPRM lobby, the offices of BCPS Office of Science and the Baltimore County Superintendent of Schools, at public presentations at schools and organizations around the County, and on the county's website.

Support for stewardship projects: In 2008, DEPRM highlighted tree-related topics on over 800 occasions. Services provided included: site assessments, assisting with planting projects and removal of invasive competing plants, conducting environmental education programs about the benefits of trees, teacher training, leading planting demonstrations, providing technical assistance with species and site selection, and funding opportunities. In addition, no-cost delivery of Tree-Mendous MD tree orders and a $10 citizen discount coupons through the county's *Growing Home Campaign* were also made available. DEPRM assisted in planning and advertising local stewardship projects such as Project Clean Stream hosted by the Alliance for the Chesapeake Bay. Students and scouts potted seedlings at the County's nursery. Baltimore County's 42 MD Green Schools and Centers were all eligible to receive a 1:1 match on all DNR Tree-Mendous Maryland tree orders in recognition of the numerous stewardships projects that were accomplished in their respective watersheds.

Maryland Green Schools in Baltimore County: Baltimore County's leadership and support of the *Maryland Green School Awards Program* has been described in previous annual reports. Baltimore

County continues to lead the state in developing and recognizing model schools. As of April 2008, thirty-eight additional public and private schools attained *MD Green School* status; two centers were recognized; 8 previously recognized schools successfully re-certified. Together, they provide valuable mentorship for other schools and set an example for the community. They plan, implement, and maintain schoolyard and community projects that provide stormwater management, water conservation, sediment control, integrated pest management, and other water quality benefits. DEPRM works with potential *MD Green School*s to provide training, develop program, find community partners, and assist with projects.

Table 4-1 reports the 2008 accomplishments of Baltimore County's newly recognized MD Green Schools by watershed. Table 4-2 reports accomplishments of the schools that re-certified in 2008. Increasingly, schools are reporting the quantitative details of their projects. The data available currently is reported below.

Table 4-1: School and Community Environmental Education Projects Implemented in County watersheds by Baltimore County's Newly Recognized Public and Private MD Green Schools and Green Centers, 2008

Environmental Learning Project	**Back River** -Norwood ES -Rosedale Center -Herring Run WA	**Baltimore Harbor** -Dundalk ES -Norwood ES	**Gwynns Falls** -Franklin MS	**Jones Falls** -Odyssey School	**Little Gunpowder** -Jackson-ville ES	**Gunpowder River** Marshy Pt Nature Center	**Loch Raven** -Franklin MS -Jacksonville ES -PotSpring ES
Agricultural projects				✓			
Air pollution control							
Bio-retention planting	✓		✓	✓	✓	✓	✓
Butterfly garden	✓	✓		✓		✓	
Energy Conservation	✓	✓	✓	✓		✓	✓
Environmental career exploration	✓						
Environmental Celebrations	✓	✓	✓	✓	✓	✓	✓
Environmental issue investigation	✓	✓	✓	✓	✓	✓	✓
Habitat restoration	✓	✓	✓	✓	✓	✓	✓
IPM	✓		✓				✓
Native plants	✓2,135 seedlings	✓		✓		✓	✓600
Litter control	✓12,300 lb street trash		✓	✓			✓
Mentoring				✓		✓	✓

Outdoor learning structures/signs	✓		✓	✓	✓	✓	✓
Protect existing trees	✓				✓	✓	
Riparian planting	✓		✓			✓	✓
Site analysis	✓				✓		✓
Solid Waste reduction/Recycling	✓	✓	✓	✓	✓	✓	✓
Stormwater Management/ Erosion control	✓	✓				✓	
Stream Studies	✓					✓	
Tree and/or shrub planting	✓2,465	✓	✓	✓	✓	✓40	✓
Turf reduction							✓
Water quality monitoring	✓			✓			✓
Water conservation/ water pollution prevention	✓76 rainbarrels	✓	✓	✓		✓	✓

Table 4-2: School and Community Environmental Education Projects Implemented in County watersheds by Baltimore County's Re-certifying Public and Private MD Green Schools, 2008

Environmental Learning Project	**Back River*** -Towson HS	**Patapsco*** Western School of Technology HS	**Jones Falls** -Jemicy School -Harbour School	**Lower Gunpowder** -Seven Oaks ES	**Loch Raven** -Cockeysville MS -Dulaney HS -Sparks ES -Lutherville Lab ES
Agricultural projects	✓				
Air pollution control	✓	✓			
Bioretention planting	✓	✓	✓		✓no-mow zone
Butterfly garden	✓	✓	✓		✓
Energy conservation	✓		✓	✓	✓
Environmental career exploration	✓	✓			✓
Environmental celebrations	✓	✓	✓	✓	✓
Environmental issue investigation	✓	✓	✓	✓	✓
Habitat restoration	✓	✓	✓	✓	✓
IPM	✓			✓	
Native plants	✓	✓	✓	✓	✓
Litter control	✓	✓	✓	✓	✓
Mentoring	✓	✓	✓	✓	✓
Outdoor learning structures/signs		✓	✓	✓	✓
Protect existing trees			✓		✓
Riparian planting	✓				✓

Site analysis	✓	✓		✓	✓
Solid waste reduction Recycling	✓	✓	✓	✓	✓one ton over 5 yrs
Stormwater management/ Erosion control	✓		✓		✓1,500+
Stream studies	✓				
Tree and/or shrub planting	✓128				✓32+
Turf reduction	✓				✓
Water Quality monitoring	✓		✓		✓
Water conservation Pollution prevention	✓		✓		✓

*Numbers reported above are taken from a school's voluntary reporting and do not reflect the total number of trees/shrubs planted by schools in a given watershed in 2008. In addition to tree plantings accomplished by the county's recognized MD Green Schools reported above, additional schools assisted by the Baltimore County Forestry Board and the BCPS Office of Science planted hundreds of trees in the county's local watersheds including Patapsco River, Back River, and others. In addition to the educational benefit for students, the combined environmental benefit from school plantings includes stormwater management, sediment and erosion control, riparian protection and other values.

The MD Green School Award Program provides a balanced framework for planning environmental learning, making the curriculum connections, and accomplishing pollution prevention on school landscapes. Schools participating in this program are establishing a foundation for sustained commitment and skillful stewardship that will in years to come provide the basis for measurable improvements in their local watershed in years to come. The county has made notable progress in its goal to achieve a more even geographic distribution of *MD Green Schools* and *Centers* throughout the county. A map of *MD Green School* locations in Baltimore County 1999-2008 is provided in Exhibit 4-1

During 2008, county staff met with school system administration, teachers, and/or students of over 200 of the County's public and private schools. Follow-up meetings were held to select activities, identify BMPs, develop community partnerships, obtain technical support, identify resources, and in some cases, proceed through the award application process. This rate of interaction is up sharply from previous years due to increased interest in the *MD Green School* program overall, and a vigorous demonstration of support by the county's public school system. A goal for 2009-2011 is to have many or most these schools ready to consider application for *MD Green School* recognition in 2-3 years. A long-term goal is to have all schools PreK-12, public and private, in Baltimore County operating as *Green Schools*, many receiving full recognition as a *MD Green School,* and all recognized *MD Green Schools* re-applying regularly to maintain their status. Additionally, all outdoor education facilities and nature centers should operate and be recognized as *Maryland Green Centers*.

In 2008, the *Getting Greener Schools* efforts in Baltimore County resulted in 7 new schools were being recognized (6 public and 1 private):

> Dundalk ES, Jacksonville ES, Norwood ES, Pot Spring ES, Franklin MS, the Rosedale Center HS, Odyssey School

Eight previously recognized schools re-certified to maintain their *MD Green School* status:

Lutherville Lab ES, Seven Oaks ES, Sparks ES, Cockeysville MS, Towson HS, Western School of Technology HS, The Jemicy School.

Two new *MD Green Centers* were recognized:

Marshy Point Nature Center (a Baltimore County public facility managed by the Department of Recreation and Parks)

Herring Run Watershed Association, (a non-profit organization conducting programming in both Baltimore City and County).

The County sustains a working relationship with all Baltimore County's *Green Schools* and *Green Centers* and will assist the ones eligible for re-application in 2009 and 2010. By 2010, several will have re-applied for the second time, sustaining their operations 10 or more years, and will be eligible for "Emeritus" or "Model MD Green School" status.

The specific recognitions received by these schools and centers have been described in previous reports. Upon recognition, each is considered a mentor school or center and agrees to assist others in adopting sustainable operations.

This excellent program, *MD Green Schools/Green Centers*, as implemented in Baltimore County, continues to raise environmental awareness among school administrators, facilities managers, teachers, students, parents, school neighbors, and nature centers. It promotes and rewards the implementation of conservation best practices and environmental stewardship. Because of the prominent location of schools in all neighborhoods, *MD Green Schools* are highly visible models for other schools and the community at large. The federal Environmental Protection Agency (EPA), other governmental agencies, national organizations, and surrounding states and jurisdictions (VA, DC, PA, WVA, DE, OR, WI, SC, NC) continue to explore this program as a program model for implementation. Further information about the *MD Green School/Green Center* program is available on the MAEOE website: www.maeoe.org or Baltimore County DEPRM's webpage at www.baltimorecountymd.gov/go/deprm. Baltimore County benefits from statewide funding support for this program provided by MAEOE, MD DNR, Constellation Energy Group, Recreation Equipment, Inc. (REI), and NOAA-BWET.

Leadership in MAEOE: MAEOE, with its broad-based membership, is the preeminent environmental education organization in the State of Maryland. It provides a forum for the exchange of information, sponsors the *MD Green School Awards Program,* the *Schoolyard Habitat Partnership,* and maintains an informational website. MAEOE hosts an annual 3-day environmental education conference that is the largest state-level environmental education conference in the nation. Over 600 educators and environmental resource staff attend each year.

MAEOE
Maryland Association for Environmental and Outdoor Education

MAEOE's primary mission is to provide professional development for classroom teachers and non-traditional outdoor educators. In 2008, it piloted new initiatives to provide higher quality, more accessible environmental education for all students in Maryland. These include 1) the certification of non-formal environmental education teachers, and 2) partnering with other stakeholders to support local and national environmental education initiatives including the

Governor's Partnership for Children in Nature, signed April 22, 2008 and the national No Child Left Inside Act which passed in the House of Representatives September 19th, 2008. MAEOE is actively working with other state educators to develop a state level environmental literacy initiative.

Other School initiatives:

Outreach to independent schools, faith-based school systems and school organizations: An evaluation of the geographic distribution of *MD Green Schools* and the number of independent schools participating, led to an initiative to reach out to independent non-public schools and faith-based schools Pre K-12. A series of presentations at the Association of Independent Maryland Schools (AIMS) Conferences, the Baltimore Jewish Environmental Network (BJENS), and the biennial Catholic School Teacher's Conference were intended to reach these audiences. Currently, several Jewish schools and approximately 15-20 Catholic schools are in the process of adopting the MD Green School model. Completed applications for a number of these are expected in April 2009.

Outreach to schools serving students with special needs: Environmental education opportunities should be accessible to all students. In recognition of the fact that there are special circumstances that often limit the children with special needs from taking advantage of the more common opportunities to experience the environment, the county is exploring ways to reach more teachers at schools providing special services. DEPRM is working with the horticulture teacher at the Forbush School to develop a presentation plan to introduce the *MD Green School* model at the biennial conference of the Maryland Association of Nonpublic Special Education Facilities (MANSEF) in fall 2009.

Currently six local schools serving special needs populations have met the requirements and have been recognized as *MD Green Schools*. These include:

- The Forbush School at Sheppard Pratt Hospital System in Towson, sustaining its operations since 1999
- The Rosedale Center High School, BCPS, newly recognized in 2008
- The RICA School, located in Baltimore City but serving Baltimore County students
- The Odyssey School, Owings Mills, newly recognized in 2008
- Jemicy School, Owings Mills campus, sustaining operations since 2004
- The Harbour School, Owings Mills campus, sustaining operations since 2004

Anecdotal reports from the teachers involved, indicate that their *MD Green School* program experience provides alternative educational settings, increases learning outcomes, and provides other tangible benefits for students. A teacher from the Regional Institute for Children and Adolescents (RICA) in Baltimore City, reports that their *MD Green School* activities have resulted in major changes in student interest, appropriate behavior, and student achievement. The county continues to explore ways to make these opportunities available to more students countywide.

Environmental Career Exploration and Internships for High School and College Students: Exploring and promoting environmental careers continues to be part of the county's outreach to

students and the public. DEPRM staff participated in elementary, middle and high school level career fairs providing environmental career information and "practice" interviews. To support these efforts, staff used two fliers on the topics: *Internship Opportunities*, and *An Introduction to Environmental Careers, Job Titles, and Suggested Coursework.* These materials were available to schools and in the DEPRM lobby. "Take Your Child to Work Day" was celebrated in late April as an opportunity to introduce young people to environmental careers.

Again in 2008, several paid internships were available for local high school and college students. The internship opportunities at DEPRM offered students the opportunity to work with resource professionals and gain valuable experience in watershed planning and monitoring, GIS, education and outreach, environmental health, ground water and stormwater management, and agricultural preservation.

4.2.1.2 Outreach to Homeowners, Citizen Groups, Businesses, and Landscape Managers

DEPRM sponsored and supported a wide variety of interactive events for families, informational displays, and presentations highlighting water quality, stormwater topics, and stewardship opportunities. Through workshops, presentations, community meetings and festivals, contact with chambers of commerce, local coalitions, and individual businesses and trade associations, DEPRM sought voluntary commitments to the adoption of best practices and alternative landscape design and maintenance protocols to reduce the flow of pollutants to local waterways, drinking water reservoirs and the Chesapeake Bay.

Citizens were reached through multi-media presentations in a variety of settings in an effort to encourage the planning and installation of functional sustainable landscaping. Through DEPRM's Growing Home Campaign, the Urban Nutrient Management Workgroup, and the Chesapeake Conservation Landscaping Coalition, the department has access to representatives in the lawn care and nursery industries and the opportunity to contribute to presentations at trade shows and training workshops for these audiences. Increasingly in 2008, DEPRM sought opportunities to work through coalitions to affect policy decisions and strategic planning that will result in long term goals and objectives related to environmental protection and resource management.

Household Hazardous Waste Collection Events were held in spring and fall 2008. Approximately 2,300 drop-offs of a variety of hazardous materials were made. In addition, citizens were encouraged to drop off hazardous waste items at the County's Eastern Sanitary Landfill from April through October (see Section 3.5 for a summary of material collected). Education outreach materials were given out at each drop-off.

DEPRM hosted booths and interactive activities at numerous festival events in local neighborhoods and schools throughout the County. Tree planting, partnering with a local *MD Green School*, the BayScapes program, and conservation landscaping were topics highlighted at many community group meetings. DEPRM lent its support to local watershed organization events. Additional presentations were made to faith communities, youth groups, neighborhood associations, as well as at numerous opportunities to reach Countywide and regional audiences. A listing of community and school events is included in Appendix 4-1.

Baltimore County's Green Renaissance: In early 2005, the Baltimore County Executive announced the *Green Renaissance* Program. It involves a series of environmental initiatives to

ensure the protection of natural resources through increased collaboration with communities, businesses, government agencies, environmental groups, and the development community. Actions and initiatives included adopting the *Montreal Process-Criteria and Indicators* to develop a strategy for forest sustainability, the *Growing Home Campaign*, and the *Rural Residential Stewardship Project*. The goal of these efforts has been described in previous reports.

The *Maryland Green School Program* in Baltimore County is aligned with the *Green Renaissance* goals and objectives. In June 2008, the Baltimore County Executive invited principals, teachers, and students from the County's *Green Schools* and *Green Centers* to a garden reception. *Green Renaissance* citations were presented in recognition of their leadership and accomplishments. This event underscores the County's commitment and support for actions accomplished by schools through the *Maryland Green School* Program.

Conservation and Sustainable Landscaping information: DEPRM continued its literature distributions at educational events, festivals, the County's public libraries, schools, Department of Permits and Development Management, and DEPRM's lobby. BayScapes brochures were distributed by DEPRM's Environmental Impact Review, Critical Areas, and Marina sections. This brochure was provided in cooperation with The Alliance for the Chesapeake Bay (ACB).

DEPRM and the Alliance for the Chesapeake Bay sponsored the annual BayScaping awards as part of the 2008 Towson Gardens Day Festival. Two awards were presented to recognize installation of conservation landscaping on private property. In addition to the community award presentation, Towson Gardens Day in April was designated "Arbor Day in Baltimore County" by the reading of an official County Executive Proclamation. This day is also proclaimed "Take Your Child to Work Day", an opportunity DEPRM uses to introduce young people to environmental careers. In behalf of the citizens of Baltimore County, the County Executive accepted the National Tree City USA recognition.

New and Updated Materials: The following new materials were developed or updated: *Growing Home Campaign* materials, all *Maryland Green School Program* materials, "Household Hazardous Waste" program flyers, "Managing Yard Materials" flyer, and various informational PowerPoint and display presentations. Additional materials addressing topics such as pet waste, recycling, transportation issues, and landscape design and maintenance were obtained from other sources and distributed by the county.

Community Partnerships: In 2008, DEPRM strengthened its partnerships with local watershed organizations, adjacent jurisdictions, non-profit environmental organizations, and other county agencies to achieve common water quality and public education goals. Since the first signing of the *Baltimore Watershed Agreement* on October 3, 2002, Baltimore County has shared its databases and other resources. With the re-signing of the agreement, DEPRM staff provided presentations to Baltimore City public and private schools, other non-Baltimore County schools, and other regional audiences on over 80 occasions. DEPRM staff participated in the Herring Run Watershed Association (HRWA) education program planning workgroup. This group provided recommendations for a new community and school environmental education program unveiled at the opening of the new building in spring 2008. The HRWA provides site-based environmental education and technical support to schools and the community. The new building models best practices and sustainable operations with a green roof, and other features. The

building is LEED certified at the silver level. The Association was successful in its application for recognition as a *Maryland Green Center* in 2008.

Urban Nutrient Management Workshops: As part of DEPRM's contribution to the Urban Nutrient Management Workgroup (UNMWG), staff participated in the planning and promotion of nutrient management workshops targeting professional landscape managers and turf technicians on public and private landscapes. Staff provided information about DEPRM's integrated watershed approach to resource management, its monitoring programs, and its education and outreach activities, and provided contacts for the purpose of expanding participation on the group. MDA is represented on the *MD Green School* steering committee. The agency will assist in efforts to promote sustainable operations on school landscapes.

Communication media and County Webpage: In an attempt to reach a broader audience, environmental videos, program reports, and news items were broadcast in cooperation with the County Office of Communication and Comcast Cable. They aired on the County's cable channel 4-5 times each week both regularly and seasonally during 2008. A representative of Comcast Cable reports 240,000 local County subscribers. The County's E-News Stream, Baltimore County's BCPS Principal's Bulletin, and MAEOE's newsletter offered additional opportunities to reach other audiences. Tree program and *MD Green School* information and applications, pollution prevention messages, environmental careers, and additional program services were incorporated and updated on the department's website: www.baltimorecountymd.gov/go/deprm.

Other Community Outreach Efforts: DEPRM's environmental education program materials were made available through the county's 16-branch public library system, 17 senior centers, and Recreation and Parks facilities. Since 1994, DEPRM has provided many presentation programs for local garden clubs, Master Gardener's groups, scout troop meetings, and community events. To increase environmental awareness and promote responsible action, printed educational materials of interest to citizens, homeowners and businesses were provided in DEPRM's office lobby. Over 100 people pass through the area on an average workday. Specific titles have been listed in previous reports.

4.2.2 Program Use: As Baltimore County's environmental education opportunities and programs continue to evolve, they have remained popular and in demand by citizens, community groups, businesses, and schools. Regionally, they served as models for other communities and jurisdictions. The selection of events in 2008 was based upon the size and type of audience, the subject matter requested, and the likely degree of effectiveness in reaching desired pollution prevention environmental education outcomes.

In 2008, approximately 680 presentations carried various components of the county's educational messages. Over half were scheduled as a result of referrals or requests for return visits. Again this year, DEPRM made use of the County's cable channel to reach a broader audience through regular and frequent airing of videos produced by the County in cooperation with Comcast Cable and expanded its office lobby display to take advantage of the audience passing through the office each day. Regarding outreach to public and private schools, less emphasis was placed on direct individual classroom involvement with students and greater emphasis was placed on venues for site assessment, teacher training, facilities management, and school administration (public and private schools). Watersheds where comprehensive plans are being implemented

were targeted for program presentations as part of the County's integrated, comprehensive approach to watershed management.

The number of events accomplished in 2008 for specific watershed audiences is shown in Table 4-3. A majority of the audiences (75%) were located in 7 urban watersheds: Back River, Middle River, Baltimore Harbor, Patapsco, Loch Raven, Gwynns Falls, and Jones Falls. The Baltimore Harbor watershed is an area where population and high rate of imperviousness suggest significant urban impact on local water resources. The Baltimore Harbor Watershed Plan recommends increased efforts in public awareness, education, and outreach to citizens and groups in this watershed. In 2002, only one event specifically targeted audiences in this watershed. Increased efforts to reach audiences in this watershed and others in Baltimore County in 2008 are shown below. In 2008, an effort was made to conduct environmental outreach and education activities to reach citizens in all of the county's watersheds.

Table 4-3: Education Events Conducted for Residents of the County and Region by Watershed Audience, 2008

Watershed	# Events	Watershed	# Events	Watershed	# Events
Back River	**65**	Jones Falls	**52**	Patapsco	**35**
Baltimore Harbor	**21**	Liberty	**14**	Prettyboy	**6**
Bird River	**19**	Little Gunpowder	**13**	Countywide	**86**
Deer Creek	**5**	Loch Raven	**69**	Regional	**82**
Gunpowder River	**6**	Lower Gunpowder	**34**	International	**0**
Gwynns Falls	**40**	Middle River	**16**		

Presentations were made to a wide variety of groups. In 2008, DEPRM placed a special emphasis on school audiences, preK-12. Table 4-4 reports presentation events by type of audience.

Table 4-4: Education Events by Type of Audience*, 2008

Type of Group/Audience	# Events for each audience
Citizens, Community Groups or Associations*	126
Public Schools*	292
Private Schools*	117
Special Needs Education	8
College/University	2
Government Agency, facility, group	52
DEPRM Lobby, Duty room*	8,700
Public Library	32
Festival/Show	21
Conference, Workshop, Training sessions	61
Business	70
TV	7 tapings for multiple airing
International	0
Countywide	86
Regional	82

*Notes: Individual schools represented at conference and training events are increasingly tracked as a single entry for a public or private school audience. Contact with individual citizens (as opposed to groups) by phone or site visit often provides valuable and significant opportunity for environmental education and outreach; these conversations are not currently tracked. Access to lobby displays is estimated to be approximately 100 people/day; the number of conferences with DEPRM office duty room staff is estimated to be 25 people/day for 50 weeks. Some presentations and events addressed audiences that included several of the groups listed above and thus were entered in more than one category.

A general listing of program presentations conducted in 2008 is provided in Appendix 4-1. An additional listing of school presentations on the topic of "recycling" (conducted by the Baltimore County Department of Public Works, Recycling Division) is provided in Appendix 4-2.

By May 2009, over 40 events were accomplished or scheduled in advance for the 2009 reporting year. An additional 2,200 citizens have conferred with DEPRM staff in the Department's Duty Room.

Currently, all sections in DEPRM are involved in outreach at some level. In 2008, environmental education and outreach activities increased in scope and were supported by use of the web, local community newspapers, the County cable channel, departmental brochures, aerial map products, conferences, workshop presentations, professional development opportunities for teachers, and the development or redesign of several displays.

4.2.3 Program Accomplishments: Formal and informal mechanisms for evaluation and assessment of the county's education and outreach efforts are built into DEPRM's environmental education program. Informal user evaluations have contributed constructive suggestions for revision of the presentation materials and the method of delivery. Increased participation rates and repeated requests for services have provided indications of efficiencies in reaching targeted audiences with appropriate messages. Contact with Baltimore County public and private school teachers who have reviewed or used program components yielded valuable suggestions for improvement or enhancement. Continued requests for program components as a local and regional model, is an indication of the perception of program quality and effectiveness. Outcomes and products such as number and species of trees planted, acreage of raingardens installed, and other in ground projects accomplished by schools and communities are increasingly being tracked.

Indications of education program success in 2008 include:

- *Supporting research and anecdotal reporting leads to increased program participation:* A 2005 research study conducted by MAEOE comparing standardized test scores of *MD Green Schools* and non-*Green Schools* in Maryland found that students at *MD Green Schools* displayed a higher academic performance level in reading and math than those at non-*Green Schools* (MSA). After controlling for socioeconomic variables and the percent of students receiving special education services, a positive, statistically significant relationship between higher reading and math achievement was indicated. The increase in student achievement is attributed to factors inherent in the nature of environmental education. The full report is available online at www.maeoe.org. Follow-up studies are planned. Other studies described in past reports show similar results. School systems, headmasters and principals across the state and in Baltimore County are interested in these findings. Increasingly they have joined in support for more opportunities for environmental education at their school.

- *Getting Greener Schools* program: DEPRM has had notable success in its outreach to schools. As shown in Table 4-5, Baltimore County is a State leader in a number of recognized *MD Green Schools* during 1999-2008. Currently, 19% of *MD Green Schools* are located in Baltimore County. Through its leadership in MAEOE, Baltimore County serves in an advisory capacity for other jurisdictions on how to garner local support and develop partnerships that will result in the adoption of more sustainable operations at local schools and more recognized *MD Green Schools.*

Table 4-5: *Maryland Green Schools* by Jurisdiction 1999-2008

Maryland Jurisdiction	# Green Schools Awarded
Garrett	8
Allegany	2
Washington	2
Frederick	4
Baltimore City	10
Carroll	13
Howard	12
Harford	21
Anne Arundel	17
Baltimore County	38
Montgomery	20
Prince Georges	13
St. Mary's	3
Charles	6
Calvert	16
Queen Anne's	4
Worcester	4
Kent	2
Dorchester	1
Cecil	3
Wicomico	1
	Total: 200*

*Note: There are 4 *MD Green Centers* serving schools in Baltimore County and 17 additional centers around the state providing programmatic and technical support for these schools.

In 2008, DEPRM initiated green school-type activities at professional workshops and faculty trainings for many public and private schools around the county. For the past few years (2006-8) the rate of new schools certifying has held steady at a high rate of 6-7 schools/year. Approximately 10-15 local schools and centers are expected to be ready to apply or re-apply in April 2009.

Originally intended as a way to recognize, celebrate, and honor schools that engage in meaningful environmental education and stewardship, the *MD Green School Awards Program* in Baltimore County now serves as a model for how other schools and centers can extend learning into the community and watershed. The program has become an important mechanism for raising awareness and initiating new stewardship projects at county public and private schools and centers. Becoming recognized as a *MD Green School* changes the overall "culture" at the school and since 1999, thousands of local teachers and students have been involved. There were over 15,850 people directly involved in 2008. Table 4-6 reports the number of students, staff, and volunteers.

Table 4-6: Number of Participants in MD Green School Program in Baltimore County, 2008

Year	# Students	# School Staff	# Volunteers*	Total
New Baltimore County *MD Green Schools*, 2008	4,220	540	-	4,760
MD Green Schools re-certifying for 1st time	1,287	339	-	1,626

MD Green Schools re-certifying for 2nd time	5,612	553	-	6,165
New *MD Green Centers*, 2008	1,250	15	2,040	3,305
Total	**12,369**	**1,447**	**2,040**	**15,856**

Note: The number of volunteers at individual schools is not reported at this time, but known to be substantial.

As of April 2008, Baltimore County had an 83% success rate for re-application by eligible schools. Fifteen of the eighteen schools eligible for re-application by 2008 have sustained their operation as a *Maryland Green School* and successfully re-certified. The three public schools that were eligible but have not re-applied have experienced major changes in staff during the months or years following their initial recognition as a *MD Green School*. DEPRM, in cooperation with the BCPS Office of Science is working with these schools to support their efforts. Along with the steady rate of new schools certifying, the county's re-certification rate is an even more important tool to measure program success. It indicates to what extent schools have integrated program initiatives and sustained the effort over time. The County's rate exceeds the overall statewide rate, and is one of the most important and effective indicators of success.

- *Baltimore County Public Schools Green School Committee:* BCPS, working with DEPRM staff has adopted the policy of working to facilitate *MD Green School* operations at all public schools PreK-12 in the BCPS system. To date, 28 of the 165 public schools in the county have been recognized. This represents 17% of Baltimore County public schools. Through the efforts of DEPRM and the BCPS Office of Science, over 30 additional schools have begun the process. This is largely due to BCPS administrative support, an increase in presentations directly to school faculty, and the establishment of a formal committee to promote and support the *MD Green School* model.

- *Professional development:* Invitations for DEPRM staff to present at seminars and training workshops hosted or sponsored by other environmental organizations have increased both locally and regionally.

- *Facilities operations:* Through professional development sessions, staff meetings, and workshops, DEPRM has led the effort to highlight the important role played by facilities managers. Schools are encouraged to establish and maintain a dialogue with facilities managers and field technicians. The BCPS Office of Facilities reports favorable results from increased communication and awareness of grounds procedures and protocols. In 2008, BCPS Office of facilities and Grounds Management worked with BCPS Office of Science and DEPRM to be pro-active on plans to institute sustainable best management practices in school facilities and grounds and to more directly involve students and teachers.

- *Bringing environmental education opportunities to all children:* In 2008, *MD Green Schools* programs were initiated and/or sustained and supported at 6 public and private *MD Green Schools* serving Baltimore County children and adolescents with special needs. Other schools with under-served populations are also participating. Public displays and visual materials were designed to be accessible to diverse audiences and show that everyone participate and benefit from environmental education and outdoor activities.

- *School Building and Schoolyard projects:* Schoolyard assessments involving students and teachers and leading to projects and community landscape design and maintenance projects have resulted in an increase in general environmental awareness as well as turf reduction, tree and forest cover enhancement on school properties, bio-diversity, wildlife habitat, bio-retention and other SWM, sediment control and other environmental benefits. Since 1999, the 38 Baltimore County *MD Green Schools* and 4 *MD Green Centers* serving Baltimore County have accomplished over 750 projects on school properties or in local communities. Refer to Table 4-1 on page 4-6 and Table 4-2 on page 4-7 for examples of the activities accomplished by the schools awarded in 2008.

An increasing number of public and private schools show interest in adopting conservation landscaping principles, removing unused turf areas on their schoolyard campuses and replacing it with no-mow zones, planting trees, restoring habitat and addressing stormwater management issues. In recent years, over 400 local schools have sent staff to grounds workshops or expressed interest in habitat restoration. Most schools involved in projects in their schoolyard routinely coordinate actions with their facility/grounds manager. The workshops sponsored by MAEOE, CBF, and the Irvine Nature Center have provided valuable how-to technical support for these activities. In 2008, a series of "Grounds for Teaching" summer workshops included *MD Green School* program models and were specially targeted to Baltimore County teachers. They were well attended by both public and private school teachers. In 2009, this series will involve "train-the-trainer" workshops.

Program requests: In 2008, as in past years, program presentations were requested by a wide variety of groups. Almost 2,000 group presentations have been conducted since 1994, and an additional 6,250 individual departmental conferences per year occurred related to reduction of the environmental impact of proposed landscape alterations. County staff use these opportunities to provide information and suggest sustainable landscape design components and other best practices for use on private property. The County enjoys high rates of referral and invitations for return visits. In 2008, presentations were conducted as a result of requests from citizens, schools, groups, government agencies, non-profit organizations, other counties and agencies, and in watersheds specifically targeted by DEPRM.

- *Program model:* DEPRM's environmental educational presentations and materials continue to be requested by public and private schools K-12, colleges, local and regional organizations, and for training of teachers and group leaders. Many environmental education fact sheets and other materials have been used as models by other organizations and agencies.

- *Program partners:* In 2008, local and regional cooperative partnerships provided more opportunities to bring environmental education to a wider audience. A current list of program partners include:

Alliance for the Chesapeake Bay
Anne Arundel Co Outdoor School at Arlington Echo
Association of Independent Maryland Schools (AIMS)
Baltimore City schools and communities
Baltimore County Forestry Board
Baltimore County Government agencies
    Recreation and Parks

- Public Works, Recycling Division
- Baltimore County Public Library System
- Baltimore County Public Schools (BCPS)
  - Office of the Superintendent
  - Office of Science
  - Office of Facilities
- Baltimore County Senior Centers
- Baltimore Gas and Electric Company (BGE)
- Baltimore Jewish Environmental Network of Synagogues (BJENS)
- Boy Scouts of America
- Carroll County Outdoor School at Hashawha
- Chesapeake Bay Program
  - Urban Nutrient Management Workgroup
- Tributary Strategy Teams
- Chesapeake Bay Trust
- Chesapeake Conservation Landscape Coalition (CCLC)
- Chesapeake Covenant Congregations (CCC)
- Comcast Cable
- Community Colleges of Baltimore County (CCBC)
- Envirothon
- Federated Garden Clubs of Maryland
- Girl Scouts of Central MD
- Herring Run Watershed Association
- Irvine Nature Center
- Jemicy School
- Jewish Community Family Education Center
- Jones Falls Watershed Association
- Living Classrooms Foundation (LCF)
- Local and regional watershed associations
- Local Chambers of Commerce
- Local community associations and coalitions
- Local nurseries and garden centers (30)
- Marshy Point Nature Center
- MD Cooperative Extension (MCE)
- MD Association of Environmental and Outdoor Education (MAEOE)
- MD Department of Agriculture (MDA)
- MD Department of the Environment (MDE)
- MD Department of Natural Resources (DNR),
- DNR Forest Service, Tree-Mendous Maryland Program
- MD Landscape and Nursery Association
- MD Public Television
- MD State Department of Education (MSDE)
- MD State Fair
- Master Gardeners (outside Baltimore County)
- National Aquarium at Baltimore

North American Association for Environmental Education (NAAEE)
Oregon Ridge Nature Center
Pearlstone Conference and Retreat Center
Prettyboy Watershed Alliance
Professional lawn care industry
Towson Garden Day Committee
Schoolyard Habitat Providers Partnership
Soil Conservation Service
US Environmental Protection Agency
US Fish and Wildlife Service, Chesapeake Bay Field Office
US Forest Service
Towson University
Washington Suburban Sanitary Commission (WSSC)

- *Business Outreach and Green Industry:* Opportunities for continued dialogue with representatives of the lawn care industry provided through participation on the Urban Nutrient Management Workgroup have raised industry awareness concerning the connection between lawn care, pesticide applications, stormwater management, and water quality. Through the Growing Home Campaign, 30 local nurseries joined in partnership with the county to provide incentives to buy and plant tress on private home landscapes, effectively increasing the urban tree canopy. The Green Building Council, in an effort to reach out to local schools teamed up with MAEOE's *MD Green School* program to support installation of green building components in new buildings and retrofits and encourage teachers to use these changes on school properties as learning opportunities. Partnerships between businesses and hundreds of local schools both public and private provide ongoing opportunities to reach the business sector.

- *Public and Private Community response:* The increasing number of unsolicited requests for DEPRM's environmental education programs and materials, and the use of the county's program as a model indicate:

(1) Community interest in the environment in general, and water quality in particular is rising.
(2) Citizens want to know more about what they can do and which actions will make a difference.
(3) Citizens are ready to become active at home, at school, at work, and in their neighborhoods.
(4) Local public school administrators and supervisors have now integrated environmental and outdoor education in standard curricula. This integration is aligned with or exceeding the Voluntary State Curriculum (VSC) standards for Maryland.
(5) Many teachers now use the local environment as context for learning across disciplines and grade levels. It is BCPS policy to encourage and assist all of its 165 public schools in initiating sustainable operations according to the *MD Green School* model.
(6) There is an increased interest demonstrated by faith-based organizations and schools. Some host annual festivals, conferences, and workshops and have

expressed interest in assisting schools in adoption of sustainable operations and increased opportunities for environmental education.

(7) Businesses increasingly seek to adopt more sustainable operations both for financial savings as well as the inherent public relations benefit: Looking "greener" and being seen as a good neighbor environmentally. They are willing to partner with schools to support environmental education activities. Table 4-7 indicates number of community partnerships sustained by a sampling of the county's public *MD Green Schools* in 2008.

Table 4-7: Community and Business Partnerships Supporting Baltimore County's Public Schools recognized as MD Green Schools, 2008

Baltimore County School	# Community Partnerships
Dulaney HS	48
Lutherville Lab ES	15
Seven Oaks ES	5
Sparks ES	11
Towson HS	24

- *Curriculum development*: In direct response to the *MD Green School* Program model, the BCPS Office of Science has developed a series of curriculum changes for grades 3, 4, and 5. These Eco-trekkers and Eco-scout activities involve an increasingly sophisticated and challenging set of outdoor investigations and experiences built into the basic required curriculum for all students. DEPRM assisted in the professional development sessions provided to prepare teachers for these new initiatives. They were developed to align with the *MD Green School Program* and are an indication of the extent to which the school system supports environmental education.

- *Venues, participation, and materials distributed*: In 2008, shifts in program emphases, demand, audience availability, method of delivery, and some program components have resulted in the changes noted in Table 4-8 below.

Table 4-8: Presentations, Participants, and Materials, 1994-2008

Year	# Presentations and Events	# Participants	# Literature Distributed
1994	4	100	387
1995	16	414	1,036
1996	22	1,009	2,576
1997	89	4,889	13,519
1998	107	12,415	18,128
1999	79	15,141	18,243
2000	112	21,191	21,178
2001	147	29,193	36,378
2002	165	224,800	32,000
2003	172	425,642	34,301
2004	174	309,030	35,320
2005	155	290,000	20,000
2006	166	317,170	20,100
2007	246*	373,950*	23,422
2008	683	352,419	52,197

* With this report and subsequent reports, the total number of presentations and participants include additional presentations made by the Baltimore County Department of Public Works, Recycling division. Literature distribution to schools by that Department is included from 2008 forward.

4.2.4 Secchi Disk Monitoring Program

In the summer of 2007 Baltimore County contracted with Bayland, Inc. for the development of a Citizens Secchi Disk Monitoring Program. This program was piloted for two summers with the communities along the tidal waters of Bird River. The citizens each received a monitoring disk, a training session and an instruction guide. A web page was created for them to enter their data and to send questions as they occurred. DEPRM is currently evaluating the success of the program to determine its usefulness as a monitoring program and citizen outreach activity.

4.2.5 The Stream Watch Program

The Stream Watch Program is intended to develop citizen stewardship through participation of citizen volunteers in the program who actively assume the role of caring for segments of the stream network by observing changes in the system, by providing stream clean-ups, and participating in planting activities. The Stream Watch Program also includes identification of potential restoration projects for possible inclusion in the Waterway Capital Improvement Program and provides a valuable addition to our Illicit Connection Program through reports by Stream Watch participants.

The Stream Watch Program is being implemented throughout the County with the *Watershed Association Restoration Planning and Implementation Grant* program (Section 4.2.6, below). One of the provisions of the grant is to administer the Stream Watch Program in the organizations activities. The County provides support to the watershed associations for implementation of the Stream Watch Program. This includes field training and use of the GIS system for stream reach segmentation.

4.2.6 Watershed Association Restoration Planning and Implementation Grant Program

At the end of 2004 the County developed a new grant program entitled, *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide funding for staff time to participate in County restoration planning, support for the Stream Watch program, identification of restoration projects, implementation of restoration projects, educational activities, and the ability to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects. Measurable successes of this program are listed in Chapter 7.

Eligible organizations must meet the following qualifications:

- The organization must be a locally based Watershed Association with membership in Baltimore County.
- The organization must have 501(c)(3) private, non-profit status.
- The organization must have a demonstrated history of identifying and conducting citizen based restoration projects.

4.2.7 The Baltimore Watershed Agreement

Baltimore County and Baltimore City have renewed their commitment to work together to protect and restore shared watersheds. The *Baltimore Watershed Agreement* was signed October 2002 and re-affirmed in 2006. The new agreement calls for workgroups in five topic areas: trash, public health, stormwater, greening, and redevelopment. Baltimore County and Baltimore City completed the development of goals for each of the five topics in 2007. In 2008 an Action Strategy Plan was developed and presented to the Committee of Principals on March 13, 2009.

4.2.8 Tree-Mendous Maryland Program in Baltimore County

Baltimore County continues to partner with the MD DNR to actively promote the Tree-Mendous Maryland Program. This state administered tree planting program is designed to provide citizens, schools, and community groups with an inexpensive way to obtain mostly native tree and shrub species for planting on public street tree easements, other public lands, and within community open spaces. DEPRM aggressively promotes the program in Baltimore County through twice-yearly, traditional and electronic mailings to over 800 individual citizens, schools, greening committees, and other interested groups. Each spring and fall, DEPRM provides assistance to groups and individuals planning tree-planting projects in the County. This may include technical advice, information about required permits, project coordination, and free tree delivery. Telephone and e-mail contact with citizens and "greening" committees is made to underscore the need for careful planting, watering, and maintenance, while frequent contact between DEPRM and the DNR staff is maintained to ensure a smooth delivery process.

In 2008, DEPRM provided technical assistance and received requests for free delivery of 18 orders, totaling 466 trees. A major benefit of the Tree-Mendous Maryland Program, as expanded and enhanced in Baltimore County, continues to be citizen education. Contact with citizens, schools, and greening committees provides opportunities to increase environmental awareness, especially concerning the value of trees and forests for managing water movement in watersheds. Tree planting and mulching demonstrations, seedling donations, and education programs for school children and communities are offered as a complimentary component to the *"Let's Be Partners..."* program. The Maryland DNR honors community tree planting efforts with annual *Maryland PLANT (*People Loving and Nurturing Trees*) Community Awards*.

In addition, Baltimore County's *Green Schools* Program in partnership with the Tree-Mendous Maryland program, provides participating schools with free trees at a 1:1 match for every Tree-Mendous tree purchased for planting on the school properties or on community open space. In 2008, three Baltimore County public schools benefited from participation in the *Green School* program by receiving 44 free trees, doubling the number of trees enhancing the ecological and aesthetic value of school properties. Data on the number of trees/year can be found in Section 7.

4.2.9 The Baltimore County Forest Conservancy District Board

Urban, suburban, and rural forests play an important role in the protection and enhancement of the County's water resources. For over 50 years, volunteers serving on the Forestry Boards in Maryland have been working to sustain valuable forest resources. Forestry Boards have always realized the value of forests in providing forest products. In recent years, Baltimore County's Forestry Board has also recognized a growing awareness of the ecological values and benefits of trees and forests for retarding soil erosion, recycling nutrients, improving water quality,

providing essential habitats for the region's forest-dependent wildlife, and for adding beauty to the landscapes of the region.

This Board has provided leadership for environmental improvement throughout the County through its tree planting and maintenance events and through its educational programs and opportunities highlighting watershed protection and the benefits of trees and forests. In recognition of the value of these programs, Baltimore County DEPRM has provided support through annual financial grants to the Board. Certain programs, developed and implemented in cooperation with the Maryland DNR and with the support of DEPRM, offer excellent opportunities for environmental education. A brief summary of Forestry board activities includes the following:

- Promotion of and support for community "greening," and for the state-sponsored Tree-Mendous Maryland Program;
- Participation in the Department of Parks and Recreation forest buffer restoration activities, Senior Expo, BCPS Advanced Placement and MD State Fair events
- Maintenance of the Board's website www.bcfb.sailorsite.net/ providing a range of information on tree and forests topics.
- Contribution of funds to the Maryland Smokey the Bear fire prevention campaign;
- Donation of scholarships annually for three high school students interested in environmental science careers to attend the annual Natural Resources Career Conference at Camp Hickory in Garrett County, Maryland;
- Distribution of seedlings in cooperation with DNR;
- Processing of the 2008 Tree City USA award for Baltimore County's commitment to a community forestry program, a forest and tree conservation ordinance and set of regulations, support of the County's Forest Conservancy District Board's environmental education programs, and an annual Arbor Day celebration;
- Facilitating the annual *Maryland PLANT Community* award: a DNR recognition program, recognizing the greening committees, schools, and groups that meet established criteria. This award is automatically presented to recipients of the Tree City award;
- Providing technical assistance and tree donations to school groups for planting projects at County parks;
- Providing technical assistance and donations of soils and fertilizers to schools for planting projects on school properties;
- Working with the Baltimore County Department of Education, the Natural Resources conservation Service (NRCS), and DEPRM in the Annual Envirothon Science Competition. Annual topics include forestry, soils, wildlife, aquatic and a fifth rotating topic on current pertinent issues, some of which have included wetlands, agricultural lands preservation, cultural landscapes, exotic, invasive species, natural resource management in urban environments, and in 2008, Recreational Impacts Upon Natural Resources. Since 2000, DEPRM staff has served as teaching experts in training sessions for Envirothon participating students in the aquatics and fifth rotating issue topics.
- Serving on the steering committee for DEPRM's forest sustainability initiative using the Montreal Process criteria and ecological indicators;
- Developing an urban forestry scholarship program in partnership with the University of MD. Providing support for the annual Envirothon competition for high school students

4.2.10 The Baltimore County Growing Home Campaign

The *Growing Home Campaign*, Baltimore County's urban tree planting and education project, was introduced to the public in spring 2006 and expanded regionally in 2007 and 2008 to include Baltimore City, as part of the Baltimore Watershed Agreement, and Harford County. The *Growing Home Campaign* is an innovative approach to expanding urban tree canopy on residential properties in the County. As a successful public-private partnership between Baltimore County, local retail nurseries and garden centers, and homeowners, the *Campaign's* goal since inception in Spring 2006 is to motivate homeowners to plant 10,000 new trees on residential property. *Growing Home* addresses behavior change at the homeowner level through (1) targeted homeowner education about planting native and other selected urban-tolerant trees in private yards, and (2) a financial incentive in the form of a $10 discount coupon redeemable toward the cost of a qualifying tree with a retail cost of at least $25 purchased from a local participating nursery or garden center. The coupons also serve as a mechanism to track the success of the *Campaign* to add trees to targeted tree deficient areas by geo-coding information and mapping the results using GIS software. Data on the number of trees planted by watershed can be found in Section 7.

The overall goal of the *Growing Home Campaign* is to increase much needed tree cover in Baltimore County, especially in the urban areas of the County. Older Baltimore County communities within the Urban Rural Demarcation Line (URDL) are in great need of additional trees. Baltimore County has identified target areas within the County's URDL where there is an existing tree deficit and an in depth assessment of the urban tree canopy in Baltimore County is currently being completed. Residential land comprises approximately 72% of the total land cover within the County's Urban Rural Demarcation Line (URDL). Recent studies show that the best opportunities for increases in Urban Tree Canopy in the County are available on private land therefore planting on residential property is crucial to successfully increasing the County's Urban Tree Canopy.

Homeowner outreach for the *Growing Home Campaign* includes comprehensive education about the value of adding trees within existing neighborhoods, guidance about site considerations and species selection, and tree planting and maintenance instructions. Also included is information on the multiple environmental benefits of planting trees including: (1) slowing stormwater runoff and reducing the cost of controlling stormwater, especially in urban areas, (2) reducing erosion, (3) filtering air and water by absorbing air pollutants and fertilizer and pesticide runoff. The educational information is distributed as a printed brochure that is widely distributed throughout the County and on the *Growing Home Campaign* website www.growinghome.info .

Homeowners play an important role in the *Campaign* by 1) purchasing trees to plant in their yards, and 2) transporting, watering and maintaining the trees. Local nurseries play an important role in the *Campaign* by 1) contributing a cost share of $5 for each reimbursed coupon, 2) promoting tree planting, 3) stocking a diverse selection of trees that are appropriately sized and priced for the average homeowner to transport and plant, and 4) offering customers knowledgeable horticultural advice about their tree selections. The *Growing Home Campaign* supports local retail nursery businesses and provides education about trees and tree purchase discounts for homeowners. During 2008, the *Campaign* also leveraged about $19 of total private sector investment per dollar of County cost share funds. Coordination of the program and

printing costs were funded in 2008 through an Urban Greening Grant from the Chesapeake Bay Trust.

4.2.11 Additional Educational Efforts

In addition to the activities described above, DEPRM staff acted on potential opportunities for informal environmental education as they became possible through contact and interaction with citizens.

As citizens routinely visit DEPRM for permits or development review, the opportunity is used to share environmental information and make recommendations. Over 100 telephone calls and email messages per week resulted in opportunities to answer questions and provide environmental education. Responses by phone, fax, email, and traditional mail were followed information packets available on the webpage, faxed, or sent through the mail. Recycling and grasscycling actions were promoted in the *Let's Be Partners* education program and detailed information was distributed by the Baltimore County DPW, Bureau of Solid Waste Management, Recycling Division. Substantial support was provided by the county to local watershed associations in the form of grant funding, organizational guidance, identification of stakeholders, training, educational presentations, brochures, data, GIS maps, and participation at local festival events.

Brochures, maps, and specific information promoting citizen education on the topic of stormwater pollutants were also distributed by staff in the following DEPRM sections: Waste Management, Environmental Health, Watershed Management and Monitoring, Field Operations, Capital Improvement, Environmental Impact Review/Critical Areas/Marinas, Stormwater Engineering, and Groundwater Management.

4.3 Summary

Baltimore County has implemented its education programs for reducing the use of pesticides, herbicides and fertilizers, controlling of stormwater pollutants, increasing tree canopy and disposing of toxic wastes. Its initiatives and programs are multi-faceted and developed for flexibility so that the message may be easily adapted to a variety of educational settings involving school administration and staff, facility managers, students, homeowners, community groups, watershed coalitions, faith communities, and businesses in various geographic settings around the County and region.

A number of important new components and materials have been developed or enhanced in order to better reach certain target audiences. Through local initiatives by individual watershed organizations, the *MD Green Schools/Green Centers* initiatives, and special professional development projects for school staff, continued emphasis has been placed on institutional landscape design, maintenance, and conservation landscaping concepts such as the benefits of native plants, integrated pest management (IPM), and removal of impervious surfaces. Pet waste, grass clippings, improper application of fertilizer, and other sources of nutrients in urban and suburban neighborhoods have been highlighted.

In its broad-based school initiatives, DEPRM has shifted emphasis from hosting individual classroom events to teacher training, outreach to supervisors and facility staff, and working with community coalition groups and businesses to foster new partnerships, provide a wider range of services, and reach more citizens.

Partnerships with other Baltimore County offices and agencies enhanced the level of communication, avoided duplication of services, and increased overall effectiveness and efficiency. Supporting materials developed by the department and by outside organizations were distributed at many venues. Volunteer citizen participation in pollution prevention and stewardship was promoted in all components of the program.

Options for program modification, expansion, and new tracking and evaluation strategies are being reviewed and the update is ongoing. Recommendations resulting from the current program assessment will guide future program implementation. Continued expansion of the partnerships involving businesses and schools throughout the County is planned for 2009. New school populations on the east and west sides of the County will be targeted for increased education and outreach. Targeted outreach to private independent and parochial schools as well as schools serving children with special needs will be conducted. New opportunities to increase awareness, interact with school administration at all levels, and affect policy will be pursued. Potential *MD Green Centers* will be targeted.

In 2008, many components of Baltimore County's *Let's Be Partners/Getting Greener Schools* program were used as a models for program development by other counties, agencies and jurisdictions. The County continues to be a leader in providing effective, innovative environmental education and outreach to its citizens, schools, and organizations.

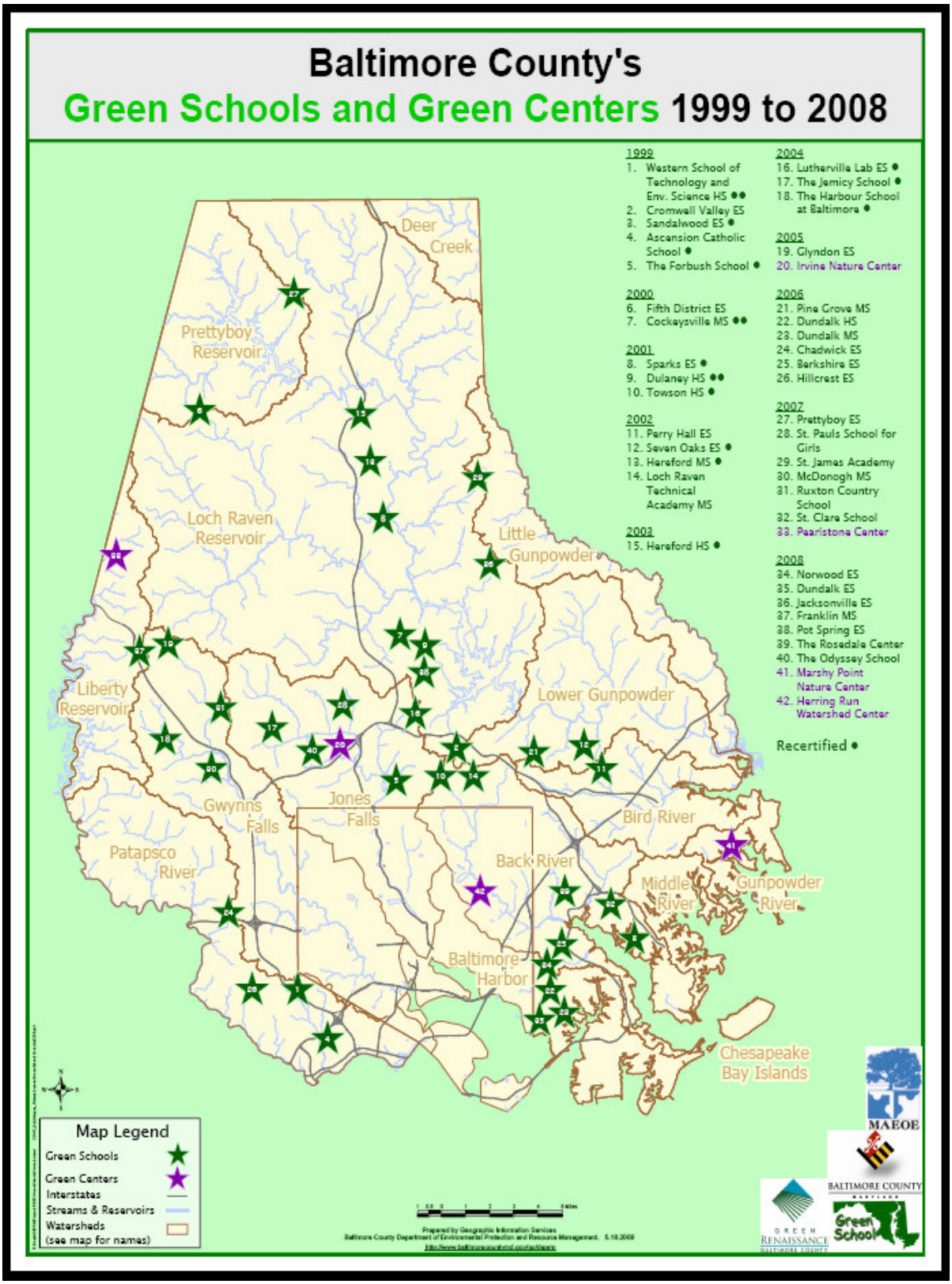
As stated in the Bay agreement, Chesapeake 2000,

> The Chesapeake Bay is dependent upon the actions of every citizen in the watershed, both today and in the future. We recognize the cumulative benefit derived from community-based watershed programs is essential for continued progress toward a healthier Chesapeake Bay.

Paralleling the tenets of the Bay agreement, Baltimore County continues to:

- Make a significant commitment to education, outreach, and stewardship.
- Provide the information and assistance that citizens need to act at home, at school, at work, and in their local watersheds.
- Use new communication technologies, such as the worldwide web and cable television, to provide information for citizens, businesses, and schools.
- Promote and facilitate meaningful outdoor interactive and investigative environmental experiences for young people.
- Provide programmatic models for the state and region.
- Work in partnerships to provide valuable assistance to public and private schools.
- Work towards "government by example," that is, the implementation of conservation design strategies and sustainable landscaping techniques on publicly owned and managed properties to serve as models for the community.

Exhibit 4-1: Baltimore County's *Maryland Green Schools and Green Centers*, 1999-2008



Appendix 4-1: Presentations, Distributions, and Events, by Watershed, 2008

DATE	ORGANIZATION	LOCATION	WATERSHED (Audience)	# PEOPLE
Jan-Nov	Lobby Display (6 topics) Ongoing throughout 2007	Towson	Countywide, Regional Jones Falls	2,450
Jan-Dec	DEPRM Duty Room	Towson	Countywide	6,250
Jan-Dec	Comcast video: "Down to Earth"	Countywide	Countywide, Regional	Est 130,000
Jan-Dec	Comcast video: "Our Land Our Legacy"	Countywide	Countywide, Regional	Est 130,000
Jan-Dec	BC Public Libraries (16): GHC	16 branches	Countywide	6,000
Jan-Dec	All Baltimore Co Senior Centers: GHC	17 locations	Countywide	1,600
Jan-Dec	All BC Park and Rec Facilities: GHC	16 facilities	Countywide	1,600
Jan-Dec	Baltimore Co MD Green Schools and Green Centers (potential and currently recognized): GHC	50 schools and centers	Countywide	380
Jan-Dec	MD AG Extension: GHC	Cockeysville	Countywide	100
Jan-Dec	Outreach to Watershed Associations (6): GHC	multiple		
			Herring Run-Back	500
			Jones Falls	200
			Patapsco	300
			Gunpowder , LR, Little GP, Lower GP	900
			Prettyboy	500
			Bird R	30
Jan-Dec	Community and Agency Outreach: GHC			
	Towson University	Towson	Jones Falls	100
	Valley Planning		Jones Falls	25
	Chesapeake Bay Foundation	Annapolis	Regional	300
	Greenbrier Garden club	Towson	Back R, Low Gunpwder	25
	MDE	Baltimore City	Regional	50
	Fran Flanigan			50
	National Aquarium	Baltimore City	Regional	200
	MD Science Center	Baltimore City	Regional	200
	Irvine Nature Center	Owings Mills	Gwynns Falls	150
Jan-Dec	Community Associations: GHC			
	Ruxton-Riderwood	Ruxton	Jones Falls	50
	Woodholme	Woodholme	Jones Falls	100
	Charlesbrooke	Towson area	Jones Falls	150
	Pot Springs	Timonium	Loch Raven	175
	Greater Towson Community Council	Towson	Jones F, Back R	160
	Dundalk	Dundalk	Baltimore Harbor	50
	Rodgers Forge	Towson	Jones F, Back R	50
	Bird River	White Marsh	Bird R	30
	Mt Washington	Baltimore City	Regional	50
Jan-Dec	DEPRM Office: GHC		Countywide	1,200

Jan-Dec	Business Outreach to Nursery Retailers (48): GHC	Countywide	Countywide	2,290
Jan-Dec	Outreach to Faith-based Groups: GHC Beth-EL Central Presbyterian St. Vincent de Paul Caring for Creation-Episcopal BJENS: Ricky Gratz	 Pikesville Towson Baltimore City Pikesville	 Jones F Jones F, Back R Regional Jones Falls Jones Falls	 75 50 50 50 50
Jan-Dec	Baltimore County Council: GHC	All districts (7)	Countywide	900
Jan-Dec	Greater Baltimore Realtors: GHC		Countywide	700
Jan-Dec	All Baltimore County Agencies: GHC		Countywide	2,600
Jan-Dec	Baltimore County Office buildings: GHC	Towson	Jones F, Countywide	200
01/02/08	St Pauls School for Boys	Brooklandville	Jones Falls	2
01/07/08	Marshy Point Nature Center	Chase	Gunpowder River	20
01/08/08	Baltimore City Office of Sustainability	Towson	Regional	2
01/09/08	Balto Jewish Env Netw of Synagogues (BJENS)	Pikesville	Jones Falls Countywide, Regional	85
01/14/08	Millbrooke ES	Pikesville	Gwynns Falls	60
01/14/08	Norwood ES	Dundalk	Back R, Balto Harbor	10
01/15/08	MAEOE Communications grp	Towson	Regional	10
01/16/08	BCPS Facilities (outdoor) BCPS Office of Science	North Bay	Countywide	6
01/17/08	St Pauls School for Boys	Brooklandville	Jones Falls	3
01/23/08	Eastwood ES Faculty	Dundalk area	Back River	6
01/23/08	MDPC-CCC	Providence	Lower Gunpwder, LR	10
01/25/08	Central MD AG Vegetable Day	North County	Prettyboy, Loch Raven, Liberty, Deer Creek	125
02/01/08	MAEOE GS Workshop: (20 schools) Lutherville Lab ES, Loyola Blakefield, Westowne ES, Notre Dame Prep HS, Krieger-Schechter Day	Cumberland	Jones Falls, Loch Raven, Patapsco, Lower Gunpowder, Countywide, Regional	65
02/02/08	MAEOE GS Intro Sessions (23 schools) Krieger-Schechter Day, Beth Tfiloh, Rosedale Center, Sparks ES,	Cumberland	Jones Falls, Back R, Loch Raven, Countywide, Regional	50
02/02/08	MAEOE GS/Center Roundtable	Cumberland	Countywide, Regional	60
02/02/08	MAEOE GS Display	Cumberland	Countywide, Regional	550
02/02/08	MAEOE GS Pre-review: (10 schools) Franklin MS, Jacksonville ES, Rosedale Cntr HS	Cumberland	Liberty, Gwynns Falls, Loch Raven, Back R., Little Gunpowder, Countywide, Regional	32
02/04/08	Timonium ES	Timonium	Loch Raven	85
02/05/08	Bridges Montessori School	Towson	Loch Raven Lower Gunpowder	6
02/13/08	EE Legislative Breakfast	Annapolis	Regional	100
02/14/08	BCPS Facilities (indoor) BCPS Office of Science	Middle River	Countywide	7

02/21/08	Chesapeake Covenant Congregations	Towson	Loch Raven Lower Gunpowder	10
02/24/08	Jewish Youth Philanthropy	Rockville	Regional	25
02/27/08	Dundalk MS Parents	Dundalk	Baltimore Harbor	125
02/27/08	Logan ES Faculty	Dundalk	Baltimore Harbor	70
02/29/08	MD Home and Garden Show	Timonium	Countywide, Regional Loch Raven	1000
03/01/08	Baltimore Watershed Conference	Towson	Countywide, Regional Loch Raven	200
03/01/08	Maryland Home and Garden	Timonium	Countywide, Regional	1000
03/02/08	Maryland Home and Garden	Timonium	Countywide, Regional	1000
03/03/08	Timonium ES Faculty	Timonium	Loch Raven	15
03/04/08	Septic System Event: Prettyboy ES (Hobner)	North County	Prettyboy	40
03/05/08	Lutherville Lab ES GS Re-ap	Lutherville	Jones F, Loch Raven	6
03/06/08	Chesapeake Covenant Congregations MPC	Towson	Loch Raven Lower Gunpowder	10
03/08/08	BCPS High School Science STEM Fair	Timonium	Countywide Loch Raven	500
03/10/08	Logan ES Faculty	Dundalk	Baltimore Harbor	125
03/11/08	MD DNR	Annapolis	Regional	6
03/12/08	Towson Gardens Day Committee presentation	Towson	Jones Falls, Back R Lower Gunpowder, Loch Raven	15
03/13/08	Dundalk MS Science Night	Dundalk	Baltimore Harbor	350
03/17/08	BCPS Facilities BCPS Office of Science	Middle River	Countywide	8
03/18/08	Newtown ES	Owings Mills	Gwynns Falls	5
03/18/08	Eastern Tech HS	Essex/Middle R	Back R, Middle River	25
April (month)	Hello Baltimore County TV Show	Countywide Broadcast	Countywide	3,000 est
April (month)	CNN Newsmakers (GH Campaign)	Regional Broadcast	Regional	3,000 est
Apr-Nov	HHW Drop-off event	Eastern	Countywide	1000
04/01/08	Envirothon School teams: TBA (7 schools) Eastern HS Kenwood HS Perry Hall HS Dulaney HS New Town HS Owings Mills HS Franklin HS	Camp Pu'tuk	Low Gunpwder, Bird R Little Gunpwder Middle R, Back R Middle R, Back R Bird R, Low Gunpwder LR, Little Gunpwder Patapsco, Gwynns Falls Gwynns Falls Gwynns F, Liberty, LR	64
04/02/08	Urban Forest Project	Baltimore City	Regional	50
04/02/08	Alliance for the Chesapeake Bay	Countywide	Lower Gunpowder Jones Falls, Loch Raven	1

04/03/08	Envirothon 9 School teams: Sparrows Pt HS (2) Patapsco HS Chesapeake HS Hereford HS (1.5) Western Tech HS (1.5) Catonsville HS Towson HS	Camp Pu'Tuk	Loch Raven Balto Harbor, Back R Patapsco Middle, Back R L R, Deer Cr, Liberty Patapsco Patapsco Jones F, Back R	61
04/04/08	Forestry for the Bay (agencies)	Oregon Ridge	Regional	75
04/05/08	Project Clean Stream	Many sites	Countywide	1200
04/09/08	Pinewood ES Faculty	Lutherville	Loch Raven	75
04/10/08	Campus Hills Community	Towson	Lower Gunpwder, LR	30
04/10/08	Western School of Tech Career event	Catonsville	Patapsco	30
04/11/08	Growing Home Kick-Off for Community and Agency Partners	Baltimore City	Countywide/Regional	60
04/12/08	CCC Annual Mtg	Upper Marlboro	Regional	40
04/13/08	Household Hazardous Waste Day	Cockeysville	Countywide	1200
04/17/08	Green School Application Review	AA Co	Regional	35
04/18/08	Bill Seibel's Clean-up event	Middle River	Middle River	20
04/19/08	Girl Scout Countywide Tree event	Camp Pu 'Tuk	LR, Countywide	125
04/22/08	Middleborough ES Career event	Middle River	Middle River, Back R	60
04/22/08	Timonium ES Career Event	Timonium	Loch Raven	30
04/22/08	Baltimore County Social Services	Towson	Countywide	50
04/22/08	(3) Towson Gardens Day/Arbor Day in BC/Take Your Child to Work Day	Towson	Jones Falls, Countywide Regional	1000
04/22/08	Ag Earth Day event (USDA, Soil Conservation Service)	North County	Regional, Loch Raven, Liberty, Prettyboy	200
04/23/08	Envirothon Competetion (18 school teams) Eastern Vo-tec HS Pikesville HS New Town HS Owings Mills HS Western HS Woodlawn HS Hereford HS (1.5) Dulaney HS Towson HS Perry Hall HS (2) Sparrows Point HS (2) Chesapeake HS Kenwood HS Franklin HS Catonsville HS	Days Cove	Low Gunpwder, Bird R Little Gunpwder Middle R, Back R Jones F Patapsco, Gwynns Falls Gwynns Falls Patapsco Gwynns Falls LR, Deer Cr, Liberty LR, Little Gunpowder Back R, Jones Falls Bird R, Low Gunpwder Balto Harbor, Back R Middle R, Back R Middle R. Back R Gwynns F, Liberty, LR Patapsco	130
04/25/08	Eastwood ES Faculty	Eastpoint area	Back River Baltimore Harbor	100

04/25/08	Citizen Volunteer Rep Sherriff's Office	Towson	Loch Raven	1
04/25/08	Dundalk Community College	Dundalk	Baltimore Harbor	100
04/27/08	Eco-Fest	Druid Hill Park	Regional	1000
05/02/08	Seven Oaks ES E-Celebration	Perry Hall	Lower Gunpowder Bird River	500
05/05/08	Pinewood ES Faculty	Timonium	Loch Raven Little Gunpowder	80
05/17/08	BCPS Elementary STEM Fair	Randallstown	Countywide Gwynns Falls	1200
05/19/08	Jacksonville ES Site Assessment w/BCPS	Jacksonville	Loch Raven	25
05/21/08	DEPRM Duty Room (BayScapes and Yard Materials info)	Towson	Countywide	125
05/29/07	MAEOE MD GS Ceremony: (68 schools, 6 Green Centers, 9 local BCo) Marshy Point, HRWA, Dundalk ES, Franklin MS, Pot Spring ES, Jacksonville ES, Norwood ES, Rosedale Sch, Odyssey Sch,	Catonsville	Little Gunpowder, Loch Raven, Gunpowder R, Balto Harbor, Back R, Jones Falls, Regional	450
06/04/08	County Executive's Reception for the County's GS Principals and Agency Partners (38 schools and 4 centers)	Towson	Countywide; Regional (8) Back R; (7) Gwy F (4) Patapsco; (7) Jones F; (2) Liberty (4) Balto Hrbor (1) Gunpowder R (1) Little Gunpwder (1) Prettyboy; (11) LR (4) Lower Gunpwder	230
06/10/08	Baltimore County Waterfront Festival	Middle River area	Countywide	2000
06/17/08	SWAP Stakeholders	Lutherville	Jones Falls Baltimore City	42
06/18/08	MD Green Schools Summit	Kings Landing	Regional	75
06/23/08	BCPS Teacher Training	Towson	Countywide	35
06/23/08	"Grounds for Teaching" Workshops	Baltimore City Cylburn	Countywide, Regional	30
06/24/08	"Grounds for Teaching" Workshops	Cromwell Valley	Lower Gunpowder, Countywide, Regional	30
06/25/08	"Grounds for Teaching" Workshops	CBF	Countywide, Regional	30
06/26/08	"Grounds for Teaching" Workshops	Marsh Point	Gunpowder R, Countywide, Regional	30
06/27/08	"Grounds for Teaching" Workshops	Western Tech	Patapsco, Countywide, Regional	30
06/30/08	Student Volunteer Presentation		Regional	40
07/07/08	"Grounds for Teaching" Workshops		Gunpowder R, Countywide, Regional	30
07/08/08	"Grounds for Teaching" Workshops		Lower Gunpowder, Countywide, Regional	30
07/08/08	Roland Park ES: Janet Felston	Baltimore City	Regional	20

07/08/08	WYPR Dan Rodericks Radio/Interview	Baltimore City	Countywide, Regional	1,500 est
07/09/08	"Grounds for Teaching" Workshops		Countywide, Regional	30
07/10/08	"Grounds for Teaching" Workshops		Countywide, Regional	30
07/10/08	BJENS: Rosellen Fleishman	Pikesville	Countywide	12
07/11/08	"Grounds for Teaching" Workshops		Gunpowder R, Countywide, Regional	30
07/17/08	Cromwell Valley Park/Master Gardeners/Park Volunteers	Hampton area	Lower Gunpowder	30
07/18/08	Artscape: Growing Home Campaign	Baltimore City	Regional, Countywide	300
07/19/08	Artscape: Growing Home Campaign	Baltimore City	Regional, Countywide	300
07/20/08	Artscape: Growing Home Campaign	Baltimore City	Regional, Countywide	300
08/5/08	Chartley Community Event	Chartley	Gwynns Falls, Liberty	500
08/07/08	Howard County Conservancy GS workshop	Woodstock	Regional	250
08/07/08	Lexmark Corp Partnership for MD GS	Woodstock	Regional	4
08/13/08	Irvine Nature Center: Green Center Partnership	Owings Mills	Countywide, Jones F Gwynns Falls	25
08/19/08	SWAP presentation	Towson	Jones Falls, Back R	10
08/19/08	Green Building Council presentation	Severna Park	Regional	6
08/22/09	Irvine Nature Center	Owings Mills	Countywide, Jones F Gwynns Falls	10
08/22/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/23/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/24/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/25/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/26/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/27/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/28/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/29/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/30/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
08/31/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
09/01/08	MD State Fair:GHC/Tree-mendous MD	Timonium	Loch Raven Countywide, Regional	1000
09/02/08	BCPS School ES Workshop for: Sussex, Sandalwood, Hebbville, McCormick, Mars Estates, Riverview, Woodmoor, Hernwood, Scotts Branch Deep Creek, Featherbed Lane, Glenmar ES	BCPS	Back R, Middle R, Gwynns Falls, Bird R, Patapsco,	70

	(12 schools)			
09/17/08	GS for UNMWG	MDA	Regional	18
09/18/08	Forest Sustainability for Local Govt's	Oregon Ridge	Countywide, Regional	110
09/21/08	Jones Falls WA Rally for the River	Baltimore City	Countywide, Jones F, Regional	7,000
09/24/08	Grounds for Teaching		Regional, Countywide	30
October (month)	Hello Baltimore County TV Show (taping 9-2-08)	Countywide Broadcast	Countywide	3,000 est
10/06/08	Windsor Mill MS Faculty	Randallstown area	Patapsco, Gwynns Falls	85
10/07/08	Archdiocese of Baltimore Catholic Teachers Conference: 42 schools 17 Baltimore County parochial schools	Baltimore City	Countywide, Regional (3) Jones F (5) Back (1) Liberty (3) Lower Gunpowder (4) Loch Raven (3) Gwynns Falls (2) Bird R (2) Patapsco (2) Balto Harbor	100
October (month)	CNN Newsmakers: GHC	Regional Broadcast	Regional	3,000 est
10/08/08	Park School Presentation	Greenspring Brooklandville	Jones Falls Countywide	20
10/11/08	Cromwell Fall Harvest Fest	Towson	Lower Gunpowder Loch Raven	1,800
10/18/07	Irvine Pumpkin Fest	Owings Mills	Jones Falls, Countywide Gwynns Falls	1,200
10/20/08	Hernwood ES Faculty	Deer Park area	Patapsco, Liberty	80
10/29/08	Cromwell Valley ES PTA	Providence area	Loch Raven, Back R, Lower Gunpowder	50
10/29/08	Stoneleigh ES Faculty and community partners	Towson	Back River	10
10/30/08	Friend's School Faculty, Stoneleigh ES, Roland Park ES Parent Groups, Citizens for Climate Action, Irvine Nature Center, Baltimore City School System, Cathedral, Bryn Mawr, Calvert, Green School, Balto Montessori, Howard Co sch, P&P F (14 schs, 4 community organizations, 2 business partners)	Baltimore City	Jones Falls, Back River Regional	25
11/02/08	HHW Collection Day	Halethorpe	Countywide	1200
11/03/08	Windsor Mill MS	Randallstown area	Patapsco, Gwynns Falls	80
11/05/08	MSDE EE Update	Pikesville	Countywide, Regional	1
11/06/08	Our Lady of Grace, Parkton	Parkton	Loch Raven, Prettyboy	10
11/13/08	HRWA EE Planning	Baltimore City	Regional, Back River	25
11/18/08	MSDE EE Update	Upper Marlboro	Countywide, Regional	200
11/25/08	Envirothon: (8 schools)	Days Cove	Low Gunpwder, Bird R Little Gunpwder	88

	Western Tech HS Catonsville HS Lansdowne HS Sparrows Pt HS Hereford HS Dulaney HS Towson HS Carver HS		Patapsco Patapsco Patapsco Balto Harbor, Back R LR, Prettyboy, Deer Cr Loch Raven, Little GP Back R, Jones F Countywide, Jones F	
11/26/08	Envirothon: (6 schools) Chesapeake HS Eastern Tech HS Perry Hall HS Franklin HS Owings Mills HS New Town HS	Days Cove	Low Gunpwder, Bird R Little Gunpwder Middle R, Back R Middle R, Back R Bird R, Low Gunpwder Gwynns F, Librty, LR Gwynns Falls Patapsco, Gwynns Falls	62
12/01/08	Mars Estates ES Faculty	Middle River	Middle R, Back R	75
12/01/08	Stoneleigh ES Faculty	Towson	Back R	75
12/08/08	McCormick ES Faculty	Rosedale	Back R	68
12/10/08	Archbishop Curley HS Administration and Faculty	Baltimore City	Regional, Back R	18
12/11/08	AG: Field Crops Day	North County	Loch Raven, Prettyboy, Liberty, Deer Cr	150
12/12/08	Cromwell Valley ES Faculty	Providence area	Loch Raven, Back R, Lower Gunpowder	3

Appendix 4-2: Education Program: Recycling Presentations, 2008
Accomplished by
Baltimore County Department of Public Works, Recycling Division

Date	School	City	Grade	Audience Size
02/11/08	Jacksonville ES	Phoenix	1	90
02/19/08	Harford Hills ES	Baltimore	K-3	175
02/19/08	Harford Hills ES	Baltimore	4-5	175
03/14/08	Glenmar ES	Baltimore	K-3	275
04/11/08	Hernwood ES	Randallstown	3	60
04/16/08	Chapel Hill ES	Perry Hall	K	140
04/21/08	Relay ES	Baltimore	2	55
04/22/08	Lansdowne ES	Baltimore	1	60
04/25/08	Eastwood ES	Baltimore	2-4	120
05/23/08	Westowne ES	Baltimore	K-2	250
05/23/08	Westowne ES	Baltimore	3-5	250
07/23/08	Red House Run ES	Baltimore	K-5	50
09/05/08	Winfield ES	Baltimore	2	75
09/11/08	Church Lane ES	Randallstown	PreK-2	300
09/16/08	Norwood ES	Baltimore	K-3	450
09/16/08	Norwood ES	Baltimore	4-5	200
09/17/08	Catonsville ES	Catonsville	4	60
09/19/08	Cedarmere ES	Reisterstown	PreK-2	250
09/19/08	Cedarmere ES	Reisterstown	3-5	200
10/07/08	Red House Run ES	Baltimore	K-3	300
10/07/08	Red House Run ES	Baltimore	4-5	200
10/16/08	Glenmar ES	Baltimore	K-3	245
10/16/08	Glenmar ES	Baltimore	4-5	200
10/21/08	Sacred Heart School	Glyndon	K-3	200
10/21/08	Sacred Heart School	Glyndon	4-5	200
10/21/08	Sacred Heart School	Glyndon	6-8	200
10/22/08	Winfield ES	Baltimore	3	65
10/23/08	Sparrows Point MS	Sparrows Pt	6-8	30
11/12/08	McCormick ES	Baltimore	K-2	165
11/12/08	McCormick ES	Baltimore	3-5	225
				Total 5,265

5.0 Permit Requirements

E.4. Illicit Discharge Detection and Elimination

Baltimore County shall maintain its illicit connection detection and elimination program to ensure that all discharges to and from the municipal separate storm sewer system that are not composed entirely of stormwater are either permitted by MDE or eliminated. The County shall follow the minimum requirements listed below or propose alternative methods for MDE approval:

a. Field screen at least 150 outfalls annually. Each outfall having a discharge or suspected of having an illicit discharge shall be sampled using a chemical test kit;

b. Conduct routine surveys of commercial and industrial watersheds for discovering and eliminating pollutant sources;

c. Maintain a program to address illegal dumping and spills;

d. Use appropriate enforcement procedures for investigating and eliminating illicit discharges, illegal dumping, and spills. Significant discharges shall be reported to MDE for enforcement and/or permitting; and

e. Report illicit discharge detection and elimination activities as specified in PART IV of this permit. Annual Reports shall include any requests and accompanying justifications for proposed modification to the illicit discharge detection and elimination program.

5.1 Introduction

The NPDES - Municipal Stormwater Discharge Permit program required full implementation of the County's stormwater outfall screening schedule by September 30, 1997. The *Manual of Practice for Detection and Removal of Illicit Connections* was completed on January 30, 1997 and guides the implementation of this project. The Watershed Monitoring Section of DEPRM is currently responsible for performing the outfall screenings, reporting screening data, and coordinating remedial actions. Specific correction measures may be the responsibility of DEPRM, the Department of Public Works (DPW), or both, depending upon the nature and sources of detected discharges. Certain illicit connections are referred to the Maryland Department of the Environment (MDE) for permitting or enforcement if there are indications that existing permit limits are being exceeded. Water main leaks are referred to Baltimore City Department of Public Works for correction. Because chlorine is extremely toxic to the fauna in a stream, it is of particular concern when leaks or discharges occur from the public distribution system. High volume, chlorinated leaks can go undetected or remain uncorrected for quite some time. This can affect any water quality monitoring projects being conducted downstream.

5.2 Program Status

The results of this reporting period are presented as three separate components: analysis of routine outfall screenings, analysis of illicit connection investigations conducted by WMM staff, and analysis of illicit connection investigations conducted by DEPRM's Regional Environmental Health Program staff. Although the regional program typically focuses on complaint-driven community hygiene issues, a small percentage of those investigations involve illicit connections.

During the calendar year 2008, the Watershed Monitoring Section of DEPRM staff conducted 217 routine outfall screenings in which 18 required further investigative or remedial actions. WMM staff investigated 31 citizen complaints and 11 complaints from DEPRM staff or other agencies. Based on an analyses of complaints investigated by DEPRM's regional staff over the past five years, approximately 13% the complaints usually involve potential illicit connections.

As revealed in the analysis in the following section, routine outfall screenings for detection of illicit connections appear to compliment citizen complaints of problems they observe. Aside from the benefits of greater public involvement and the resolution of complaints, citizens provide surveillance at a level beyond that of the monitoring staff. A majority of the time citizens call while they are actually observing a problem and often can provide immediate local information that increases the chance of eliminating illicit connections. The routine outfall screenings catch the chronic problems that may be missed by the public, such as chlorine leaks from the municipal water supply.

5.3 Analysis of Outfall Screenings

A routine outfall screening consists of:

(1) A quantitative analysis of the effluent. This includes measuring the effluent flow rate, temperature and pH, and field-testing with the LaMotte NPDES test kit. This includes parts per million tests for copper, chlorine, and phenol. A qualitative assessment of the effluent, the outfall structure and the receiving channel, noting such conditions as water color, odor, vegetative condition, sedimentation, erosion, damage, etc.

(2) A visual inspection of each outfall, noting any structural damage.

If the problem is severe enough to warrant immediate correction, then an investigation begins immediately. Some sites are determined to have problems severe enough to warrant immediate investigation and/or corrective action after only one screening.

In Baltimore County, there are approximately 3,612 total outfalls. There are two types of outfalls: major and minor. Major outfalls are >36" and minor outfalls are <36". There are 707 major outfalls in our database and 628 have been prioritized. This includes the 45 outfalls that we have found not to exist or are not in a location where they can be sampled. The minor outfalls are just starting to become prioritized, 61 have been completed so far. There are a greater number of them (2,905), so they will be dealt with in phases. Concentration will be on the small outfalls in the area where the Small Watershed Action Plans (Section 7) are being focused.

Outfalls are chosen by their priority. The prioritization system works as follows: Outfalls that have not yet been screened twice have not been prioritized. Outfalls that have been screened two or more times are assigned one of three priority ratings. Outfalls with major problems that require immediate correction and/or close monitoring, or outfalls with recurrent problems will be

assigned a *Priority 1 (Critical)* rating. Outfalls with moderate to minor problems that have the potential to become severe are assigned a *Priority 2 (High)* rating. Outfalls with minor or no problems that do not require close monitoring are given a Priority 3 *(Low)* rating. Outfalls categorized as "Low Priority" are on a ten-year screening cycle, "High Priority" outfalls are screened once each year, and "Critical" outfalls are screened four times each year. This system allows for a more streamlined approach in selecting outfalls to screen, and provides a more efficient use of manpower. Outfall priority may be changed if it improves or degrades. The small outfalls will be prioritized after one screening, due to there being many more of them than the major outfalls.

Table 5-1 lists the number of outfalls 36 inches or larger in diameter by watershed and by the priority classification described above. To date, 79 of the outfalls 36 inches or larger in diameter have not been sampled sufficiently to be prioritized. Additional screening effort will allow the County to assess and prioritize the status of these outfalls.

Table 5-1: Major Outfalls by Watershed and Priority Classification

Watershed	Priority 1	Priority 2	Priority 3	Total
Upper Western Shore				
Loch Raven	6	34	31	71
Lower Gunpowder	5	23	9	37
Gunpowder River	0	0	0	0
Little Gunpowder Falls	0	2	0	2
Bird River	2	9	28	39
Middle River	3	7	5	15
Total	**16**	**75**	**73**	**164**
Patapsco-Back River				
Patapsco River	2	10	65	77
Gwynns Falls	16	44	96	156
Jones Falls	0	18	35	53
Back River	8	44	56	108
Baltimore Harbor	6	10	9	25
Liberty Reservoir	0	0	0	0
Total	**32**	**126**	**261**	**419**
Grand Total	**48**	**201**	**334**	**583**

The locations of the prioritized major outfalls and those remaining to be prioritized are shown in Figure 5-1. As can be noted from the figure, the majority of the outfalls occur within the Urban-Rural Demarcation Line. There is no consistent pattern of outfall location in relation to the prioritization category.

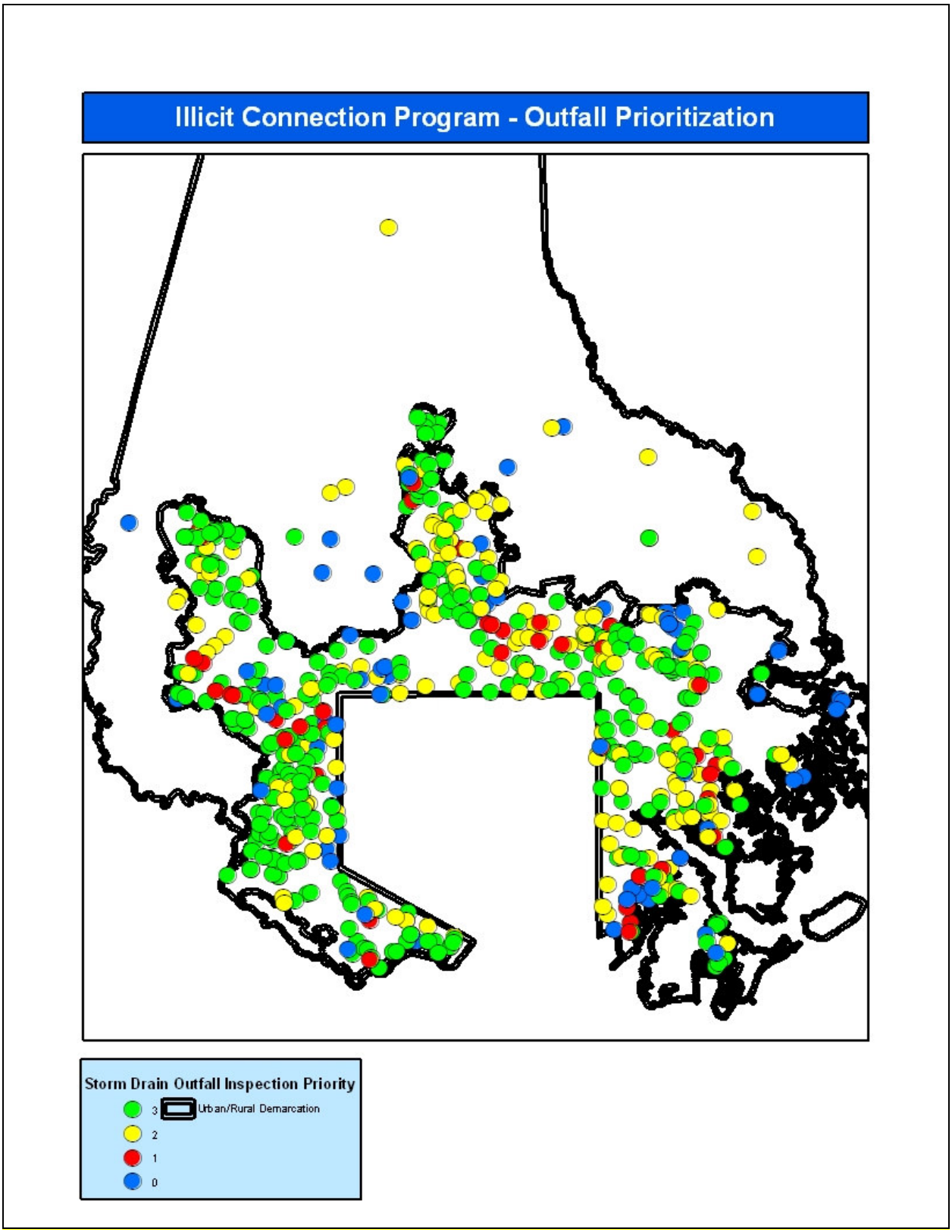


Figure 5-1. Major Outfall Prioritization. Note most outfalls are inside the Urban-Rural Demarcation Line (URDL).

The percentages of the 583 outfalls, which have been given a rating, in each category are shown in Figure 5-2.

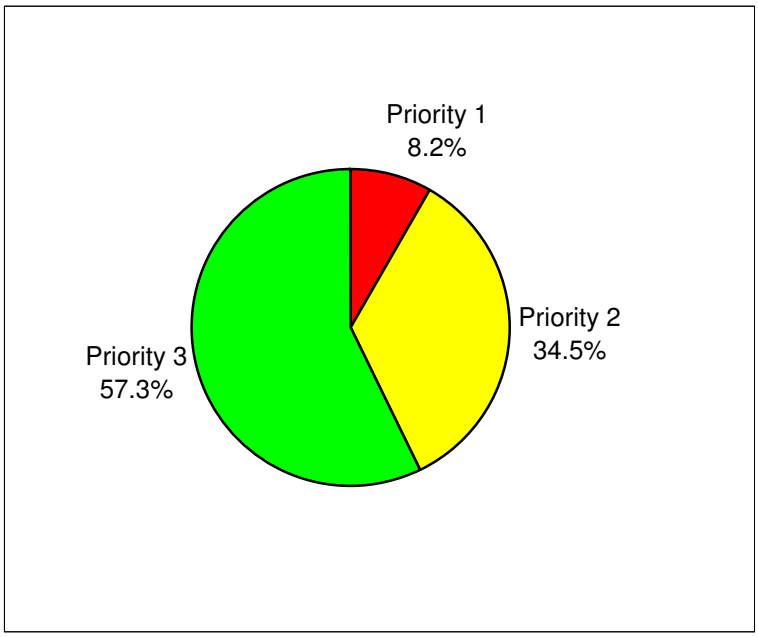


Figure 5-2: Major Outfall Screening Priority Distribution

Of the 217 outfalls screened during 2008, 203 were major outfalls and 14 were minor outfalls. They were selected from the newly prioritized database based on the following criteria:

- Citizens who called or wrote to express concern about stream water quality, but the indicated conditions did not warrant an immediate investigation; and
- Previous screenings indicated water quality problems might exist.

Figure 5-3 shows the quantitative problems and Figure 5-4 shows the qualitative problems found. As indicated in Figure 5-3, by the bar labeled "*none detected*", 164 out of the 217 routine outfall screenings had no detectable quantitative problems. Phenol, chlorine, and copper are considered as indicators if they are above .17 mg/L, .4 mg/L, and .21mg/L respectively. Temperature is considered a potential problem if it exceeds 75 degrees F (23.9 degrees C), which occurred in 22 outfalls. The criteria used to determine if pH is out of range is if it is under 6.0 or above 9.0, and a problem was detected at seven outfalls. Copper was detected at three outfalls and phenol was detected at 21 outfalls. Chlorine was detected at 12 outfalls. There were a total of 65 quantitative problems.

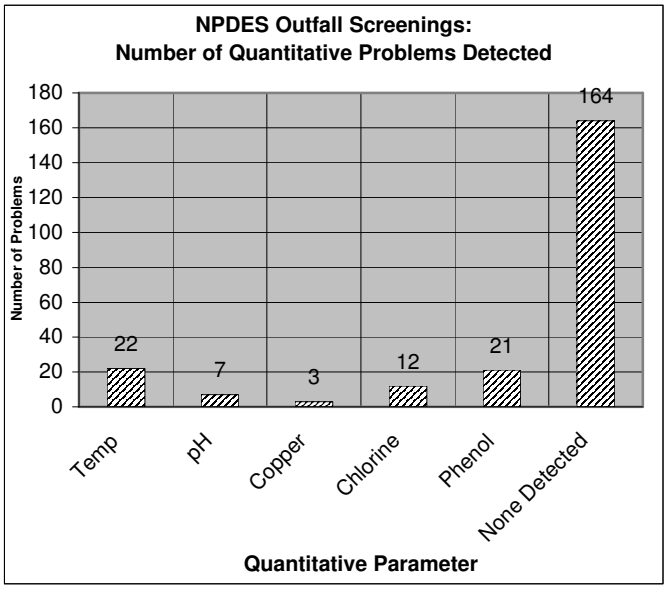


Figure 5-3. Number of *quantitative* problems detected.

Figure 5-4 illustrates incidences of problems observed during *qualitative* assessments such as: visual evidence of sewage, oil, and structural problems. Qualitative and "visual problems" were those most frequently encountered which included observations regarding color, odor, clarity, and receiving water characteristics and sediment deposition immediately at and below each outfall. Trash, erosion, and sediment deposition were observed at 190, 80, and 198 outfalls, respectively. Of the total 217 outfalls screened, there were a total of 494 qualitatively assessed problems, however, 3 had no observed or qualitatively assessed problems. Many of the outfalls screened had more than one problem.

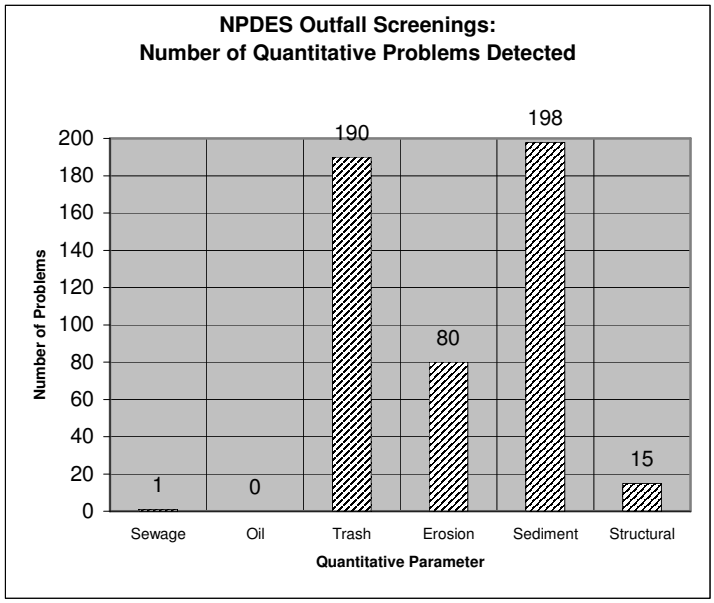


Figure 5-4. Number of *qualitative* problems visually observed.

As described above, routine outfall screenings include a quantitative analysis, a qualitative assessment and a visual inspection. Based on these three procedures, a total of 559 problems were encountered during the 217 routine outfall screenings during this reporting period. Many of the outfalls had more than one problem. Observations regarding the receiving channel within the immediate vicinity of the outfall were also included.

During 2008, outfall screening was distributed among seven watersheds as follows: Gwynns Falls (79), Back River (15), Baltimore Harbor (16), Patapsco (12), Loch Raven (35), Bird River (3), Lower Gunpowder (38), and Jones Falls (9), Deer Creek (5), Middle River (4), Prettyboy (1).

5.4 Illicit Connections Investigations and Corrections

During the calendar year 2008, the Watershed Monitoring section processed sixty complaints, of which thirty were citizen complaints. Twenty-four cases were referred to other agencies. Of those twenty-four, six are still ongoing. DEPRM is handling the remaining thirty-six complaints. Of those, twenty-nine have been closed and seven remain ongoing investigations. These complaints and their status are detailed in Table 5-2.

Table 5-2: Complaints Processed from January 1, 2008 through December 31, 2008

Case No.	COMPLAINT / DATE	ACTION TAKEN	STATUS	LOCATION
08-001	Outfall with broken joint and erosion. 1/8/08	Referred to Stormwater.	Correction notice issued property owners. **Case closed**	Outfall 708. 24 E7
08-002	Stream eroding badly below double outfalls. 1/8/08	Referred to CPO.	Info has been passed along for inclusion in the Scott's Level Restoration project. **Case closed**	Outfall 287. 24 E11
08-003	Steam baseflow samples	Tested several places for	Sediment had come	24 F11

	consistently show high nutrients. 1/8/08	ammonia. Also found significant sediment had washed into stream.	from a water leak. Levels of ammonia found did not indicate sewage. Stream is in a residential neighborhood and nutrients probably come from non-point sources like fertilizing. Stream also originates in a SWM pond, which may be a contributor as well. **On-going**	
08-004	Citizen complaint of soapy discharge in stream. 1/3/08	Investigated stream at several spots but found no discharge.	**Case closed**	Sussex Road. 33 D2
08-005	Citizen complaint of stream flooding.	Referred to CPO.	Will let homeowner know of upcoming projects. **Case closed**	8520 Allenswood Road. 24 J12
08-006	Excessive trash behind the Fox Chevrolet Body Shop. 1/15/08	Referred to Environmental Health.	Violation issued. **Case closed**	6633 Security Boulevard. 33 D9
08-007	Complaint of green water in stream.	Team investigated and suspected the green was from a dye test.	DPW confirmed there was a dye test in the area. **Case closed**	St. Charles Avenue. 42 A4
08-008	Excessive erosion downstream of outfall.	Erosion is occurring on a restored section of Minebank Run.	This bank has never been able to support vegetation. **Case closed**	Outfall 568. 27 F6
08-009	Sewage smell coming from storm drain inlet. 2/8/08		No sewage leaks found, smell is from wet vegetation. **Case closed**	400 Pennsylvania Avenue. 27 C6
08-010	Water constantly running in manhole. 2/8/008	Tested for ammonia, boron and chlorine at an outfall downstream.	Water is a piped stream. **Case closed**	Watkins Alley. 27 D6
08-011	Foam in stream. 3/5/08	Nothing unusual was found upon inspection.	**Case closed**	Ridge Road. 17 G7
08-012	Dumpsters without covers, leaking juice and drums of material uncovered. 3/7/08		PDM took no action concerning dumpsters. Environmental Health found one of four drums without a lid. **Case closed**	Greenspring Shopping Center. 26 A11
08-013	Fish Kill on Minebank Run. 3/13/08	Visited several spots and found County Public Safety Building had improper drum storage and were throwing trash in the woods.	Inspector spoke with Police Department to correct this activity. **Case closed**	Glen Eagle Court. 27 H6
08-014	Pollution in tributary to Western Run. 1/8/08	Found the Stormwater pond at the development on Smith and Pebble Brook to be discharging plumes of sediment to stream.	Sediment pond is functioning properly. **Case closed**	26 E11
08-015	Excessive litter from Schittino's is ended up in the stream. 2/29/08		PDM issued correction notice and upon reinspection area along	1701 Edmondson Avenue. 41 B3

			the fence was clean. **Case closed**	
08-016	Dead fallen tree is trapping litter on the beach. 3/26/08	Tree is actually still alive.	Recreation and Parks removed tree and cleaned up trash. **Case closed**	Inverness Park. 44 K6
08-017	Downed tree causing flooding and a possible water leak. 2/20/08	Highways reported that the tree is actually on private property. The water leak was a natural spring.	**Case closed**	19 Hickory Ridge Court. 32 J11
08-018	Mowing and digging in critical area on county property. 3/29/08		Recreation and Parks. **On-going**	7811 Fairgreen Road.
08-019	Citizen reported an oil spill.	Investigated and found the oil sheen was from iron bacteria and was naturally occurring.	**Case closed**	Fort Holabird Park. 44 E5
08-020	Outfall 80% submerged. 4/3/08	Highways said the outfall is on private property and the county does not have access.	DEPRM does not have jurisdiction over a private storm drain system either. **Case closed**	Outfall so-277. 44 E6
08-021	Pond turned a color. 4/16/08	Pond turned colors from an algae die off.	Recommended another aerator and chemical to absorb the ammonia. **Case closed**	11245 Greenspring Road. 17 J12
08-022	Stream was a milky-green color. 4/16/08	Upon inspection did not find any discoloration.	**Case closed**	Openshaw Road. 4 G9
08-023	Minebank Run is running a rusty brown color. 4/17/08	Upon inspection did not find anything unusual.	Minebank run is usually more brownish due to brown algae on bottom and sediment coloring. **Case closed**	Minebank Run. 28 B3
08-024	Possible sewage overflow in Red House Run. 4/18/08	Turned out to be a water main break.	Baltimore City repaired leak. **Case closed**	Raspe and St. Patrick. 36 F2
08-025	Citizen saw construction workers dumping into stream. 4/18/08	Field staff extensively walked area and could find no debris.	**Case closed**	Pine Grove Middle School. 28 D5
08-026	Staff doing fieldwork found a stream that was sudsy and black. 5/2/08	Source was traced to an outfall at road crossing.	Referred to MDE Emergency line. **On-going**	11100 Gilroy. 18 E3.
08-027	Below outfall has severe erosion. 4/10/08	Referred to CPO.	Project not warranted at this time, will be put in the storm drain problem file. **Case closed**	Outfall #529. 41 B5
08-028	Citizen complained of excessive algae in community pond. 3/18/08	Tested streams feeding pond, nothing unusual found.	Lack of buffer and impervious drainage is causing algae, no illicit connections present. **Case closed**	19 B10
08-029	Citizen complaint of broken net and subsequent release of		Referred to MDE. **On-going**	36 K11

	trash in the Back River. 7/7/08			
08-030	Routine outfall screening found significant amount of foam. 4/24/08	Dye tested sanitary sewer in industrial park, does not appear to be the source.	**On-going**	Outfall #004. 18 F5
08-031	Citizen complained of farmer that has soil being washed into nearby stream. 4/28/08		MDE referred to the Soil Conservation District. **On-going**	Corner of Dave Rill and Upper Beckleysville. 5 B4
08-032	Citizen suspects water main is leaking into stream. 5/16/08	Water was positive for chlorine, traced manhole in front of 750 Main Street.	Pipe has been repaired. **Case closed**	750 Main Street. 16 B10
08-033	Routine screening found outfall 100% submerged. 6/26/08	Referred to DPW Highways.	Outfall is located on private property; county does not have access easement to repair. **Case closed**	Outfall #509. 44 F7
08-034	Citizen complaint of fire truck discharging sewage to stream. 4/29/08		Volunteer fire department was conducting training exercises, involving hydrant water, not sewage. **Case closed**	
08-035	Rocks piled in front of outfall. 4/15/08		Highways removed the rocks. **Case closed**	Outfall #so-2556. 4 G4
08-036	Fish kill in Moore's Branch. 7/30/08	Suspect low flows, warm water to have resulted in fish kill. Stream looked fine the following day and fish were swimming around.	**Case closed**	Park School. 26 C8
08-037	During routine outfall visit found severe stream erosion. 8/5/08		Referred to CPO. **On-going**	Stream across from 1516 Forest Park Ave. 33 G12
08-038	During routine outfall visit found stream erosion. 8/5/08		Referred to CPO. **On-going**	Outfall 557. 33 G9
08-039	Water bubbling out of grass strip by sidewalk and running into storm drain. 2/5/08	Referred to Fire Department.	Water has stopped running. **Case closed**	1101 Kenilworth Drive. 27 A4
08-040	Complaint of trash dumping. 4/14/08		Tree was removed by Public Works. Rec and Parks removed trash and posted no dumping sign. **Case closed**	Dead end of Dunbar Avenue. 41 B2
08-041	Excessive dog feces and grass clippings in yard. 8/20/08		Site has been cleaned. **Case closed**	9414 Tulsmere Road. 24 D10
08-042	Missing sanitary sewer cover. 8/5/08	Referred to Emergency sewer service.	Manhole cover has been replaced. **Case closed**	Behind 5201 Franklintown Road. 33 H11
08-043	Chlorine found during routine outfall visit. 8/1/08		Referred to Baltimore City. **On-going**	Outfall #496.

08-044	During routine visit, homeowner complained of erosion in yard from outfall. 4/15/08	Homeowner said his neighbor redirected outfall flow into a concentrated area.	The Public Works Storm Drain Design Section is in the process of discussing this problem. **On-going**	Outfall #so-2560-dc
08-045	During routine visit found severe erosion below outfall. 7/29/08		Referred to CPO. **On-going**	Outfall #171, behind 2322 Salem Village Rd. 28 C5
08-046	During routine outfall visit found holes rusted in bottom of outfall. 7/29/08		After Utilities investigated, the issue is being discussed with Storm Drain Design. **Case closed**	Outfall #so-558. 28 H9
08-047	Citizen complained of stream smelling like sewage. 9/17/08		Did not find any smell, no sewer leaks found. **Case closed**	5200 Southwestern Boulevard. 42 A7
08-048	Citizen complaint of sewage overflows into stream. 8/28/08		Pipe was heavily infested with tree roots, which have been removed. Public Works is recommending to their engineering section that the pipe be relined. **Case closed**	1244 Sulpher Spring Road. 41 K8
08-049	Car leaking oil and getting into storm drain. 10/2/08		Issued a citation for illegal discharge of petroleum. Street was clean upon reinspection. **Case closed**	660 Kingston Road. 37 J8
08-050	Large bare patch of soil on stream bank where animals graze. 10/7/08		Soil Conservation District found no violation or major problem. **Case closed**	4224 Mount Zion Road. 10 F4
08-051	Water flowing out of PVC pipe in sidewalk. 10/31/08	Water had .2 ppm of chlorine in it.	Water was from freezer condensate, which they are allowed to discharge. **Case closed**	512 York Road. 27 D6
08-052	Chlorine found during routine outfall screening. 11/12/08	Water was being discharged to stormdrain from pipe that was flushing newly lined water pipes.	Public Works had the contractor cease flushing and choose one of the approved methods of discharging chlorinated water. **Case closed**	Outfall #368
08-053	Citizen complaint of high, muddy flows in stream. 11/14/08	Stream flows looked normal and were clear. Noted work has begun in area on water pipes.	**Case closed**	1305 Malvern Avenue. 26 J7
08-054	Citizen concerned about obstruction of SWM pond. 11/5/08	As-built denied.	Referred to Stormwater. **On-going**	5226 Scenic Dr. 29 H7
08-055	Citizen saw chemicals being dumped into stream. 8/6/08	Stream was fine. Parking lot is a popular place to wash cars, could have been someone dumping a wash bucket.	**Case closed**	Double Rock Park. 28 E11

08-056	Horses with access to stream, trampling banks. 8/08		Referred to Agricultural Preservation. **On-going**	3321 Butler Road. 10 K11
08-057	Citizen complaint of stream being darker and higher than usual. 12/17/08		Ran water quality test kit and found nothing unusual. **Case closed**	34 Oak Shadows Court. 32 J12
08-058	Field staff noticed water bubbling up from crack in street. 12/29/08	Referred to City.	Water main has been fixed. **Case closed**	115 Oakdale Avenue. 41 B3
08-059	Stream erosion with banks 4.5' high. 12/30/08		Erosion is limited to a few areas, most of stream stable. No action taken. **Case closed**	Outfall 278. 28 K4
08-060	Citizen noted large pile of dirt with no sediment contols. 12/9/09		Inspector issued notice to build sediment fence. **Case closed**	End of Newburg Avenue. 41 C6

5.5 Regional Illicit Connections Investigations and Complaint Database

For many decades, Baltimore County health inspectors have investigated complaints that are now categorized as potential illicit connections. These complaints include septic systems, leaky refuse and grease containers, the dumping of used motor oil, leaky engines, and industrial maintenance activities among others. Because these investigations are only a small percentage of the thousands of complaints received each year by the regional programs, it was difficult to separate complaints with a potential illicit connection from the rest of the caseload. These thousands of complaints were analyzed and broken down into the categories seen in Figure 5-5. After looking at the data from the past five years, it was determined that the breakdown into categories is approximately the same each year and we can assume these numbers will continue to be the same in the future.

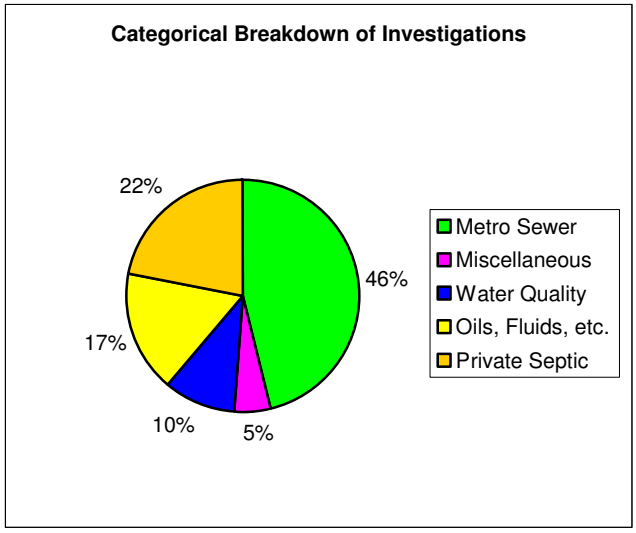


Figure 5-5. Involvement of the Regional Programs in the Investigation of Illicit Connections. This is the approximate breakdown of cases based on past data.

5.6 Summary

The Outfall Prioritization Program has increased efficiency in detecting pollutants. A database is used to assign a priority rating for each outfall based on past screening data and the potential for having illicit connections. Outfalls are screened periodically based on their priority rating, which is assigned or appropriately changed when information is entered. The type and severity of pollution determines the outfall's position in the queue. The combination of citizen involvement, routine outfall screenings and the regional staff complaint investigations is working well to our continuing goal of preventing and eliminating illicit connections.

6.0 Permit Requirements

C. Source Identification

Sources of pollutants in stormwater runoff shall be identified and linked to specific water quality impacts on a watershed basis. This process shall be used to develop watershed restoration plans that effectively improve water quality. The following information shall be submitted in geographic information system (GIS) format with associated tables as required in PART IV of this permit.

1. Storm drain system: major outfalls, inlets, and associated drainage areas;
2. Urban best management practices (BMP): stormwater management facility data including locations and delineated drainage areas;
3. Impervious surfaces: delineated controlled and uncontrolled impervious areas;
4. Monitoring locations: locations established for chemical, biological, and physical monitoring of watershed restoration efforts and the *2000 Maryland Stormwater Design Manual* or other innovative stormwater management technologies approved by MDE; and
5. Watershed restoration: restoration project descriptions and locations.

PART IV. PROGRAM REVIEW AND ANNUAL REPORTING OF PROGRESS

A. **Annual Reporting**

2. To further judge the effectiveness and progress of implementing this permit, the following information shall be submitted on databases (in a format) consistent with Attachment A. Annually, except where noted, the following shall be submitted:
   a. Storm drain system mapping (PART III. C.1.);
   b. Urban BMP locations (PART III. C.2);
   c. Impervious surfaces (PART III. C.3);
   d. Watershed restoration project locations (PART III. C.5);
   e. Chemical monitoring (PART III. C.4. and PART III. H.1);
   f. Illicit Discharge Detection and Elimination activities (PART III. E.4);
   g. Responsible personnel certification information (PART III. E.3)
   h. Grading permit information – quarterly (PART III. E.3); and
   i. Fiscal analyses – cost for NPDES related implementation (PART III. I.)

This section describes the Geographic Information System (GIS) data layers and the databases submitted with the Annual Report. The GIS data layers are described in

Section 6.1. Section 6.2 describes the databases that have been created for the NPDES Report, along with data sources and limitations.

6.1 Source Identification – Geographic Information System Data Layers

6.1.1 Storm Drain System

The storm drain system GIS data layers were submitted with last years' report. These datalayers represent the Baltimore County storm drain system based on a set of keysheets maintained prior to the development of GIS. The layer was created by a consultant based on the keysheets and available aerial photography. The datalayer is incomplete and does not extend north to the Hunt Valley area of the County. In addition, there are errors in the depiction of the storm drain system, with some systems having no outfalls.

The GIS data layer for the storm drain system is currently being updated. A pilot project is currently underway to develop the layer in the Jones Falls watershed. This pilot project is intended to assure that the data layer captures the needs of all county agencies that utilize the storm drain information.

The storm drain system is also represented by two files for the outfall locations; Major_outfalls and Minor_outfalls. The drainage areas to the major outfalls are presented in the outfall_drainage.lyr file. These three files can be found on the accompanying CD under Data/GIS Datalayers/Storm Drain Layer.

6.1.2 Urban Best Management Practices

The urban best management practices are represented by two datalayers, SWM_2009_Locations.shp and SWMDrainage2009.shp. These layers are located under Data/GIS Datalayers/Urban Best Management Practices. The locations layer displays the locations of the stormwater management facilities as a point, while the drainage are layer displays the drainage areas to built facilities.

The location datalayer will have errors due to coordinates either being missing or wrong. Some of this is historical, as until 2000 the County required engineers to submit drawings based on the Baltimore County coordinate system. Conversion to Maryland State Plan resulted in errors.

6.1.3 Impervious Surfaces

The impervious surfaces in Baltimore County are represented by two separate datalayers, building_poly and roads_poly. These layers are located under Data/GIS Datalayers/Impervious Surfaces. The layers were created based on aerials flown 2005. The building datalayer includes all residential, commercial, and industrial buildings. It also includes sheds, barns and other accessory structures. The roads datalayer includes all roads and parking lots. It does not include driveways, except in rural areas. Sidewalks are not depicted.

This data layer is based on the 2005 aerials and represents an update of the previously submitted impervious surfaces datalayers, which were based on aerials flown in 1995-1997.

6.1.4 Monitoring Locations

Monitoring locations for Baltimore County are presented in the three separate files, one for chemical monitoring, one for biological monitoring, and one for geomorphological monitoring. The files are located under Data/GIS Datalayers/Monitoring Locations, with a separate file folder for each type of monitoring.

6.1.5 Watershed Restoration

Two data layers are submitted with this report. The file cip.shp displays the locations of the various Capital Restoration Projects along with their type and their status. Cip_drainage_new.shp presents the drainage area to the various restoration projects. This layer is used to calculate the pollutant load reductions that result from restoration efforts associated with stormwater management facility conversions and stormwater management facility retrofits. It is also used to determine the amount of impervious area addressed by restoration activities. It is located under Data/GIS datalayers/Watershed Restoration.

6.2 Databases

All databases can be found on the accompanying CD under the file folder named Data. Each type of monitoring has its own folder under the Data folder.

6.2.1 Chemical Data

Six databases are included with this report. One data base contains the tidal water monitoring data (Tidal_08.xls), a second contains the baseflow monitoring data (Baltimore County Baseflow_08), while a third contains the storm event and baseflow monitoring data from Scotts Level Branch and Powder Mill (Scott'sLevel_PowderMill_08.xls). Also included is the database containing the Scotts Level Branch in-stream gage data and the calculated pollutant concentrations and loads at 15 minute intervals. This database is split into three separate Excel files due to the size of the files. The final data base contains the calculated EMCs for each storm at the Scotts Level Branch in-stream monitoring site.

6.2.2 Biological Data

The random point biological data is presented in an Access97 database titled – Benthic EDAS 2008.mdb. This Access application was created by Tetra Tech, Inc for the specific purposed of calculating biological and habitat metric data in accordance with the Maryland Biological Stream Survey (MBSS) protocols. The database contains biological macroinvertebrate, fish assemblage, and habitat data collected by Baltimore County from 2003 through 2008. Also included in this directory is the fish data collected from the Prettyboy brook trout study (Fish_Prettyboy.mdb, see section 9.5 for the data results), fish data collected from Scotts Level Branch and Powder Mill Run (Fish_Scotts.mdb), and fish data collected at restoration sites (Fish_MNBK_WV.mdb).

6.2.3 Geomorphological Data

Three Excel spreadsheet files contain the geomorphological data. These files are:

- Scotts Level 2009.xls – This file contains data from the 20 cross section in Scotts Level Branch, including the overlay charts from previous years, and the calculations of cut/fill volumes,
- Windlass Run CX 2009.xls – Contains the cross section data for Windlass Run, and
- Powder Mill 2009.xls – Contains the cross section data for Powder Mill Run. This data was not included in this years report, but will be included in future reports.

6.2.4 Illicit Discharge Detection and Elimination

The results from the illicit discharge monitoring are presented since the inception of the program in Illicit.mdb for major outfall. We have initiated screening of the minor outfalls and have developed a separate database to track the results (Illicit_small_outfalls.mdb). Also included in this folder is the draft revision to the Illicit Connection Standard Operating Procedures that update the original SOP developed 1996.

6.2.5 Responsible Personnel Certification Information

A database of Responsible Personnel Certification has not been submitted with this report the information is displayed in Appendix 2-1.

6.2.6 Grading Permit Information

Grading permit information is submitted on a quarterly basis and has not been resubmitted with this report.

7.0 Permit Requirements

F. <u>Watershed Assessment and Planning</u>

Baltimore County shall continue to update and revise watershed assessments that have been developed for its 10 urban watersheds (Baltimore Harbor, Bird River, Back River, Gwynns Falls, Jones Falls, Little Gunpowder, Loch Raven, Lower Gunpowder River, Middle River, and the Patapsco River). The overall goal is to ensure that each County watershed is thoroughly evaluated and has an action plan to maximize water quality improvements. Additionally, the County shall encourage the public to participate in the development and implementation of watershed restoration activities. At a minimum, the County shall:

1. Continue to perform and update detailed assessments in all of its urban watersheds. These watershed assessments shall include:
    a. Determining current water quality conditions;
    b. Identifying and ranking water quality problems;
    c. Identifying all structural and non-structural water quality improvements opportunities;
    d. Reporting the results of a visual watershed inspection;
    e. Specifying how the restoration efforts will be monitored; and
    f. Providing an estimated cost and a detailed implementation schedule for those improvement opportunities identified above.

2. By 6/15/2006, the County shall complete the prioritization process for selecting subwatersheds for restoration started during the previous permit term. These subwatersheds shall contain at least 20% of the County's impervious cover. Restoration efforts resulting from this prioritization process shall be in addition to typical stormwater management facility maintenance; and

3. By the end of this permit term, the County shall propose for restoration subwatersheds containing another 10% of the County's impervious surface area with poor or no stormwater management. These sub-watersheds shall be in addition to the 20% already proposed for restoration under the requirements above.

G. <u>Watershed Restoration</u>

The County shall implement those practices identified in Part III. F. above to control stormwater discharges to the maximum extent practicable. The overall goal is to maximize the water quality in the County's urban watersheds, using efforts that are definable and the effects of which are measurable. At a minimum, the County shall:

1. Complete the implementation of those restoration efforts that were identified and initiated during the previous permit term to restore 10% of the County's impervious surface area.

2. Within one year of permit issuance, begin to implement restoration of an additional 10%

of the County's impervious surface area. .

3. Annually, Baltimore County shall update its impervious surface restoration accounting sheets for each of its urban watersheds. At a minimum, these data shall include:

   a. Total impervious acres for each urban watershed;

   b. A schedule and cost estimate for the design, construction, and completion for each retrofit project;

   c. The impervious acres controlled or restored within each watershed; and

   d. The monitoring data and surrogate parameter analyses used to determine water quality improvements.

J. Total Maximum Daily Loads

Stormwater BMPs and programs implemented as a result of this permit must be consistent with available waste load allocations (WLA's)[see 40 CFR122.44(d)(1)(vii)(B)] developed under a Total Maximum Daily Load (TMDL). MDE has determined that owners of storm drain systems that implement the requirements of this permit will be controlling stormwater pollution to the maximum extent practicable. Therefore, satisfying the conditions of the permit will meet WLA's specified in TMDL's developed for impaired water bodies. If assessment of the stormwater management program indicates TMDL WLAs are not being met, additional or alternative stormwater controls must be implemented to achieve WLAs.

7.1 Introduction

Environmental consultants managed by the Department of Environmental Protection and Resource Management (DEPRM) – Watershed Management and Monitoring Section have prepared watershed management plans for 10 of the 14 8-digit watersheds located in Baltimore County. The remaining four watersheds do not have significant urban components and therefore are not required to have watershed management plans for this permit. These watershed management plans and the four watersheds that do not have plans will be enhanced through the creation of Action Plans that will set restoration goals, identify steps to achieve those goals, provide an implementation schedule and a monitoring plan. The Action Plans will be prepared with the input from stakeholders within the planning area and identify opportunities for citizen based watershed restoration. The Action Plans will include the identification of potential stormwater management conversion sites, capital projects, as well as citizen based stream restoration opportunities, operational program implementation, and an implementation schedule. In 2004, DEPRM hired a consultant to assist in engaging stakeholders in development of the Action Plans.

This section includes updates on the status of the watershed management plans, Small Watershed Action Plans (SWAPs) and Capital Improvement Program's (CIP) restoration projects. Although the major focus of the implementation of the watershed management plans centers on capital projects, this component cannot alone satisfy water quality improvement. In Baltimore County water quality improvement is a multi-faceted effort involving other components such as sediment control, storm drain inlet cleaning, street sweeping, recycling, solid & hazardous waste management, illicit connection reduction, citizen education, sanitary sewer system infiltration/exfiltration reduction and others. These County-wide programs are described in other sections of this report.

The County's capital budget includes the current budget year and the subsequent 5 years. The capital budget is on a two-year cycle tied to bond referenda. Additional funding for these projects is provided by the Maryland Department of the Environment (MDE) through the Small Creeks and Estuaries and the Stormwater Pollution Control Cost-share Programs, the 319 program, and by the EPA Chesapeake Bay/Habitat Restoration Program. Starting in FY09, additional funding was made available through the Chesapeake and Atlantic Coastal Bays 2010 Trust Fund. Section 11 details the entire funding budget for watershed planning and restoration implementation in Baltimore County.

7.2 Status of Watershed Management Plans

7.2.1 Water Quality Management Plans

Water quality management plans have been completed for ten of the fourteen major watersheds in Baltimore County. The four remaining watersheds have limited urban development and therefore are not required by the NPDES – Municipal Stormwater Discharge Permit to have water quality management plans. However, recognizing the benefits of a watershed management plan, Baltimore County has completed the development of a Prettyboy Watershed Plan under the State's Watershed Restoration Action Strategy (WRAS) process. Harford County in conjunction with stakeholders has also completed the WRAS process to develop a watershed plan for Deer Creek watershed. Table 7-1 presents the watersheds and the year of completion of the water quality management plan. The recently completed Gwynns Falls Watershed Management Plan was a cooperative effort between Baltimore County and Baltimore City.

Table 7-1: Status of Watershed Management Plans

Watershed	Watershed Plan Status	Completion Date
Upper Western Shore		
Deer Creek	WRAS	6/30/07
Prettyboy Reservoir	WRAS	1/4/08
Loch Raven	Complete	9/30/96
Lower Gunpowder Falls	Complete	9/30/98
Little Gunpowder River	Complete	3/31/02
Bird River	Complete	3/29/96
Gunpowder River	Not Required	
Middle River	Complete	3/30/01
Patapsco/Back River		
Liberty Reservoir	Not Required	
Patapsco	Complete	9/30/98
Gwynns Falls	Complete	12/1/04
Jones Falls	Complete	9/30/96
Back River	Complete	9/30/96
Baltimore Harbor	Complete	3/30/01

Baltimore County enlisted the services of consultants for the preparation of the Watershed Management Plans. While the details of each plan vary, a common framework is incorporated into each plan. This framework includes:

1. watershed modeling using US EPA Stormwater Management Model (SWMM);
2. stream stability assessment using Rosgen classification methodology Levels I,II,III;
3. identification and ranking of water quality problems;
4. development of non-point source control management strategies;
5. prioritization of programs and projects; and

6. preparation of the final document, integrating the above tasks and preparing maps and tables to relate results.

Two of the watershed management plans (Middle River and Baltimore Harbor) did not include a stream stability assessment due to the limited mileage of open stream channels. These two watershed management plans did, however, include tidal estuarine water quality models, which were not a component in any of the other plans. The completed watershed management plans have been previously submitted to MDE and may be consulted for greater detail.
Table 7-2 indicates the consultants that have prepared the plans and the cost associated with each plan. The total cost for the preparation of the watershed management plans is slightly over two million dollars.

Table 7-2: Watershed Management Plans Consultants and Costs

Watershed	Consultant	Cost
Loch Raven Reservoir	Tetra Tech, Inc.	$180,827
Lower Gunpowder Falls	Parsons, Brinkerhoff, Quade & Douglas, Inc.	$262,461
Little Gunpowder Falls	Biohabitats, Inc.	$210,076
Bird River	Dames & Moore, Inc.	$165,450
Middle River	Versar, Inc.	$155,224
Patapsco River	Tetra Tech, Inc.	$284,100
Gwynns Falls*	Parsons Brinkerhoff	$326,422
Jones Falls	Dames & Moore, Inc.	$168,251
Back River	Camp, Dresser & McKee, Inc.	$149,905
Baltimore Harbor	Roy F. Weston, Inc.	$145,021
Total Cost		**$2,047,737.00**

*Includes Cost for Baltimore City Portion of the Plan

7.2.2 Small Watershed Action Plans (SWAPs)

In 2005, Baltimore County initiated a new round of watershed planning, entitled Small Watershed Action Plans (SWAPs). The SWAP planning process is meant to bring together the many mandates that the County is charged to meet in each individual watershed, including the requirements of the NPDES – Municipal Stormwater Discharge Permit, Total Maximum Daily Loads (TMDLs), goals in the Chesapeake 2000 and the Tributary Strategies, the Reservoir Management Program and the Baltimore Watershed Agreement. The small watershed action planning process is designed to bring all these individual mandates together at a subwatershed level that will help residents understand the intent of each program, how to most efficiently meet the goals, and define the roles of the partners. The SWAPs will build on the previously completed technical Water Quality Management Plans listed in Section 7.2.1.

Stakeholders are invited to participate in the development of each SWAP. A series of three meetings are held over the course of the development of each SWAP. The first introduces the stakeholders to the process and solicits their input on the characterization of the planning area and goals. The second meeting presents the final characterization document and solicits input on preferred restoration options. The third meeting presents the SWAP, which includes not only County actions and projects, but also citizen based and business based restoration activities and options. Planning areas were selected on similarity of impacts within each area, allowing focus on specific issues related to the stakeholders that live and work within each planning area. Twenty-three planning areas have been delineated.

The Lower Jones Falls and Upper Back River SWAPs were completed in the fall of 2008 with funding from an U.S. Environmental Protection Agency – Region III Water Quality Cooperative Assistance grant. This funding permitted the hiring of contractual staff and the Center for Watershed Protection to assist in the development of the Action Plans. These two SWAPs were developed in conjunction with Baltimore City, Herring Run Watershed Association, and Jones Falls Watershed Association. A Watershed Restoration Action Strategy (WRAS) was developed in January 2008 for the Prettyboy watershed. This was in partnership with DNR, MDE, Carroll County, York County PA, the Soil Conservation Districts, and the Prettyboy Watershed Alliance. These same organizations are continuing with semi-annual meetings to follow-up on implementation of the plan.

Four SWAPs are currently under development. The Goodwin-Hunt Valley-Loveton SWAP in the Loch Raven Watershed, and the Lower Patapsco SWAP in the Patapsco River Watershed have been on hold until later in 2009. The Northeastern Jones Falls SWAP, and the Tidal Back River SWAP are currently in active development. The two active SWAPs are anticipated to be completed in early 2010.

7.3 Obtaining Pollution Reduction Numbers

7.3.1 Stream Restorations

The calculation of pollutant load reductions due to stream restoration were based on the re-analysis of the Spring Branch data presented in the NPDES 2006 Annual Report, which resulted in the following pollutant load reduction estimates:

- Total Nitrogen – 0.202 pounds per linear foot of stream restoration
- Total Phosphorus – 0.0107 pounds per linear foot of stream restoration
- Total Suspended Solids – 3.58 pound per linear foot of stream restoration

7.3.2 Shoreline Enhancement Projects

To obtain nutrient reduction numbers associated with shoreline enhancement projects, it must be determined how much sediment the project is theoretically preventing from entering a waterway. To calculate an estimate of annual erosion at a given shoreline site, the equation V=LEB is used, where 'V'is volume eroded, 'L'is length of shoreline, 'E' is erosion rate and 'B' is bank height. This equation yields a volume expressed in cubic feet per year. Cubic feet are converted to pounds using a soil bulk density of 93.6 lb/ft^3. Pounds are then converted to tons using a factor of 0.0005. Lengths of shoreline and bank heights are taken from engineering and project plans prepared by consultants for Baltimore County and erosion rates from Department of Natural Resources website, http://shorelines.dnr.state.md.us are used.

Nitrogen and Phosphorus loading rates for shorelines are taken from *'Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay'*, published February 1992. The mean total N and total P loading concentrations in the study are 0.73 lb/ton and 0.48 lb/ton respectively (p. 44).

7.3.3 Stormwater Retrofits

Drainage areas for stormwater management facilities are delineated to determine the acreage on which to apply the pollution reduction efficiencies shown in Table 7-3. Efficiencies are applied to pollutant loads based on land use of these drainage areas.

Table 7-3 Percent Removal Efficiency of BMPs

BMP	Pollutants		
	TSS	TP	TN
Detention Facilities	10	10	5
Extended Detention Facilities	60	20	30
Wet Ponds	80	50	50
Infiltration Practices	90	70	50
Filtration Practices	85	60	40

Detention Facilities = Detention Pond and Hydrodynamic Devices (DP, OGS, and UGS)
Extended Detention Facilities = Extended Detention Ponds (EDSD, EDSW, ED)
Wet Ponds and Wetlands = Wet Pond and Shallow Marsh (WP and SM)
Infiltration Practices = Infiltration Trench and Infiltration Basins (IB, IT and ITWQC), Porous Paving (PP), and Dry Wells (DW)
Filtration Practices = Sand filters and Bioretention Facilities (SF, BIO)

Section 10.2 describes the calculation of pollutant loads for both watersheds and for the drainage area to stormwater management facilities. The pollutant load reductions for stormwater management facility retrofits and conversions uses the loads calculated in accordance with Section 10.2 and the pollutant removal efficiencies based on facility type found in Section 1 – Table 1-8.

7.3.4 Community Reforestation Program

Baltimore County's reforestation program plants trees on public and private land, in stream buffers and open areas. Nutrient reductions associated with buffer plantings are obtained using the sum of a reduction efficiency and a land use change. A reduction efficiency of 25% for Nitrogen and 50% for Phosphorus is applied to 4X the area planted for nitrogen and 2X the area planted for phosphorus. The land use change is from pervious urban nutrient load to forested nutrient load, using loading rates from the Phase 4.3 Chesapeake Bay Program Model. Open area plantings (non-buffer) simply use this land use change to calculate load reductions.

7.3.5 Activities of Volunteer Organizations

Many of the activities that local watershed groups and their volunteers engage in have nitrogen and phosphorus reducing capabilities. Using loading rates and reduction efficiencies from the Phase 4.3 Chesapeake Bay Program Watershed Model, the following Best Management Practices (BMPs) yield nutrient reduction numbers:

- Downspout Disconnection & Rain Barrels - Rooftop acres disconnected is estimated and the loading rate for impervious surface associated with the geographical area is applied to this acreage. At this point in time, these two BMPs are classified as an 'infiltration' practice and the total nitrogen and total phosphorus reduction efficiencies, 50% and 70% respectively, are applied to the estimated load.

- Rain Gardens - Rain gardens drain specific areas of pervious and/or impervious surface. Using nutrient loads based on these two land use types, and applying 'infilltration' reduction efficiencies to these loads, nutrient reduction numbers for rain gardens can be determined.

- Stream Buffer Tree Plantings - Nutrient reductions associated with buffer plantings are obtained using the sum of a reduction efficiency plus a land use change. A reduction

efficiency of 25% for Nitrogen and 50% for Phosphorus is applied to 4X the area planted for nitrogen and 2X the area planted for phosphorus. The land use change is from pervious to forest is calculated using the respective loading rates for Nitrogen and Phosphorus per acre for these land use types. The difference between these figures represents the reduction per year in the associated nutrient.

- Street Tree/Open Space Plantings - Here the land use conversion from pervious acres to forest acres described above is used to determine nutrient reduction.

7.4 Capital Restoration Projects - Upper Western Shore Watersheds

The Upper Western Shore watersheds include: Deer Creek in the Susquehanna River Basin, and Prettyboy Reservoir, Loch Raven Reservoir, Lower Gunpowder Falls, Little Gunpowder Falls, Bird River, Gunpowder River and Middle River in the Gunpowder Falls River Basin. Five of the eight watersheds require watershed management plans based on NPDES requirements on the amount of urban development within the watershed.

7.4.1 Deer Creek

Due to the rural nature of this watershed a watershed management plan is not required by the NPDES – Municipal Stormwater Discharge Permit. Baltimore County's portion of this watershed is approximately eleven square miles. There are no capital improvement projects currently planned for this watershed. Deer Creek is part of the Susquehanna River Basin. The predominate land use in the watershed is agriculture. A Deer Creek WRAS was prepared by Harford County. Baltimore County participated in that effort.

7.4.2 Prettyboy Reservoir

The Prettyboy Reservoir serves as a holding reservoir for the Loch Raven Reservoir. When the Loch Raven Reservoir water levels are low, water is released from Prettyboy Reservoir to maintain the levels in Loch Raven. Water is also released from Prettyboy Reservoir during the summer to maintain the low temperatures necessary to support the trout fishery in Gunpowder Falls.

The Prettyboy Reservoir watershed in Baltimore County is approximately thirty-seven square miles. Its predominate land uses are agriculture and forest. The Prettyboy Reservoir watershed has been listed as impaired by Maryland Department of the Environment for nutrients, mercury in fish tissue, heavy metals, bacteria, and biological impairment. In 2003 a Water Quality Analysis for heavy metals, that indicated no impairment was submitted to EPA and approved. A copy of the document can be found on the web at:
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_prettyboy_final_metals.asp

A TMDL for mercury in fish tissue was prepared and submitted to EPA and approved in 2004. The major source of mercury is from air deposition due to discharges from power plants and incinerators. As such, the major factor in reducing mercury contamination in Prettyboy Reservoir is reductions in emissions, with secondary actions including hazardous waste collection days and "e-cycling". The document may be found on the web at:
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL_final_prettyboy_Hg.asp

The nutrient TMDL for Prettyboy has been prepared and was approved by EPA in March 2007. The TMDL calls for a 54% reduction in Total Phosphorus in order to maintain chlorophyll at levels below eutrophic levels and to maintain dissolved oxygen above the limit of 5mg/l. It was determined through the modeling effort that reductions in nitrogen would have limited effect on the chlorophyll a and dissolved oxygen concentrations. The document may be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Pub_Notice/tmdl_PN_Gunpowder_P_Sed.asp#TMDL_Prettyboy_Reservoir_Nut

The bacteria TMDL was submitted to EPA in August 2008 for the Prettyboy Reservoir watershed. The document may be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Pub_Notice/TMDL_PN_PrettyboyReservoir_Bacteria.asp

The draft *2008 Integrated Report of Surface Water Quality in Maryland* includes a revised non-tidal stream biological listing criteria. Based on the revised criteria, the Prettyboy Reservoir watershed has been delisted for biological impairment. An examination of the biological data would seem to indicate that while the entire watershed is not biologically impaired, the Prettyboy Branch in the south eastern-portion of the watershed is biologically in a poor condition.

With this budget cycle capital money has been proposed for fiscal years 2010 and 2012 for the design and construction of a stream restoration project as indicated in Table 7-4. DEPRM is currently selecting a stream segment for the stream restoration project. Design is to be awarded in 2009.

Table 7-4: Prettyboy Reservoir Watershed – CIP Status

Capital Improvement Projects Through 2008 Prettyboy Reservoir Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Projects Under Design or Construction								
Projects in the Capital Budget								
Prettyboy SR (Design)	SR		225,000	10				
Prettyboy SR (Const.)	SR		450,000	12				
Totals			675,000					

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

In calendar year 2002 Baltimore County participated in a study that examined this watershed to identify threats to the source water resource. Additional participants in this study included Baltimore City, Trust for Public Lands (TPL), USDA Forest Service, University of Massachusetts, and the Baltimore Metropolitan Council of Governments. GIS was used extensively to target areas for preservation and conservation. A draft report was prepared in

November of 2002 and a final one completed in 2003. Residents have organized an environmental organization called the Prettyboy Watershed Alliance and are actively engaged in restoration and resource management activities within the watershed.

The Prettyboy watershed was selected by Maryland Department of the Environment for the preparation of a Watershed Restoration Action Strategy (WRAS). The WRAS was completed in January 2008. The WRAS specifically addressed the nutrient TMDL, along with other stakeholder-identified goals. The completed WRAS can be found on DEPRM's web site at www.baltimorecountymd.gov/go/prettyboy.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Prettyboy Watershed Alliance (PWA) has received two grants under this program. The organization uses the funds to increase their membership, expand their base of volunteers, engage citizens with Stream Watch, participate in the Prettyboy WRAS, and develop partnerships with local schools.

7.4.3 Loch Raven Reservoir Watershed

The Loch Raven Reservoir watershed is listed as impaired by heavy metals, mercury, nutrients, sediment, and biological impairments. In 2008, the draft *2008 Integrated Report of Surface Water Quality in Maryland* listed Loch Raven Reservoir watershed as impaired by bacteria, and with the new biological listing criteria listed the entire watershed as biologically impaired, but removed the individual impairment listing for 12-digit watersheds.

A Water Quality Analysis for heavy metals was performed and submitted to EPA for approval. No impairment for heavy metals was found. The document may be found on the web at: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_lochraven_final_metals.asp

A TMDL for mercury in fish tissue was prepared and submitted to EPA and approved in 2004. The major source of mercury is from air deposition due to discharges from power plants and incinerators. As such, the major factor in reducing mercury contamination in Loch Raven Reservoir in reductions in emissions, with secondary actions including hazardous waste collection days and "e-cycling". The document may be found on the web at: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL_final_lochraven_Hg.asp

The nutrient and sediment TMDLs for Loch Raven Reservoir were approved by EPA in March 2007. As with the Prettyboy Reservoir, Total Phosphorus was found to be the limiting nutrient. The TMDL calls for a 50% reduction in Total Phosphorus and a 25% reduction in sediment. The sediment reduction is intended to expend the longevity of the reservoir by reducing the rate of infilling of the reservoir. The document can be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Pub_Notice/tmdl_PN_Gunpowder_P_Sed.asp#TMDL_Loch_Raven_Reservoir

The Loch Raven Reservoir Watershed Management Plan was completed in 1997. The plan has been submitted to Maryland Department of the Environment. Previous reports have discussed various aspects of the plan. The Goodwin Run-Hunt Valley-Loveton SWAP, discussed above will provide the level of detain necessary for meeting a diverse array of environmental goals.

Table 7-5 presents the status of the capital improvement projects in the Loch Raven Reservoir watershed.

Table 7-5: Loch Raven Reservoir Watershed – CIP Status

Capital Improvement Projects Through 2008 Loch Raven Reservoir Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Spring Branch	NWET	47	276,473	97	343.4	42.3	5,821	12.3
Spring Branch	SR	(10,000)	1,868,380	97	2,020.0	107.0	35,800	140.9
Long Quarter Branch	NWET	139	150,000	99	780.0	90.6	23,643	63.4
Long Quarter Branch	SR	(2,300)	564,581	99	464.6	24.6	23,643	69.7
Dulaney Valley Branch	SR	(1,700)	220,000	98	343.4	18.2	6,086	7.6
East Beaver Dam Run I	SR	(2,000)	372,000	00	404.0	21.4	7,160	12.4
Goodwin Run - Padonia Rd	SR	(700)	491,000	02	141.4	7.5	2,506	60.4
Hampton Branch	SR	(2,500)	630,000	04	505.0	26.8	8.950	19.8
Western Run@Ashland Ch	SR	(500)	365,675	04	101.0	5.4	1,790	2.9
Spring Branch II	SR	(2,500)	1,080,495	08	505.0	26.8	8,950	35.6
Projects Under Design or Construction								
Gypsy Lane Trib.	SR		750,000	10				
Projects in the Capital Budget								
East Beaver Dam Run II	SR		720,000	12				47.8
Loch Raven Retrofit	RET		150,000	14				
Loch Raven SR (Design)	SR		250,000	14				
Totals		186 (22,200)	7,888,604		5,607.8	370.6	115,408	472.8

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

To date eight stream restoration projects have been completed in the watershed and several additional stream restoration projects are in the Capital budget for the future years. The completed stream restoration projects have restored 22,200 linear feet of stream channel.

Two new stormwater management wet ponds have been installed in the Loch Raven Reservoir watershed to date. These two facilities provide water quality and peak flow attenuation for a total of 186 acres of urban land. The resulting pollutant load reductions are displayed in Table 7-3. An additional retrofit, yet to be identified, and three stream restoration projects are currently funded for in the capital budget.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Gunpowder Valley Conservancy (GVC) geographically includes the Loch Raven Reservoir, Lower Gunpowder, Little Gunpowder, Gunpowder River and Bird River watersheds within their organization. The GVC applied for and received their third grant under this program. The organization intends to use the funds to expand their membership base, identify new volunteers, improve their web communication, organize tree planting and clean-up projects, engage citizens in Stream Watch, and conduct neighborhood outreach events. The GVC geographic range includes all of the Gunpowder Basin, therefore the restoration activities can occur anywhere within the basin.

7.4.4 Lower Gunpowder Falls Watershed

The Lower Gunpowder Falls watershed exhibits a diversity of land uses, with the portion below the mainstem of the Gunpowder River within the Perry Hall planned growth area, and the portion above the mainstem devoted mainly to agriculture and forest cover. The Lower Gunpowder Falls is listed by MDE as being impaired by heavy metals, nutrients, and as being biological impaired. In 2008, the draft *2008 Integrated Report of Surface Water Quality in Maryland* listed Lower Gunpowder Falls watershed as biologically impaired according to the new biological listing criteria, but removed the individual impairment listing for 12-digit watersheds.

A Water Quality Assessment for heavy metals was conducted in 2003 and submitted to EPA for approval indicating that the waters were not impaired by heavy metals. The document can be found on the web at:
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_lowergunpowder_final_metals.asp

The draft *2008 Integrated Report of Surface Water Quality in Maryland* indicates that the Lower Gunpowder Falls is a high priority for development of a nutrient TMDL within the next two years. Maryland Department of the Environment is waiting on the final development of the Chesapeake Bay Model – Phase V prior to initiating the model for the Lower Gunpowder Falls TMDL development.

The Lower Gunpowder Falls Watershed Management Plan was completed in 1999. The plan has been submitted to MDE. Previous reports have discussed various aspects of the plan. The development of a SWAP within the Lower Gunpowder Falls is not anticipated to take place in the next several years. The timing of the development of the SWAPs for the Lower Gunpowder will depend on the development of TMDLs for the watershed. Table 7-6 presents the status of the capital improvement projects in the Lower Gunpowder watershed.

Table 7-6: Lower Gunpowder Falls Watershed – CIP Status

Capital Improvement Projects Through 2008 Lower Gunpowder River Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Minebank Run I	SR	(7,000)	1,189,684	00	1,414	74.9	25,060	222.9
Minebank Run II	SR	(10,000)	4,400,000	05	2,020	107.0	35,800	156.7
Minebank Run Trib @ Waller	SR	(482)	258,958	08	97	5.2	1,726	0.1
Cromwell Bridge (DPW)	SR	(1,500)	2,500,000		303	16.1	5,370	
Projects Under Design or Construction								
Jennifer Branch	SR	(4,500)	3,000,000	09	909	48.2	16,110	54.2
Proposed Projects								
Northwind Farms (design)	SR		250,000	10/11				
Lower Gunpowder (design)	SR		250,000	10/11				
Northwind Farms (const.)	SR		800,000	12/13				
Lower Gunpowder (const)	SR		400,000	12/13				
Totals		(23,000)	13,048,642		4,743	251.4	84,066	433.9

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

Three stream restoration projects, which encompass almost the entire Minebank Run watershed, have been completed to date for a total of 19,000 feet of restored stream channel. The amount shown in the table above does not include the construction cost of a bridge that crosses the stream and needed repairs. Two additional stream restoration projects are currently in the design phase. The capital budget also included funding for four future stream restoration projects.

7.4.5 Little Gunpowder Falls Watershed

The Little Gunpowder Falls watershed is located on the eastern side of Baltimore County. The mainstem of the Little Gunpowder Falls serves as the boundary between Baltimore County and Harford County. MDE has previously listed Little Gunpowder Falls as impaired by heavy metals, nutrients, and as being biologically impaired. A Water Quality Assessment for heavy metals was conducted in 2003 and submitted to EPA for approval indicating that the waters were not impaired by heavy metals. The document can be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_littlegunpowder_final_metals.asp

The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in Little Gunpowder Falls being delisted for biological impairment. A Water Quality Analysis (WQA) for nutrient impairment was submitted to EPA for approval in January 2009. With EPA approval of the nutrient Water Quality Analysis, the Little Gunpowder Falls watershed will be placed in category 1 as meeting all water quality standards.

Currently, no capital improvement projects are under design or construction in this watershed. The Watershed Management Plan was completed in March 2002. There is relatively little urban land in the Little Gunpowder Falls watershed and consequently this watershed has fewer

potential projects. The projects that were identified through the watershed management plan, while needed, have a lower priority when considered on a County-wide basis. Table 7-7 presents the capital commitment to the Little Gunpowder Falls watershed through FY2012. The funding for a stream restoration project has been allotted for FY 2012.

Table 7-7: Little Gunpowder Falls Watershed – CIP Status

Capital Improvement Projects Through 2008 Little Gunpowder Falls Watershed								
Project	**Facility Type**	**DA**	**Cost**	**Date**	**Removal Rate (lb./year)**			**Impervious Acres**
					TN	**TP**	**TSS**	
Completed Projects								
None								
Projects Under Design or Construction								
None								
Proposed Projects								
Little Gunpowder (design)	SR		250,000	12				
Totals			250,000					

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

7.4.6 Bird River Watershed

The Bird River is listed as impaired for sediment and as being biologically impaired. A Water Quality Assessment for nutrients was conducted in 2005 and with EPA concurrence (May 9, 2005) was delisted as impaired by nutrients. The Water Quality Assessment can be found at:

http://www.mde.state.md.us/assets/document/Bird%20River%20WQA_final.pdf

The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in Bird River being designated as having insufficient data to determine biological impairment. Therefore, the watershed has been placed into category 3 with regards to biological impairment listing until such time as there is sufficient data to make a determination.

The Bird River Watershed Management Plan was completed in 1995 and was the first watershed management plan completed by Baltimore County. Much of the County's capital improvement work completed to date has been done in the Bird River watershed. Table 7-8 presents project status through calendar year 2008. A total of eight stormwater management facilities have been created or converted to water quality management to date. These facilities manage a total of 492 acres of urban land for water quality and peak flow attenuation.

A total of 30,780 linear feet of stream restoration has either been completed or is in the design phase in the Bird River Watershed. This number does not include the Maryland State Highway Administration stream restoration project on the White Marsh Run mainstem between Route 95 and Route 7, nor the Allison Transmissions stream restoration project below Route 7. Funds for an additional stream restoration project have been provided in the capital budget. Three additional stream restoration projects are in the design phase.

Table 7-8: Bird River Watershed – CIP Status

Capital Improvement Projects Through 2008 Bird River Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Burnam Woods	CNV	36	11,687	95	226.8	29.2	4,583	11.0
Featherhill	CNV	85	18,013	95	461.2	59.7	9,477	18.6
Lawrence Hill	CNV	58	102,091	96	289.4	37.6	4,437	9.8
Perryvale	SR	(800)	120,000	99	161.6	8.6	2,864	3.4
Perryvale-ex.-detention	CNV	38	120,000	99	296.8	38.5	3,489	13.4
Franklin Square	NWET	97	935,416	99	126.3	13.5	1,663	11.5
White Marsh Mall	CNV	112	435,838	99	661.7	46.6	14,734	31.1
White Marsh Run – Main	SR	(4,000)	982,387	00	808.0	42.8	14,320	46.6
White Marsh Business	RET	40	235,597	99	211.0	19.2	14,038	32.2
S. Fork White Marsh	SR	(1,900)	391,803	98	383.8	20.3	6,802	21.1
Bird-Silver Meadow	SR	(400)	128,945	99	80.8	4.3	1,432	21.3
Bird-Woodcroft	SR	(2,000)	700,000	00	404.0	21.4	7,160	56.5
Evergreen SWM	CNV	26	40,828	02	168.5	21.4	2,247	9.0
N. Fork White Marsh Run	SR	(7,000)	1,239,140	04	1,414.0	74.9	25,060	37.8
East Br. Honeygo Run	SR	(4,000)	1,330,000	04	808.0	42.8	14,320	9.3
S. Fork@ Franklin Square	SR	(2,600)	600,000	04	525.2	27.8	9,308	87.1
Projects Under Design or Construction								
WMR@Wht Mrsh Rd-desg	SR	(5,280)	764,500	09	1,066.6	56.5	18,902	73.0
S. Fork WMR@ Kings Ave.	SR	(2,500)	1,020,000	09	505.0	26.8	8,950	21.1
Whitemarsh Run@ Orbitan	SR	(300)	325,000	09	60.6	3.1	1,074	
Proposed Projects								
N. Fork II (Design)	SR		300,000	12				
N. Fork II (Construction)	SR		850,000	12				
Totals		492 (30,780)	9,501,245		8,659.3	595.0	164,860	513.8

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

7.4.7 Gunpowder River Watershed

The Gunpowder River tidal portion is listed as impaired for nutrients. The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in Gunpowder River being designated as having insufficient data to determine biological impairment. Therefore, the watershed has been placed into category 3 with regards to biological impairment listing until such time as there is sufficient data to make a determination. A watershed management plan is not required for the Gunpowder River watershed for the NPDES – Municipal Stormwater Discharge Permit due to the limited urban development. This is a ten square mile watershed and only one capital project has been completed in the watershed. This project is listed in Table 7-9.

Table 7-9: Gunpowder River Watershed – CIP Status

Capital Improvement Projects Through 2008 Gunpowder River Watershed								
Project	Facility Type	DA	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Carrollwood Park	RET	59	350,000	95	367.3	46.3	7,750	17.6
Projects Under Design or Construction								
None								
Proposed Projects								
None								
Totals		59	350,000		367.3	46.3	7,750.1	17.6

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

7.4.8 Middle River Watershed

The tidal portion of the Middle River watershed is listed as impaired for nutrients and sediment. The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in Middle River being designated as having insufficient data to determine biological impairment. Therefore, the watershed has been placed into category 3 with regards to biological impairment listing until such time as there is sufficient data to make a determination.

The Middle River Watershed Management Plan was submitted to Maryland Department of the Environment in 2001. Under DEPRM's Capital Improvement Program, dredging of many of the creeks within this estuary was completed in 2002. To fulfill the dredging permit requirements, a feasibility study was completed to identify potential retrofit sites. Capital projects in Middle River are displayed in Table 7-10.

Much of the capital improvement work that has been completed in the Middle River watershed consists of shoreline improvement projects. A total of five shoreline enhancements have been completed. Five retrofit projects have been completed and one is still under design. The revitalization efforts in the Essex community have provided opportunities for additional water quality enhancements. The Tall Trees project removed deteriorating apartment buildings and created a park. DEPRM used the opportunity to stabilize the stream channel and create a wet pond with an attractive fountain.

Table 7-10: Middle River Watershed – CIP Status

Capital Improvement Projects Through 2008 Middle River Watershed								
Project	Facility Type	DA (ft)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Turkey Point	SE	(1,000)	127,539	97	112.7	74.1	308,880	
Sue Creek	STWET	22	93,274	97	141.4	18.1	2,656	6.9
Dark Head Park	SE	(780)	168,000	90	426.2	280.2	1167600	
Pottery Farm Park	SE	(1700)	351,000	95	190.5	125.3	521,914	
Hawthorne Park	SE	(350)	64,000	95	39.1	25.7	107172	

Dark Head Park II (repair)	SE	na	15,094	99	na	na	na	
Norman Creek	STWET	25	131,151	95	168.7	23.0	2,484	3.5
Tall Trees	SR	(1,000)	1,100,000	06	202.0	10.7	3,580	
Tall Trees	RET	135	combined	06	602.8	71.4		40.9
Frog Mortar	RET		82,000	08	441.1	57.7		18.3
Projects Under Design or Construction								
Galloway Creek	RET		150,000	10				
Proposed Projects								
None								
Totals		182 (4,830)	2,282,058		2,324.5	686.2	2,114,286	69.6

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined
STWET: Stormwater Wetland

7.5 Capital Restoration Projects - Patapsco/Back River Watersheds

The Patapsco/Back River Basin watersheds include: Liberty Reservoir, Patapsco River, Gwynns Falls, Jones Falls, Back River and Baltimore Harbor. Five of the six watersheds require watershed management plans based on the amount of urban development within the watershed.

7.5.1 Liberty Reservoir Watershed

The Liberty Reservoir is listed as impaired for nutrients, metals, sediment, bacteria, with some streams listed as being impaired biologically. A TMDL for mercury in fish tissue was prepared and submitted to EPA for approval in December 2002. The major source of mercury is from air deposition due to discharges from power plants and incinerators. As such, the major factor in reducing mercury contamination in Loch Raven Reservoir in reductions in emissions, with secondary actions including hazardous waste collection days and "e-cycling". The document may be found on the web at:

http://www.mde.state.md.us/assets/document/tmdl/liberty/Liberty_main_pn.pdf

A Water Quality Analysis for chromium and lead was performed and submitted to EPA. EPA concurred (November 10, 2003) that no impairment by chromium and lead is occurring. The document may be found on the web at:

http://www.mde.state.md.us/assets/document/Liberty%20Reservoir%20WQA_final(1).pdf

The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in the entire Liberty Reservoir watershed being listed as biologically impaired. A bacteria TMDL for the Liberty Reservoir was submitted to EPA for approval in September of 2008. The document may be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Pub_Notice/TMDL_PN_Liberty_bacteria.asp

A nutrient TMDL for the Liberty Reservoir watershed is currently being prepared by MDE.

A watershed management plan is not required for the Liberty Reservoir watershed for the NPDES – Municipal Stormwater Discharge Permit due to the limited urban development. The

Liberty Reservoir serves as a drinking water reservoir for portions of Carroll County, Howard County, Baltimore County, Anne Arundel County and Baltimore City. Much of the Baltimore County portion of the drainage area to Liberty Reservoir is under forest cover. While there are no planned capital improvement projects for this watershed, its importance as a water supply reservoir require that additional planning of preservation and reforestation activities be considered in the future.

7.5.2 Patapsco River Watershed

The Patapsco River watershed is listed as impaired for nutrients, sediment, metals, and as being biologically impaired. The changes in the biological listing criteria in the draft *2008 Integrated Report of Surface Water Quality in Maryland* resulted in the entire Patapsco River watershed being designated as biologically impaired.

The Patapsco River Watershed Management Plan was submitted to Maryland Department of the Environment in 2000. Table 7-11 provides a summary of the capital improvement projects in the Patapsco River watershed. One retrofit and five stream restoration projects have been completed in the Herbert Run and Bens Run subwatersheds. A retrofit project was also completed in conjunction with the County's Department of Public Works. An additional stream restoration project is in the design and construction phase. A total of 4,750 linear feet of stream channel has either been restored or is in design to be restored. Additional funding for projects is allocated in the capital budget through FY2012.

A Total Maximum Daily Load (TMDL) has been completed for nutrients, and was submitted to EPA on December 14, 2006 for consideration. The nutrient TMDL was approved by EPA in December 2007. This TMDL covers all of the watersheds draining to Baltimore Harbor. The TMDL has estimated that a 15% reduction in urban non-point source load will be needed, along with upgrades to the Patapsco WWTP to meet water quality standards for tidal Baltimore Harbor. The document can be found on the web at:

http://www.mde.state.md.us/assets/document/harbor-main-051906_PN.pdf

A water quality Analysis for nutrients is open for public comment until June 19, 2009. A TMDL for sediments is also open for public comment until June 19, 2009.

A SWAP has been initiated in the lower urban portion of the Patapsco River watershed. One of the goals for this SWAP will be to reduce nitrogen and phosphorus urban non-point pollutant loadings by 15% through a combination of County actions and projects, and citizen and business actions. The SWAP is anticipated to be completed once additional resources are acquired.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Friends of Patapsco Valley and Heritage Greenway (FPVHG) applied for their forth grant under this program. The organization intends to use the funds to expand their base of volunteers,

increase their membership, organize stream clean ups, engage citizens in Stream Watch, and outreach to schools and institutions.

Table 7-11: Patapsco River Watershed – CIP Status

Capital Improvement Projects Through 2008 Patapsco River Watershed								
Project	**Facility Type**	**DA (LF)**	**Cost**	**Date**	**Removal Rate (lb./year)**			**Impervious Acres**
					TN	**TP**	**TSS**	
Completed Projects								
Bloomsbury (DPW)	RET	10		90	63.5	8.4		1.4
Herbert Run@ Selma Ave.	SR	(550)	227,000	00	111.1	5.9	1,969	38.5
Herbert Run @ Leeds Ave	SR	(300)	78,144	03	60.6	3.2	1,074	2.8
2203 Sulphur Spring Rd	SR	(200)	111,000	03	40.4	2.1	716	10.7
Halethorpe Streambank	SR	(100)	61,500	03	20.2	1.1	358	
Bens Run	SR	(2,000)	570,964	04	404.0	21.4	7,160	21.3
Bens Run	STWET	30	incl. above	04	389.9	41.1	3,150	41.4
Projects Under Design or Construction								
Herbert Run @ First Ave	SR	(1600)	400,000	04	323.2	17.1	5,728	22.6
Herbert Run @ Paradise Ave. - cd	SR		600,000	09	na	na	na	
Proposed Projects								
Patapsco	SR		300,000	12/13				
Totals		40 (4,750)	2,348,608		1,412.9	100.3	20,155	138.7

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
cd: Consent Decree requirement
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined
STWET: Stormwater Wetland

7.5.3 Gwynns Falls Watershed

The County has completed the Gwynns Falls watershed management plan as a joint effort with Baltimore City and using the services of a professional consultant. Approximately two-thirds of the watershed is located in Baltimore County. Owings Mills, one of the County's two designated growth areas, is highly urbanized and located within this watershed. Table 7-12 displays the status of capital projects in the Gwynns Falls watershed.

A TMDL for nutrients has been completed for the Patapsco Basin, including Gwynns Falls. The TMDL identifies a 15% reduction from urban non-point sources as necessary to meet water quality standards in tidal Baltimore Harbor. The nutrient TMDL was approved by EPA in December 2007. The document can be viewed on the web at the location given under the discussion of the Patapsco watershed in section 7.4.2 above.

A TMDL for bacteria has also been developed for Gwynns Falls requiring a reduction in bacteria loads in the range of 98%. The bacteria TMDL was approved by EPA in December 2007. This document can be viewed on the web at:
http://www.mde.state.md.us/assets/document/GwynnsFalls_TMDL_071206_PN.pdf#TMDL_Georges_Creek_bacteria

One hundred and twenty-five (125) acres of urban land have been address through enhanced stormwater management through conversion of existing stormwater management facilities or retrofits of uncontrolled urban discharge. A total of 4,235 feet of stream restoration has been completed. A complete assessment of potential projects is underway for the Scotts Level Branch. This subwatershed was identified in the watershed Management Plan and through staff discussions as one for DEPRM to identify and implement all feasible capital projects. Long term monitoring will be ongoing as well in an effort to quantify the water quality improvements. Over $6,000,000 have been allocated for restoration within the Gwynns Falls in fiscal years 2010 through 2014.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Gwynns Falls Watershed Association applied for and received their second grant under this program. The organization intends to use the funds to expand their base of volunteers, increase their membership, organize stream clean ups, engage citizens in Stream Watch, and outreach to schools and institutions.

Table 7-12: Gwynns Falls Watershed – CIP Status

Capital Improvement Projects Through 2008 Gwynns Falls Watershed								
Project	**Facility Type**	**DA** (LF)	**Cost**	**Date**	**Removal Rate (lb./year)**			**Impervious Acres**
					TN	**TP**	**TSS**	
Completed Projects								
Greenshire Court	SR	(135)	17,690	99	27.3	1.4	483	3.9
Dead Run @ Security/McD	BE	(250)	23, 690	02				
Rutherford Business Ctr.	CNV	56	134,000	03	265.6	30.5	13,188	22.9
Dead R@ HS Ftbridge/wall	SR	(200)	141,000	03	40.4	2.1	716	1.7
Woodlawn HS retrofit	RET/BE	8.9	206,000	03	51.6	9.5	1,399	3.8
Dead Run@ Whitehead Rd	SCR/BE	60	155,000	03				
DR@Woodlawn Dr (Fox)	SR	(450)	232,594	04	90.9	4.8	1,611	24.8
Dead R @ Dogwood Rd	BE	(1,200)	Na	04				
Chartley SR	SR	(2,000)	970,000	06	404.0	21.4	7,160	13.4
Projects Under Design or Construction								
Scotts Level, Feasibility	RET		150,000	09				
Gwynns Falls @ Gwynnbrook - cd	SR		na	09	na	na	na	
Proposed Projects								
I70 Interchange WQ	RET		1,100,000	10				
Scotts Level Retrofit	RET		300,000	10				
Scotts Level I (Design)	SR		500,000	10				
Scotts Level I (Con)	SR		1,250,000	12				
Western Hills Ret	RET		300,000	12				
West View Park Des-Con	SR		1,450,000	12				
Scotts Level II	SR		800,000	14				

Scotts Level Ret	RET		350,000	14				
Totals		124.9 (4,235)	8,056,284		879.8	69.7	24,557	70.5

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
HAB: Habitat improvement
RET: Retrofit
cd: Consent Decree requirement
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined
BE: Buffer Enhancement

7.5.4 Jones Falls Watershed

The Jones Falls Watershed Management Plan was submitted to Maryland Department of the Environment in 1997. Table 7-13 provides a summary of the capital improvement projects in the Jones Falls watershed either completed, in design or proposed.

Three outfalls with a combined acreage of 133 acres have completed retrofit projects to provide water quality improvement. A total of 7,050 linear feet of stream restoration has either been completed or is in the design phase. An additional two retrofits and two stream restoration projects have been allocated for in the future capital budget.

A TMDL for nutrients has been completed for the Patapsco Basin, including Jones Falls. The TMDL identifies a 15% reduction from urban non-point sources as necessary to meet water quality standards in tidal Baltimore Harbor. The nutrient TMDL was approved by EPA in December 2007. The document can be viewed on the web at the location given under the discussion of the Patapsco watershed in section 7.4.2 above.

A TMDL for bacteria has also been developed for Jones Falls and was submitted to EPA September 22, 2006. The bacteria TMDL for Jones Falls was approved in February 2008. This TMDL requires a reduction in bacteria loads in the range of ~95%. This document can be viewed on the web at:

http://www.mde.state.md.us/assets/document/Jones_Falls_TMDL_071706_PN.pdf

Water Quality Assessments were performed by MDE for zinc, copper, and lead. The analysis of zinc was performed first and received EPA concurrence on February 20, 2003. The document can be found at the first link listed below. EPA also concurred with the Water Quality Assessment for copper and lead on December 2, 2004 (second link). Both of these Water Quality Assessments found no impairment related to the heavy metals considered.

http://www.mde.state.md.us/assets/document/Jones%20Falls%20WQA_final(1).pdf

http://www.mde.state.md.us/assets/document/Jones%20Falls%20WQA_final(2).pdf

Table 7-13: Jones Falls Watershed – CIP Status

Capital Improvement Projects Through 2008 Jones Falls Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Robin Hood Cr. minor outf	DET	17	307,359	98	83.0	10.9	185	2.6
Kenilworth Park #144	DET	83	Inc. above	98	441.6	50.0	14,031	39.9
Orchard Hills outfall #149	DET	33	Inc. above	98	547.9	70.8	1,362	20.8

Roland Run - Essex Rd.	SR	(400)	479,488	98	80.8	4.3	1,432	
Roland Run – Sem. Ave.	SR	(100)	Inc. above	98	20.2	1.1	358	
Towson Run – VFW Hall	SR	(600)	349,869	00	121.2	6.4	2,148	70.6
Roland Run – Jeffers Rd.	SR	(1,550)	451,083	02	313.1	16.6	5,585	66.0
Wood Valley	SR	(2,000)	1,077,510	04	404.0	21.4	7,160	24.9
Roland Run-Riderwd. Hills	SR	(2,400)	1,100,000	07	484.8	25.7	8,592	98.3
Projects Under Design or Construction								
Roland Run @Greenspring	SR	(3,500)	1,500,000	09	707.0	37.5	12,530	
Roland Run @Greenspring	RET		620,000	09				
Proposed Projects								
Towson Run @ Cloisters	RET		700,000	10				
Roland Run @ Kellog (D)	SR		200,000	10				
Roland Run @ Kellog (C)	SR		600,000	10				
Totals		133 (10,550)	7,385,309		3,203.6	244.7	53,383	323.1

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
DET: Detention Pond
HAB: Habitat improvement
cd: Consent Decree requirement
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined
BE: Buffer Enhancement

In conjunction with Baltimore City a SWAP for the lower portion of the Jones Falls watershed was completed in the fall of 2008. It is available on DEPRM's web site at http://www.baltimorecountymd.gov/Agencies/environment/watersheds/ep_jonesmain.html. EPA Region III awarded Baltimore County a Water Quality Cooperative Assistance Grant in the amount of $200,000 for the creation of two SWAPs. The one for the Jones Falls includes the subwatersheds of Slaughterhouse Run, Moores Run, Western Run and the Baltimore City portion of the Jones Falls.

A SWAP for Northeastern Jones Falls is currently being developed. The SWAP will address the reductions of nitrogen and phosphorus loads necessary to meet water quality standards. It is anticipated to be completed in 2009.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Jones Falls Watershed Association (JFWA) has applied for their third grant under this program. The organization intends to use the funds to expand their base of volunteers, increase their membership, organize buffer plantings and removal of invasive plants, engage citizens in Stream Watch, and outreach to schools and institutions.

7.5.5 Back River Watershed

The Back River Watershed Management Plan was submitted to Maryland Department of the Environment in 1997. Table 7-14 provides a summary of the capital improvement projects in the Back River watershed either completed, in design or proposed.

Seven stormwater retrofit/conversion projects, addressing 598 acres of drainage area, have been completed. Eight stream restoration projects addressing 10,181 linear feet of degraded stream channel have either been completed or are in the design phase.

A TMDL for nutrients has been completed for the Back River watershed and approved by EPA June 29, 2005. The TMDL identifies a 15% reduction from urban non-point sources as necessary to meet water quality standards in tidal Back River, along with nutrient reductions from the Back River WWTP. This document can be viewed on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL_final_backriver_eutro.asp

In addition to the nutrient TMDL, MDE has developed a TMDL for chlordane (EPA approval December 17, 1999) and a TMDL for bacteria approved by EPA December 4,2007. A Water Quality Assessment was performed for zinc (EPA concurrence December 23, 2004) indicating no impairment due to zinc. These documents can be viewed on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/tmdl_backriver.asp

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Pub_Notice/TMDL_PN_herringrun_bacteria.asp

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_final_backriver_zinc.asp

In conjunction with Baltimore City a SWAP for the upper portion of the Back River watershed was completed in the fall of 2008. It is available on DEPRM's web site at www.baltimorecountymd.gov/go/backriver. EPA Region III awarded Baltimore County a Water Quality Cooperative Assistance Grant in the amount of $200,000 for the creation of two SWAPs. One of these SWAPs was for Back River and includes fourteen of the upper subwatersheds.

To expand the County's overall restoration strategy, DEPRM developed the *Watershed Association Restoration Planning and Implementation Grant* Program. This grant program was developed to address staffing needs of local Watershed Associations. The intent of the grant is to provide part-time funding for staff of volunteer groups. These groups assist the county with participation in County restoration planning, identification of restoration projects, implementation of restoration projects, identify Stream Watch participants, offer educational activities, and can use the grant to leverage additional funding. Annual funding is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended on projects.

The Herring Run Watershed Association (HRWA) has received grants for three consecutive years under this. The organization intends to use the funds to expand their base of volunteers, increase their membership, organize street tree planting projects, organize stream clean up events, engage citizens in Stream Watch, and outreach to schools.

Table 7-14: Back River Watershed – CIP Status

Capital Improvement Projects Through 2008 Back River Watershed								
Project	Facility Type	DA (LF)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Coxs Point I	SE	(220)	45,000		113.5	74.6	311,200	
Coxs Point II	SE	(1,950)	295,000		1,388.2	912.8	3,803,352	
Rocky Point Beach	SE	(1,110)	324,945		1,319.7	867.7	3,615,600	
Rocky Point Long Creek	SE	(1,370)	151,667		407.2	267.7	1,115,618	
Lynch Point Cove – SM	CNV	27	250,000	97	214.0	27.3	3,565	9.8
Stemmers Run@ Dbl Rock	SR	(1,881)	362,905	97	380.0	20.1	6,734	156.5
Stemmers Run	SCR	33	121,000	98				
Redhouse E.S. Retrofit	RET	34	136,794	98	360.6	48.0	4,041	12.0
Greenhill WQ Retrofit	SCR	12	35,273	98	66.3	8.2	1,781	4.1
Rocky Point @ Ballestone	SE	(2,000)	389,480	98	290.1	190.8	794,851	
Redhouse Run Md-7	SCR	11	49,925	99	1.3	0.3	104	1.7
Rossville Industrial Park	CNV	155	184,210	99	931.1	114.6	33,619	59.9
Herring Run (Wiltondale)	SR	(1,400)	295,860	99	282.8	15.0	5,012	113.3
Herring Run (Goucher)	SR	(300)	158,538	00	60.6	3.2	1,074	1.8
OverleaTrib @ HS Prop	SR	(2,600)	529,260	01	525.2	27.8	9,308	20.7
Linover Park	SR	(1,000)	206,745	02	202.0	10.7	3,580	3.7
Rocky Pt. Habitat Creation	HAB	(690)	519,505	02	78.0	51.3	213,670	
Martin Blvd Interchange	NEXT	191	629,144	04	1,153.1	146.8	23,332	50.2
Linwood Avenue	SR	(500)	283,968	04	101.0	5.4	1,790	24.9
Glenwest	RET	135	458,000	04				
Glenwest	SR	(500)	Inc. above	04	101.0	5.4	1,790	
Herring Run @ Sussex Rd.	SRepair	na	96,572	07				
Golden Tree Sec I	CNV				155.3	20.2		6.8
Golden Tree Sec III	CNV				104.9	13.8		4.0
Projects Under Design or Construction								
Redhouse Rn@ St. Pat Rd	SR	(2,000)	1,500,000	10	404.0	21.4	7,160	
Essex Skypark	SE		650,000	10				
Proposed Projects								
Redhouse Run			800,000	10				
Totals		598 (17,521)	8,473,791		8,639.9	2,853.1	9,957,181	469.4

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
RET: Retrofit
SR: Stream Restoration
HAB: Habitat improvement
NEXT: New Extended Detention Pond
SCR: StormCeptor
TBD: To Be Determined
SE: Shoreline Enhancement

7.5.6 Baltimore Harbor Watershed

The Baltimore Harbor Watershed Management Plan was submitted to Maryland Department of the Environment in 2001. Table 7-15 presents the status of capital improvement projects through 2008.

Nine stormwater retrofit/conversion projects have been completed to date along with twelve shoreline enhancement projects. The nine retrofit projects address 620 acres of urban development for water quality improvements. Twelve shoreline enhancement projects have been

completed in the Baltimore Harbor watershed. The capital budget contains money for one additional retrofit project.

A TMDL for nutrients has been completed for the Patapsco Basin, including the Baltimore Harbor watershed. The nutrient TMDL was approved by EPA in December 2007. The TMDL identifies a 15% reduction from urban non-point sources as necessary to meet water quality standards in tidal Baltimore Harbor. The document can be viewed on the web at the location given under the discussion of the Patapsco watershed in section 7.4.2 above. In addition, a TMDL for chlordane (EPA approval March 23, 2001) has been developed. This document can be viewed on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/tmdl_baltoharbor.asp

A number of Water Quality Assessments have been performed in Baltimore Harbor resulting in the delisting of Baltimore Harbor as being impaired by zinc, lead, and chromium (EPA concurrence January 18, 2005). These documents can be found on the web at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_final_harbor_Cr.asp

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/WQA_final_harbor_Zn_Pb.asp

Table 7-15: Baltimore Harbor Watershed – CIP Status

Capital Improvement Projects Through 2008 Baltimore Harbor Watershed								
Project	Facility Type	DA (ft.)	Cost	Date	Removal Rate (lb./year)			Impervious Acres
					TN	TP	TSS	
Completed Projects								
Concrete Homes	SE	(430)	65,000	90	133.4	87.7	365,452	
Watersedge Park	SE	(480)	92,000	90	72.8	47.9	199,400	
Merritt Point Park	SE	(1880)	175,000	90	128.5	84.5	352,000	
Bear Creek I	SE	(475)	66,000	90	112.6	74.1	308,599	
West Inverness	SE	(230)	19,000	90	14.1	9.3	38,800	
Geise Ave.	RET				1.0	0.2		0.5
Chink Creek	RET	12.6		90	86.6	11.4		3.3
Hughes Ave	RET	17		90	12.0	3.1		5.0
Charlesmont	SE	(750)	47,000	93	76.9	50.5	210,600	
Sandy Plains Elem.	SE	(380)	108,000	98	82.7	54.4	226,568	
Tabasco Cove	STWET	135	128,209	96	689.5	72.9	40,851	70.7
Lynch Point Cove	NWET	27	247,660	97				
North Point Creek	NEXT	90	117,277	98	512.5	68.5	8,081	17.0
Schoolhouse @ Oakleigh	SCR	61.5	419,133	98	10.4	2.3	4,259	10.9
Schoolhouse Cove	SCR	61.5	419,133	98	25.4	5.9		21.8
Bear Creek II Shore	SE	(700)	138,558	99	83.2	54.7	228,010	
Bear Creek II SD Retrofit	NWET	12	93,026	99	86.6	11.4	1,672	4.7
Sandy Plains Elem.	SE	380	97,349	99	82.7	54.4	226,568	
Watersedge Park II (repair)	SE	(90)	21,062	99	0.0	0.0	0.0	
Lynch Cove Retrofit site-I	STWET	217	500,000	03	1,564.7	198.4	3,565	84.9
Lynch Cove Retrofit site-II	STWET	109	combined	03	732.1	88.5	3,565	52.9
West Inverness	SE		372,000	03	14.1	9.3	38,750	
Fleming Park	SE	(1767)	540,303	07	25.6	16.9	70,228	

Projects Under Design or Construction								
Pleasure Island	SE		2,805,000	10				
Proposed Projects								
Bear Creek Headwaters	RET	152	100,000	12				
Totals		1274.6 (7,182)	6,570,710		4,547	1006	2,326,968	271.7

Abbreviations
CNV: SWM Pond Conversion
NWET: New Wet Pond
SR: Stream Restoration
STWET: Stormwater Wetland
HAB: Habitat improvement
NEXT: New Extended Detention Pond
SCR: StormCeptor
SE: Shoreline Enhancement
TBD: To Be Determined

7.6 Community Reforestation Program

The Community Reforestation Program (CRP) was established by the Department of Environmental Protection and Resource Management to provide a dedicated workforce for planting, monitoring, and maintaining forest mitigation projects. The Program is funded through fees-in-lieu of mitigation for forests removed as a result of public and private land development, as required by the implementation of the County's Forest Conservation Act and Chesapeake Bay Critical Areas Regulations. The CRP is the only full-time County-wide reforestation mitigation program among Maryland's counties.

The CRP includes a four-person reforestation crew that carries out year-round reforestation operations. The crew is based at a 1-acre site in eastern Baltimore County that is provided by the Department of Recreation and Parks. This home base houses a growing out nursery for 10 thousand tree seedlings; equipment and machinery needed for planting, monitoring, and maintaining the reforestation projects; and office space for the reforestation team.

Occasionally, the CRP will undertake special grant-funded projects to improve water quality and groundwater recharge, as well as wildlife habitat. The most recent example is the expansion of forest buffers and the reforestation of fields on private rural properties. To date, the CRP has reforested over 155 acres in 32 projects in urban and rural areas of Baltimore County. Despite weather fluctuations, ever-present deer and vole predation, and other natural and human stressors, the Program has maintained a strategy of flexibility in matching species selection, planting techniques, tree protection equipment, and maintenance efforts to site characteristics. As a result the Program has experienced a steady increase in tree survival to the present 85+% in recent projects.

Table 7-16 shows an accounting by calendar year and Table 7-17 is a cumulative accounting through 2008 by watershed. The calculation method for pollutant reduction uses a land use conversion to forest cover. An additional reduction is taken for forest planted within a riparian buffer. These methods are described in Section 7.3.4. This is the first NPDES annual report to include tracking of reforestation projects and the resulting nutrient reductions.

Table 7-16: Baltimore County Reforestation Projects by Calendar Year

Year	Acres Planted	N Reduction	P Reduction
1996	11.5	652.5	96.5
1997	3.2	95.0	14.2
1998	3.4	62.0	9.4

1999	6.2	90.2	14.1
2000	5.8	159.7	23.6
2001	15.2	433.6	64.1
2002	13.6	330.5	46.9
2003	18.8	544.1	81.5
2004	16.5	412.3	60.8
2005	25.4	398.5	60.5
2006	19.4	237.4	36.3
2007	16.1	429.6	64.7
Totals	**155.1**	**3,845.1**	**572.7**

Table 7-17: Baltimore County Reforestation Projects by Watershed through 2008

Watershed	Acres Planted	N Reduction (lbs/yr)	P Reduction (lbs/yr)
Upper Western Shore			
Loch Raven	56.12	1644.5	244.6
Lower Gunpowder	1.25	35.5	5.3
Bird River	5.5	166.8	23.1
Gunpowder	20.86	478.7	73.5
Middle River	3.8	115.0	17.3
Upper Western Shore Totals	**87.6**	**2440.5**	**363.8**
Patapsco/Back River			
Liberty	1.0	24.4	3.6
Patapsco	38.8	616.5	92.1
Gwynns Falls	1.5	42.6	6.3
Jones Falls	13.7	332.4	48.6
Back River	8.9	270.4	40.6
Baltimore Harbor	3.0	90.8	13.6
Patapsco/Back River Totals	**66.9**	**1,377.1**	**204.8**
Grand Totals	**154.5**	**3,817.6**	**568.5**

7.7 Volunteer Organizations

Baltimore County has several very active volunteer organizations whose mission is focused on enhancement of environmental resources. In an effort to expand their ability to organize and conduct restoration activities, DEPRM developed a grant program entitled, *Watershed Association Restoration Planning and Implementation Grant* program. This grant program was developed to keep permanent staff with the county's local Watershed Associations. The groups continue implementation of restoration projects and educational activities, and also participate in County restoration planning, support the Stream Watch program, and the money can be used to leverage additional grant funding. We also capture an accounting of the groups' efforts and then add these restoration activities into our County's totals for meeting nutrient reduction goals. Annual funding for each group is limited up to $30,000 with a minimum of 1000 hours of staff time to be expended each year. Table 7-18 below is the nutrient reductions by group.

Table 7-18: Watershed Groups' Projects Resulting in Nutrient Reductions

Watershed Group	Project	N Reduction (lbs/yr)	P Reduction (lbs/yr)
2006			
Gunpowder Valley Conservancy	Buffer Plantings	130.4	18.6
Herring Run Watershed Association	Rain Barrels	0.9	0.1

	Tree Plantings	3.5	0.6
Jones Falls Watershed Association	Buffer Plantings	52.1	7.4
	Tree Plantings	18.1	2.8
Friends of Patapsco Valley	Tree Plantings	8.9	1.4
2007			
Gunpowder Valley Conservancy	Buffer Plantings	195.6	27.8
Herring Run Watershed Association	Rain Barrels	0.9	0.1
	Buffer Plantings	9.1	1.3
	Tree Plantings	0.4	0.1
Jones Falls Watershed Association	Buffer Plantings	104.3	14.8
	Rain Barrels	0.8	0.1
	Rain Garden	7.9	1.6
Friends of Patapsco Valley	Buffer Plantings	40.1	5.7
	Tree Plantings	8.9	1.4
	Rain Garden	1.0	0.1
Totals		**582.9**	**83.9**

7.8 Additional Restoration Efforts

7.8.1 Growing Home Campaign

The *Growing Home Campaign* provides a needed alternative for the control of urban non-point source pollution. There are approximately 130,000 acres of land within Baltimore County's urban area delineated by the County's Urban Rural Demarcation Line (URDL). Residentially zoned land covers approximately 100,000 acres. Overall only about 20% of the County's urban area is managed by stormwater facilities, half of which are older stormwater detention ponds providing no significant water quality functions. Additional significant acreage of residential development exists outside the URDL at lower densities. DEPRM's watershed water quality management plans have identified a relatively small number of feasible locations for construction of stormwater water quality retrofits on public land. The Growing home Campaign is one way the County is gaining stormwater benefits from private lands and includes a cost share component. Tables 7-19 and 7-20 show the number of trees purchased and their planting location by watershed. Future reports will attempt to quantify the stormwater benefit from this program.

Table 7-19: Number of Trees Planted in the Upper Western Shore Basin

	Deer Creek	Prettyboy Reservoir	Loch Raven	Lower Gunpowder	Little Gunpowder	Bird River	Gunpowder River	Middle River
2006	25	4	195	70	11	36	0	16
2007	12	3	153	87	31	72	23	35
2008	16	11	192	95	25	26	0	37

Table 7-20: Number of Trees Planted in the Patapsco/Back River Basin

	Liberty Reservoir	Patapsco L. N. Br.	Gwynns Falls	Jones Falls	Back River	Baltimore Harbor
2006	0	19	34	43	58	2
2007	5	67	74	74	77	12
2008	2	49	48	149	84	37

7.8.2 Tree-Mendous Maryland Program in Baltimore County

Baltimore County continues to partner with the MD DNR to actively promote the Tree-Mendous Maryland Program. In 2008, DEPRM provided technical assistance and received requests for

free delivery of 18 orders, totaling 466 trees. The Tree-Mendous Maryland program in Baltimore County continues to be a valuable component of the effort to increase urban, suburban, and rural forest cover in Baltimore County. During the course of the 38 planting seasons since the program has been in existence, DEPRM has delivered almost 13,000 trees in 509 orders requesting free delivery, serving school and neighborhood groups in hundreds of communities. Figure 7-1 below indicates the numbers of trees delivered by Baltimore County since program inception. Since 2004, DEPRM has been tracking the total number of Tree-Mendous trees ordered by Baltimore County groups versus the number delivered free by DEPRM. When tree orders that did not request free delivery are factored in for the years 2004 to 2008, the approximate number of Tree-Mendous trees planted yearly in the County remains at about 1,200 trees. Future reports will attempt to quantify the stormwater benefit from this program.

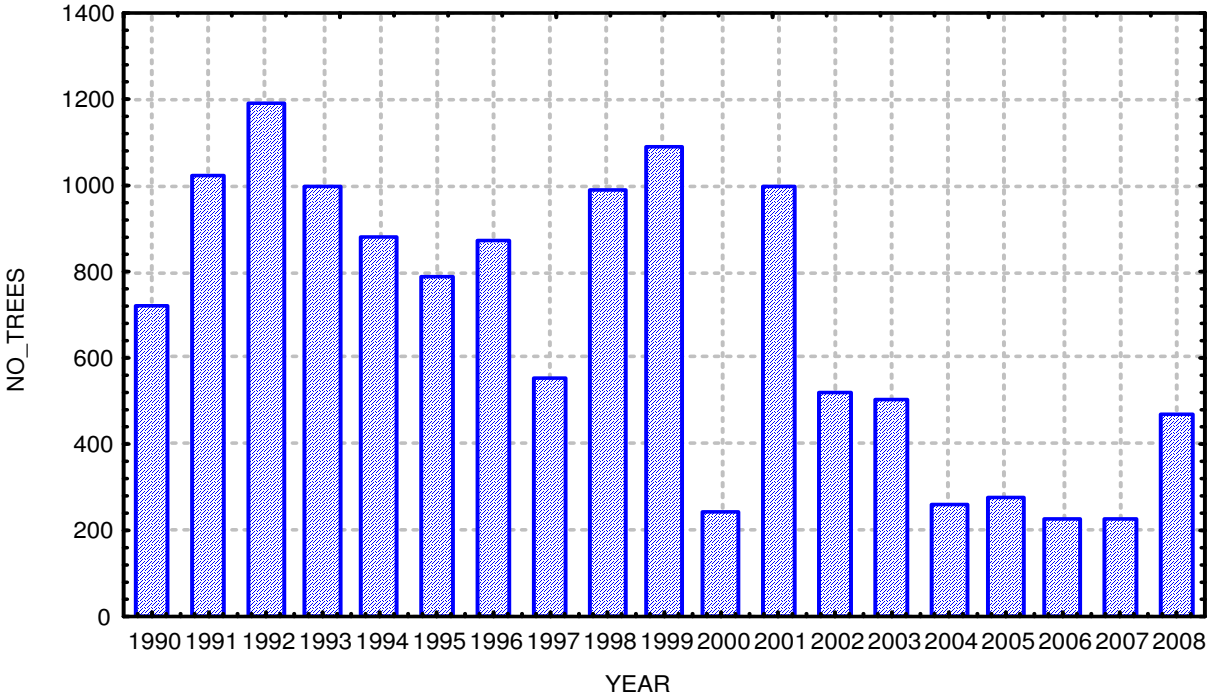


Figure 7-1: Number of trees obtained through the Tree-Mendous Maryland Program with technical assistance and free tree delivery by DEPRM between 1990 and 2008.

7.9 Pollution Reduction Tracking Database

The pollution reduction tracking database currently tracks reductions from capital construction projects. It includes elements that are shown in the pollutant reduction tables in this section. In addition, pollutant reduction attributable to certain types of restoration (stream channel restoration and buffer planting) must continue to be monitored and assessed. Spring Branch has provided the data for a preliminary estimate of pollutant load reduction per linear foot of restored stream channel. A grant project that DEPRM and the Water Environment Research Federation (WERF) have completed provides information on pollutant reduction benefits of urban forested riparian buffers. The Chesapeake Bay Program has assigned a tentative pollutant removal efficiency of 25% for Total Nitrogen and 50% for Total Phosphorus and Total Suspended Solids.

In addition to the pollutant removal efficiencies the Chesapeake Bay Program counts urban forest riparian buffers as a land use conversion. The establishment of DEPRM's Community

Reforestation Program (CRP) provides a dedicated workforce for planting, monitoring, and maintaining forest mitigation projects. The County is including reduction efficiencies for these projects for the first time in this current 2009 report. The calculation method for pollutant reduction uses a land use conversion to forest cover. An additional reduction is taken for forest planted within a riparian buffer. These methods are described in Section 7.3.4.

7.10 Impervious Surface Calculation

The impervious surface acreage in Baltimore County was calculated by using a GIS planimetric building footprint data layer and a planimetric roadway data layer that was created from aerial photography flown from 1995-1997. The building data layer does not include sidewalks or driveways. The roads data layer includes parking lots. The data are presented by watershed in Table 7-15. A new planimetric data layer for both buildings and roadways, based on 2005 aerial photography, is available for this reporting year. The new impervious cover based on the 2005 aerials is also presented in Table 7-21.

Using this methodology a total impervious coverage increased from 36,300 acres to 40,900 acres over the 8-year period. This represents ~575 acres of new impervious cover each year.

Table 7-21: Baltimore County Impervious Area by Watershed – Changes Between 1997 and 2005

Watershed	Drainage Area (acres)	Total Acres Impervious 1997	% Impervious 1997	Total Acres Impervious 2005	% Impervious 2005
Upper Western Shore Watersheds					
Deer Creek	7,131	167.2	2.35	193.4	2.71
Prettyboy Reservoir	25,545	463.7	1.81	528.2	2.07
Loch Raven Reservoir	139,554	6,277.3	4.50	7,203.9	5.16
Lower Gunpowder Falls	29,471	2,091.3	7.10	2,474.4	8.40
Little Gunpowder Falls	17,229	598.6	3.47	702.4	4.08
Bird River	16,463	2,125.9	12.91	2,836.4	17.23
Gunpowder River	6,065	346.2	5.71	436.5	7.20
Middle River	6,520	1,300.2	19.94	1,442.2	22.12
Upper Western Shore Totals	**247,978**	**13,370.4**	**5.55**	**15,817.4**	**6.38**
Patapsco/Back River Watersheds					
Liberty Reservoir	17,555	528.0	3.01	685.5	3.90
Patapsco River	33,186	4,125.1	12.43	4,574.2	13.78
Gwynns Falls	28,643	6,152.5	21.48	6,989.6	24.40
Jones Falls	25,945	3,513.6	13.54	3,890.3	14.99
Back River	23,248	5,255.9	22.61	5,846.4	25.15
Baltimore Harbor	11,453	2,973.0	25.96	3,124.8	27.28
Patapsco/Back River Totals	**140,030**	**22,548.1**	**16.10**	**25,110.8**	**17.93**
County-Wide Totals	**388,008**	**36,301.6**	**9.35**	**40,928.2**	**10.55**

To meet the current NPDES permit requirement Baltimore County must provide restoration for impervious land areas that are equal to or greater than 20% of the County's urban impervious cover. Roads and buildings that are owned by the Maryland State Highway Administration and other state agencies, along with federally owned property, do not have to be addressed by Baltimore County. Therefore the roadways and building that are owned by the Maryland State Highway Administration, other state agencies, and the federal government were identified and the acreage of impervious cover associated with those were removed from Baltimore County's requirement. The results are presented in Table 7-22. The roadways and buildings owned by the

state and federal government account for 4,482 acres of impervious area in Baltimore County or 11% of the total impervious area.

Table 7-22 calculates that Baltimore County is required to manage 10% of 36,446 acres, which equals 3,645 acres of impervious cover each 5-year permit term. Baltimore County is required to manage 20% of the county impervious area by June 2010. This is currently accounted for through the construction of restoration projects and state-of-the-art stormwater management facilities (see Section 1) and also through street sweeping and storm drain inlet cleaning (see Section 3). Watershed management plans list specific potential projects that address water quality restoration. The capital budget provides funds on a watershed basis for implementation of the projects found to be feasible. The specific projects completed and currently under design or construction are listed in Tables 7-4 through 7-15 by watershed. Unidentified projects for each watershed are also listed by type.

Table 7-22: Baltimore County and Maryland State Highway Impervious Acreage

Watershed	Impervious Acres in Baltimore Co.	Impervious Acres owned by SHA	Remaining Impervious Acres
Upper Western Shore Watersheds			
Deer Creek	193.4	27.8	165.5
Prettyboy Reservoir	528.2	21.7	506.5
Loch Raven Reservoir	7,203.9	643.9	6,560.0
Lower Gunpowder Falls	2,474.4	192.9	2,281.5
Little Gunpowder Falls	702.4	90.5	611.9
Bird River	436.5	283.6	396.0
Gunpowder River	2,836.4	40.4	2,552.7
Middle River	1,442.2	279.8	1,162.3
Upper Western Shore	**15,817.4**	**1580.6**	**14,236.4**
Patapsco/Back River Watersheds			
Liberty Reservoir	685.5	123.9	561.6
Patapsco River	4,574.2	721.3	3,852.9
Gwynns Falls	6,989.6	727.6	6,261.9
Jones Falls	3,890.3	467.7	3,422.6
Back River	5,846.4	548.8	5,297.6
Baltimore Harbor	3,124.8	312.0	2,812.8
Patapsco/Back River	**25,110.8**	**2901.3**	**22,209.4**
County-Wide Totals	**40,928.2**	**4,481.9**	**36,445.8**

The drainage areas for most of the completed projects and the associated impervious acreage have been delineated with the use of GIS. The drainage area for each CIP project that has been completed was delineated using topography or consultant information. An associated GIS data layer was created of all the CIP project drainage areas. The area of impervious surfaces within each digitized drainage area was measured. The total of these impervious surfaces was categorized by watershed and is included in Table 7-23.

The impervious acreage addressed by completed capital improvement projects is listed in Table 7-23. Baltimore County through its Capital Improvement Program has addressed 2,781 acres of its impervious acreage required under the current NPDES permit. In addition, 4,005.0 acres of impervious cover has been address through installation of stormwater management that does not have any further potential for retrofits (e.g. stormcepters, underground storage) or is already providing advanced water quality benefits (e.g. extended detention). This results in a total of

18.6% of the impervious area in the County addressed through water quality controls. Section 10 contains a complete accounting of pollutant load reduction and impervious acres addressed.

Table 7-23: Impervious Acreage Addressed by Completed Capital Projects and Advanced Treatment SWM Facilities

Watershed	Impervious Acres to be Addressed	CIP Projects Drainage Area	CIP Project Impervious Acres Addressed	SWM Advanced Treatment Impervious Acres Addressed	Total Impervious Area Addressed	Total Percent of Impervious Addressed
Upper Western Shore						
Deer Creek	165.5	0	0	0.0	0	0.0%
Prettyboy Reservoir	506.5	0	0	4.6	4.6	0.6%
Loch Raven Reservoir	6,560.0	2,341.9	472.8	615.4	1,088.2	16.6%
Lower Gunpowder Falls	2,281.5	2,324.3	434.0	256.8	690.8	30.3%
Little Gunpowder Falls	611.9	0	0	27.8	27.8	4.5%
Bird River	2,552.7	2,193.2	513.8	414.5	928.3	36.4%
Gunpowder River	396.0	65.9	17.6	27.7	45.3	11.4%
Middle River	1,162.3	232.7	69.6	82.5	152.1	13.1%
Upper Western Shore Totals	**14,236.4**	**7,158.0**	**1,507.8**	**1429.3**	**2,937.1**	**20.6%**
Patapsco/Back River						
Liberty Reservoir	561.6	0	0	33.2	33.2	0.6%
Patapsco River	3,852.9	486.2	138.7	395.2	533.9	13.9%
Gwynns Falls	6,261.9	113.9	70.5	1,209.3	1,279.8	20.4%
Jones Falls	3,422.6	1,013.1	323.1	371.9	695.0	20.3%
Back River	5,297.6	1,703.5	469.4	518.0	987.4	18.6%
Baltimore Harbor	2,812.8	696.2	271.8	48.1	319.9	11.4%
Patapsco/Back River Totals	**22,209.4**	**4,012.9**	**1,273.5**	**2,575.7**	**3,849.2**	**17.3%**
County-Wide Totals	**36445.8**	**11,170.9**	**2,781.3**	**4005.0**	**6786.3**	**18.6%**

The recently developed SWAPs and those currently under development will provide information to determine the extent of the restoration options necessary to meet TMDL determined pollutant load reductions, and the Maryland Chesapeake Bay Tributary Strategies. At the same time these plans will satisfy the NPDES – MS4 permit to address impervious area. Table 7-24 presents the information of the impervious cover that will be addressed by these five plans.

Table 7-24: County Impervious Cover Addressed by the Current SWAPs

Planning Area	Status	County Drainage Area (acres)	Total Impervious Area	% County Imp. Area (total = 36,446)
Prettyboy WRAS	Complete	25,545	507	1.4
Lower Jones Falls SWAP	Complete	5,485	1,052	2.9
Upper Back River SWAP	Complete	15,395	4,218	13.6
Spring Branch SWAP*	Complete	1,006	187	0.5
Tidal Back River SWAP	In Development	7,720	1,424	3.9
Northeastern Jones Falls SWAP	In Development	7,463	1,705	4.7
Loch Raven Reservoir Urban Southwest	In Development	9,126	1,823	5.9
Lower Patapsco	Delayed	17,569	3,365	10.9
Total		**89,309**	**14,281**	**44.0**

*The Spring Branch SWAP will become a part of the Loch Raven Reservoir Urban Southwest SWAP.

As can be seen from the Table 7-24, over forty percent of the impervious area in the County will be addressed by these seven plans. As projects are implemented as prioritized through these plans or in other portions of the County, the impervious area addressed by those projects will be added to Table 7-23.

8.0 Permit Requirements

D. Discharge Characterization

Baltimore County and 10 other municipalities in Maryland have been conducting discharge characterization monitoring since the early 1990's. From this expansive monitoring, a statewide database has been developed that includes hundreds of storms across numerous land uses. Summaries of this dataset and other research performed nationally effectively characterize stormwater runoff in Maryland for NPDES municipal stormwater purposes. These data shall be used by Baltimore County for guidance to improve stormwater management programs and develop watershed restoration projects. Monitoring required under this permit is now designed to assess the effectiveness of stormwater management programs and watershed restoration projects developed by the County. Details about this monitoring can be found in PART III. H.

H. Assessment of Controls

Assessment of controls is critical for determining the effectiveness of the NPDES stormwater management program and progress toward improving water quality. Therefore, Baltimore County shall use chemical, biological, and physical monitoring to document work toward meeting the watershed restoration goals identified above. Additionally, the County shall continue physical stream monitoring in the Windlass Run to assess the implementation of the *2000 Maryland Stormwater Design Manual* or other innovative stormwater management technologies approved by MDE. Specific monitoring requirement are described below.

1. Watershed Restoration Assessment

   The County shall monitor the Scotts Level Branch, or, select and submit for MDE's approval a new watershed restoration project for monitoring. Ample time shall be provided so that pre-restoration monitoring, or characterization monitoring can take place. Priority will be given to new practices where little monitoring data exist or where the cumulative effects of watershed restoration activities can be assessed. An outfall and associated in-stream station, or other locations based on an approved study design shall be monitored. The minimum criteria for chemical, biological, physical monitoring are as follows:

   a. Chemical Monitoring

      i. Twelve (12) storm events shall be monitored per year at each monitoring location with at least three occurring per quarter. Quarters shall be based on the calendar year. If extended dry weather periods occur, baseflow samples shall be taken at least once per month at the monitoring stations if flow is observed;

      ii. Discrete samples of stormwater flow shall be collected at the monitoring stations using automated or manual sampling methods. Measurements of

pH and water temperature shall be taken;

iii. At least three (3) samples determined to be representative of each storm event shall be submitted to a laboratory for analysis according to methods listed under 40 CFR Part 136 and event mean concentrations (EMC) shall be calculated for:

Biochemcial Oxygen demand (BOD_5)	Total Lead
Total Kjeldahl Nitrogen (TKN)	Total Copper
Nitrate plus Nitrite	Total Zinc
Total Suspended Solids	Total Phosphorus
Total Petroleum Hydrocarbons (TPH)	Oil and Grease*
Fecal Coliform or E. coli	(*Optional).

iv. Continuous flow measurements shall be recorded at the in-stream monitoring station or other practical locations based on an approved study design. Data collected shall be used to estimate annual and seasonal pollutant loads and for the calibration of the watershed assessment models.

b. Biological Monitoring

i. Benthic macroinvertebrate samples shall be gathered each Spring between the outfall and in-stream stations or other practical locations based on an approved study design; and

ii. The County shall use the U.S. Environmental Protection Agenciy's (EPA) Rapid Bioassessment Protocols (RBP), Maryland Biological Stream Survey (MBSS), or other similar method approved by MDE.

c. Physical Monitoring

i. A geomorphologic stream assessment shall be conducted between the outfall and in-stream monitoring locations or in a reasonable area based on an approved study design. This assessment shall be include an annual comparison of permanently monumented stream channel cross-sections and the stream profile;

ii. A stream habitat assessment shall be conducted using techniques defined by the EPA's RBP, MBSS, or other similar method approved by MDE; and

iii. A hydrologic and/or hydraulic model shall be used (e.g., TR-20, HEC-2, HSPF, SWMM, etc.) to analyze the effects of rainfall discharge rates; stage; and if necessary, continuous flow on channel geometry.

d. Annual Data Submittal: The County shall describe in detail its monitoring activities for the previous year and include the following:

i. EMCs submitted on MDE's long-term monitoring database as specified in PART IV below;

Chemical, biological, and physical monitoring results and a combined analysis for the Scotts Level Branch or other approved monitoring

ii. locations; and

iii. Any requests and accompanying justifications for proposed modification to the monitoring program.

2. Stormwater Management Assessment

The County shall continue monitoring the Windlass Run for determining the effectiveness of the *2000 Maryland Stormwater Design Manual* for stream channel protection. Physical stream monitoring protocols shall include:

a. An annual stream profile and survey of permanently monumented cross-sections in the Windlass Run to evaluate channel stability in conjunction with the implementation of the *2000 Maryland Stormwater Design Manual*.

b. A comparison of the annual stream profile and survey of the permanently monumented cross-sections with baseline conditions for assessing areas of aggradation and degradation; and

c. A hydrologic and/or hydraulic model shall be used (e.g., TR-20, HEC-2, HEC-RAS, HSPF, SWMM, etc.) to analyze the effects of rainfall discharge rates; stage; and, if necessary, continuous flow on channel geometry.

8.1 Introduction

The third term of the Baltimore County – NPDES MS4 Permit that became effective June 15, 2005 resulted in a change in the long-term monitoring location. The long-term monitoring site was moved from Spring Branch in the Loch Raven watershed to Scotts Level Branch in Gwynns Falls watershed. This report will present the research design and monitoring data for Scotts Level Branch (8.2, 8.3), and the data for Windlass Run (8.4).

8.2 Scotts Level Branch Long-Term Monitoring

The Baltimore County NPDES Municipal Stormwater Discharge Permit requires monitoring of restoration effectiveness. For the first two rounds of the 5-year permit, the Spring Branch subwatershed had been monitored to determine the effectiveness of the stream restoration in promoting stream stability, reduction in pollutant loads, and improvement in the benthic macroinvertebrate community. Using the experience gained in monitoring Spring Branch, a more effective monitoring program has been designed for the Scotts Level Branch subwatershed, as detailed below.

Scotts Level Branch is located in the Gwynns Falls watershed in the Patapsco/Back River Basin. The 303(d) lists these waters as being impaired by nutrients, suspended sediments, and fecal coliform bacteria. In addition, Scotts Level Branch is listed as impaired for biology. The TMDLs for nutrients and bacteria have been completed. The TMDL for nutrients has identified a reduction of 15% nitrogen and phosphorus loads from urban non-point sources as needed to meet water quality standards in Baltimore Harbor. The TMDL for bacteria has identified a ~98% reduction for human and domestic pet sources.

While the Spring Branch study monitored the effectiveness of one large restoration project, the Scotts Level Branch monitoring is designed on the basis that a number of restoration projects will be implemented within the subwatershed over a period of time. The ability to detect effects of individual restoration projects will be dependent on the size of the restoration project in relation to the total subwatershed size. Therefore each restoration project will be monitored for project effectiveness, dependent on staff availability. The cumulative effects of restoration will be measured at the long-term in-stream monitoring site.

In order to assess restoration progress in the Scotts Level Branch subwatershed, a paired watershed, before-after design concept will be used. Two additional subwatersheds within Gwynns Falls, Powder Mill Run and Upper Gwynns Falls (above Gwynnbrook Road) have been selected as the "paired" subwatersheds (Figure 8-1).

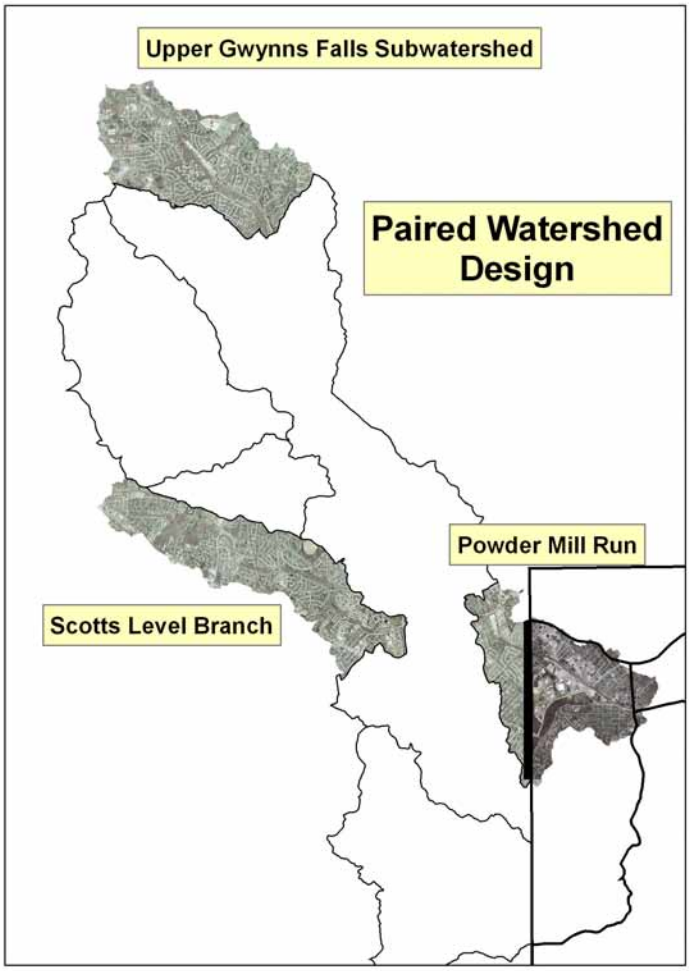


Figure 8-1: Subwatersheds to be used in the Paired Watershed Monitoring Design.

Table 8-1 presents a comparison between the three subwatersheds in relation to overall size, land use composition, percent impervious cover, and stream length. The third subwatershed (Upper Gwynns Falls) was added due to the fact that Baltimore City will be doing stream restoration work in the Powder Mill Run subwatershed. Restoration work will also be conducted in the Upper Gwynns Falls subwatershed in the future, with restoration work in Scotts Level Branch beginning in a few years.

Table 8-1: Scotts Level Branch, Powder Mill Run, and Upper Gwynns Falls Information

Parameter	Scotts Level Branch	Powder Mill Run	Upper Gwynns Falls
Area (acres)	2,186	2,436	2,637
Land Use			
% Residential	91.1	63.4	74.9
% Commercial/Ind	6.0	32.5	6.3
% Forest	2.9	4.1	11.6
Impervious Cover (%)	23.7	33.8	21.4
Stream Miles	8.0	5.9	11.1

The monitoring will consist of flow monitoring, chemical monitoring, geomorphological monitoring, and biological monitoring as described below.

8.2.1 Monitoring Design

8.2.1.1 Flow Monitoring

Each of the three subwatersheds has had a gage installed and operated by the US Geological Survey (Table 8-2) with funding provided by Baltimore County in total for the Powder Mill Run and Scotts Level Branch gages and in part for the Upper Gwynns Falls gage (Delight). USGS will provide the rating curves for the gages and annual data. A 36" outfall near the headwater of Scotts Level Branch will be monitored for discharge and chemistry. A weir was installed to permit continuous flow monitoring with a water level sensor installed and operated by Baltimore County. USGS has a preliminary rating curve, but technical issues need to be worked out before it will be finalized. This outfall has a drainage area of 15.9 acres with ~35% impervious cover. The land use is ~88% medium residential and therefore representative of the major land use in each of the subwatersheds.

Table 8-2: USGS Gage Information

Gage Number	Location	Measurements			Real Time	Period of Record
		Stage	Discharge	Precipitation		
01589197	Upper Gwynns Falls	X	X	X	Yes	October, 1998 - Current
01589305	Powder Mill Run	X	X		Yes	November, 2005 – Current
01589290	Scotts Level Branch	X	X		Yes	November, 2005 – Current

The flow monitoring will be used in conjunction with the chemical monitoring (described below) to determine pollutant loads and in relation to the geomorphological monitoring. Over time the flow data will be assessed for any changes in relation to restoration work that is conducted in the subwatersheds.

8.2.1.2 Chemical Monitoring

The chemical monitoring will include both storm event and baseflow monitoring components. The standard list of chemicals detailed in the permit requirements will be analyzed. Figure 8-2 displays the location of the chemical monitoring sites in Scotts Level Branch by type.

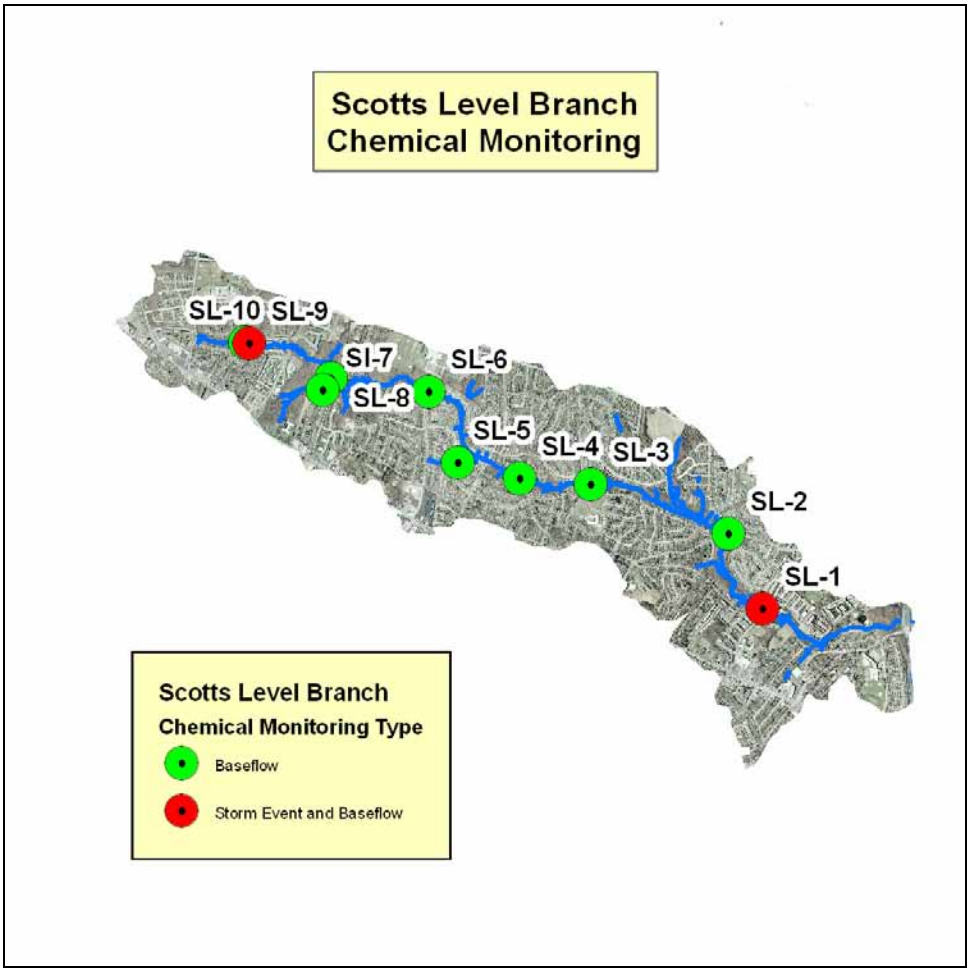


Figure 8-2: Scotts Level Branch Chemical Monitoring Locations

Storm Event Monitoring

Storm event monitoring will occur at each of the three USGS gages and at the outfall. The two Scotts Level Branch storm event monitoring sites (SL-1 in-stream, and SL-9 outfall) will be monitored for 12 storms each calendar year seeking to acquire samples for the entire hydrograph. At the other USGS gage at the Upper Gwynns Falls storm event grab samples will be collected to represent a range of stage discharges. The data for the Powder Mill site will come from Baltimore City. The data from all four sites will be analyzed using regression analysis to determine the relationship between discharge and pollutant concentration. These relationships will then be used in conjunction with the flow data collected from the USGS operated gages and the water level sensor operated by DEPRM. The results and subsequent analysis following restoration will be used to determine annual loads and any load reductions due to restoration activities.

The pollutant load data collected from the Scotts Level Branch outfall will be used to estimate the wash load (the load derived from the land surface). While the pollutant load estimate derived from the Scotts Level Branch in-stream site will estimate the watershed load, which includes both the wash load and the load derived from stream bank erosion. The geomorphological analysis (see below) will attempt to determine the stream channel erosion component via changes in the channel cross-section and analysis of the pollutant concentration of the stream bank and bed. Thus the wash load (derived from the outfall data) plus the stream erosion load (derived from the geomorphological data) should equal the watershed load (derived from the in-stream monitoring data). These data should provide an estimate of the relative proportions of pollutants derived from the land surface and the stream corridor. This will have important implications for restoration efforts in urban settings. If, as the literature suggests, a large component of the sediment and total phosphorus load is derived from the stream channel, then in order to meet sediment and phosphorus load reduction requirements for TMDLs and the Chesapeake Bay Program additional effort will need to be focused on stream restoration.

Baseflow Monitoring

Scotts Level Branch baseflow monitoring will occur at the outfall (SL-9), two tributary locations, and six mainstem locations for a total of 10 baseflow monitoring sites (Figure 8-2). Within Powder Mill Run baseflow monitoring will take place at the USGS gage and two up-stream sites that are representative of each major branch (one in the County and one in the City). Baseflow monitoring in Upper Gwynns Falls will occur only at the USGS gage site. The baseflow sites in Scotts Level Branch, Powder Mill Run, and Upper Gwynns Falls will be monitored quarterly during baseflow conditions (preceded by a minimum of 72 hours dry weather).

Analysis of baseflow pollutants is especially important in relation to nitrogen. Research work conducted by the County, indicates that ~50% of the nitrogen load occurs during dry weather conditions. The baseflow sampling will be used in conjunction with the storm event sampling to partition the annual discharge and pollutant load between baseflow (dry weather) conditions and storm event conditions.

8.2.1.3 Geomorphological Monitoring

The geomorphological monitoring is intended to provide an estimate of stream erosion and deposition rates, and an estimate of the pollutant load derived from stream channel erosion. In addition, it is intended over time to provide an estimate of the effects of restoration on stream stability on both a project basis and over the entire subwatershed.

In order to assure unbiased selection of cross-section locations, Scotts Level Branch and Powder Mill Run were divided into 30 equal length stream segments, 20 in Scotts Level Branch (Figure 8-3) and 10 in Powder Mill Run (Figures 8-4). Within each segment a point was randomly selected, using a GIS subroutine, for location of permanent cross sections. These cross sections will be monitored annually with the results overlaid to provide an assessment of the amount of channel change. Three longitudinal profile reaches will be selected in Scotts Level Branch for annual assessment.

Stream bank and bed core samples will be collected in the vicinity of the permanent cross sections for laboratory analysis of bulk density, particle size distribution, total nitrogen, and total

phosphorus. These will be one-time sample collections, with 10% of the sites, randomly selected, for a second round of sample collection to provide an analysis of annual variability. Based on the annul and long term change, and the results of the core samples, the estimated annual sediment, total nitrogen, and total phosphorus loads will be calculated for comparison with the chemical monitoring results derived from the in-stream monitoring site.

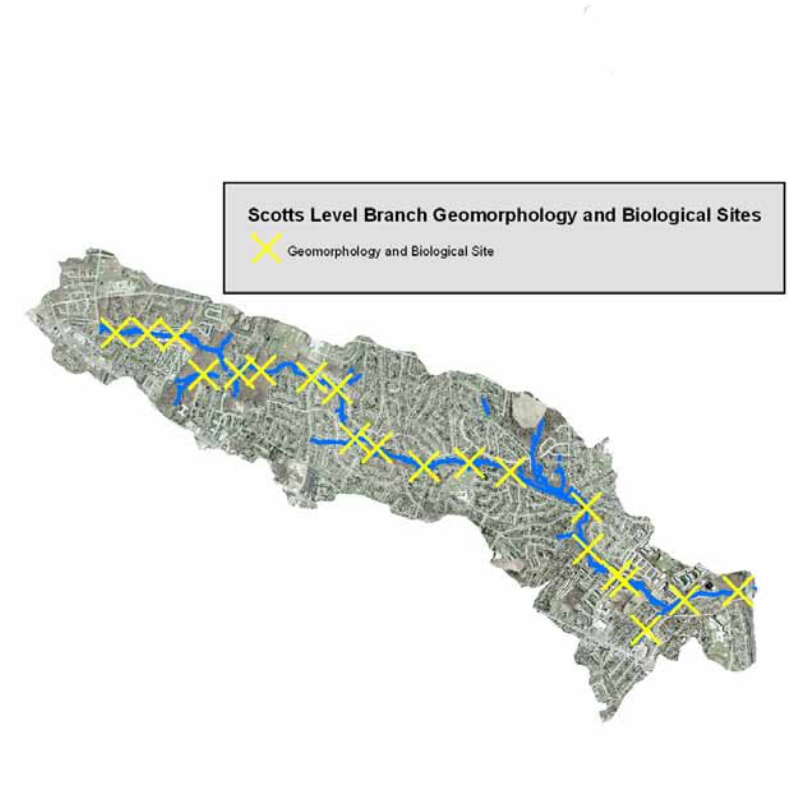


Figure 8-3: Scotts Level Branch Geomorphological and Biological Monitoring Site Locations

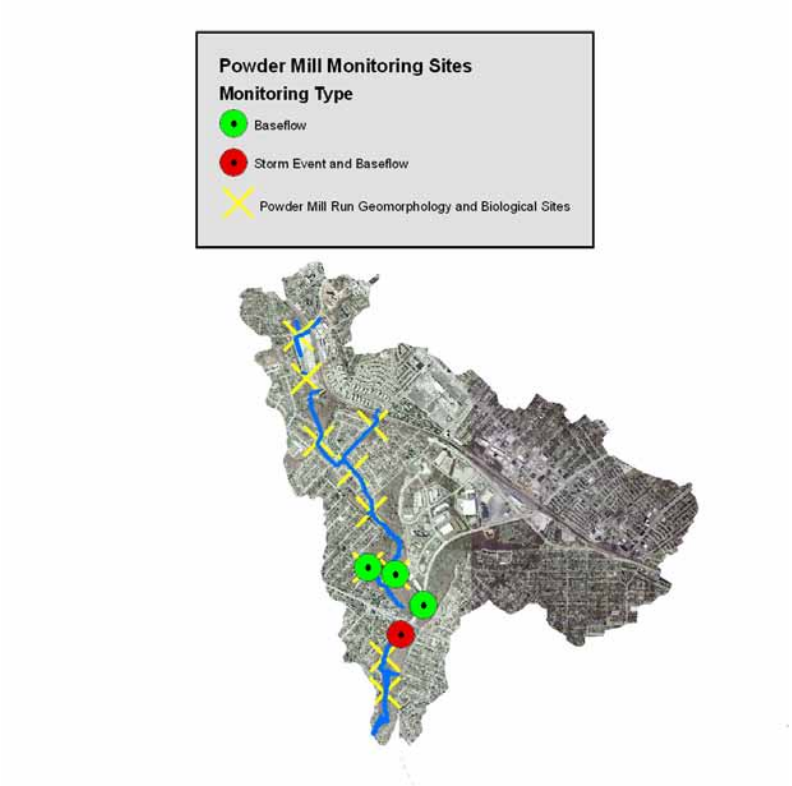


Figure 8-4: Powder Mill Run Geomorphological and Biological Monitoring Sites

8.2.1.4 Biological Monitoring

Benthic macroinvertebrate and fish sampling will be conducted annually at five fixed stations on Scotts Level Branch and three fixed stations on Powder Mill Run, during the appropriate index periods (March-April for macroinvertebrates, June-September for fish). Maryland Biological Stream Survey (MBSS) methods will be followed. Macroinvertebrate identification will be to the Genus taxonomic level or the lowest practical identification level. At the time of sample collection, the appropriate MBSS stream habitat assessment will be conducted.

The results of the biological monitoring will be compared with results from the cross sectional monitoring and the habitat analysis. In addition, the results will be compared between the two subwatersheds and to reference sites within Baltimore County. Inter-annual comparisons and changes in the biological community will be related to restoration progress within Scotts Level Branch.

8.3 Scotts Level Branch Long-Term Site Monitoring Results

8.3.1 Flow Monitoring

The U.S. Geological Survey under an agreement with Baltimore County installed a continuous gage on Scotts Level Branch where it crosses Rolling Road on September 29, 2005. This site is designated as SL-1. They also installed a continuous gage on Powder Mill Run below Liberty Road. In the fall of 2007, a weir with a continuous gage was installed at the outfall in Scotts Level Branch to provide a continuous discharge record. The data for Scotts Level Branch are analyzed in this report.

Precipitation Data: Hourly and daily precipitation data were acquired from the Department of Public Works stream gage located on Saint Luke's Lane. These data were recorded in conjunction with the Scotts Level Branch discharge data discussed below. Calendar year 2008 had one hundred twenty-nine days of recorded measurable precipitation. The daily data were analyzed for precipitation amount (Table 8-3). As can be seen from Table 8-3, a little less than 40% of the days recorded less than a 0.1 inch of precipitation. Precipitation over one inch occurred on only 9% of the days, but accounted for 40.0% of the total amount of the precipitation in 2007. The maximum daily rainfall was 3.44 inches recorded on September 27, 2008. A total of 43.68 inches of precipitation, more than the long-term average (~42 inches), was recorded at the Department of Public Works rain gauge for 2008.

Table 8- 3: Precipitation Data Analysis for Calendar 2008

Precipitation Category	# of Days	% Days	Total Amount	% of accumulation
<.1	50	39%	1.61	3.7%
.1-<.5	51	40%	11.51	26.4%
.5-<1.0	18	14%	13.13	30.1%
1.0-<1.5	5	4%	6.75	15.5%
1.5-<2.0	2	2%	3.09	7.1%
2.0-<2.5	2	2%	4.15	9.5%
2.5-<3.0	0	0%	0.00	0.0%
3.0-3.5	1	1%	3.44	7.9%
Total	**129**		**43.68**	

Often storms span more than one day. The hourly precipitation data were used to delimit individual storms, by identifying the initiation of rain events greater than .05 inches, and the end of the storm event defined as greater than six hours with no rainfall recorded. A total of 51 distinct storms were identified. These storms were analyzed for amount of precipitation, intensity (inches/hour), and duration. The results of this analysis are presented in Table 8-4.

Table 8-4: 2008 Precipitation Amount, Intensity, and Duration by Category

Precipitation Category (Inches)	Accumulation Amount				Intensity (inches/hour)			Duration (hours)		
	# Storms	% Storms	Total Acc.	% Acc.	Intensity Category	# Storm	% storms	Duration Category	# storms	% storms
< .1	2	3.9	0.17	0.5	< .1	21	41.2	<1	10	19.6
.1 - <.25	15	29.4	2.36	7.2	.1 - <.25	20	39.2	1 – <3	9	17.6
.25 - <.50	11	21.6	4.02	12.3	.25 - <.50	8	15.7	3 – <6	12	23.5
.50 - <.75	9	17.6	5.47	16.7	.50 - <.75	1	2.0	6 – <9	9	17.6
.75 – <1.00	5	9.8	4.52	13.8	.75 – <1.00	0	0.0	9 – <12	6	11.8
1.00 – <1.50	6	11.8	7.73	23.6	1.00 – <1.50	0	0.0	12 – <15	2	3.9
1.50 – <2.00	0	0.0	0.00	0.0	1.50 – <2.00	1	2.0	15 – <18	0	0.0
2.00 – <3.00	2	3.9	4.80	14.7	2.00 – <3.00	0	0.0	18 – <21	1	2.0
3.00 – <4.00	1	2.0	3.67	11.2	3.00 – <4.00	0	0.0	21 – <24	0	0.0
>4.00	0	0.0	0.00	0.0	>4.00	0	0.0	>24	2	3.9
Total	**51**	**100**	**32.74**	**100**		**51**	**100**		**51**	**100**

About 33% of the storms were less than 0.25 inches in total amount of precipitation, but these storms accounted for only 7.9% of the total amount of rainfall. Only 17.7% of the storms were over one inch in total amount of rainfall and these storms accounted for almost half (49.5%) of

the total amount of precipitation in 2008. The largest storm for 2008 recorded 3.67 inches of precipitation over approximately a 25-hour period. The highest intensity recorded at the DPW gauge in 2008 was 1.96 inches per hour. The majority of storms (80.4%) highest recorded hourly intensity was less than or equal to a quarter inch per hour. Likewise slightly more than half of the storms (60.7%) were less than 6 hours in duration.

Flow Data: The Scotts Level Branch gage data includes 15-minute discharge readings from the period of October 1, 2005 to March 9, 2009. The entire record was analyzed for storm events. The data were visually scanned to determine the inception of each storm event. The termination of the event was based on three hours of discharge at the same rate. A total of 371 storm events for the period were identified, of which, 125 occurred in the calendar year 2008. Figure 8-5 displays the daily discharge and precipitation for calendar year 2008. The correlation coefficient was determined to be r = .84. The database was further coded to reflect the concurrence of storms as indicated by the increase in discharge and the precipitation from recorded at the DPW Rolling Road gauge. This resulted in 46 storms that had an overlap of both precipitation and storm discharge, and an increase in the correlation coefficient to r = .98, during 2008.

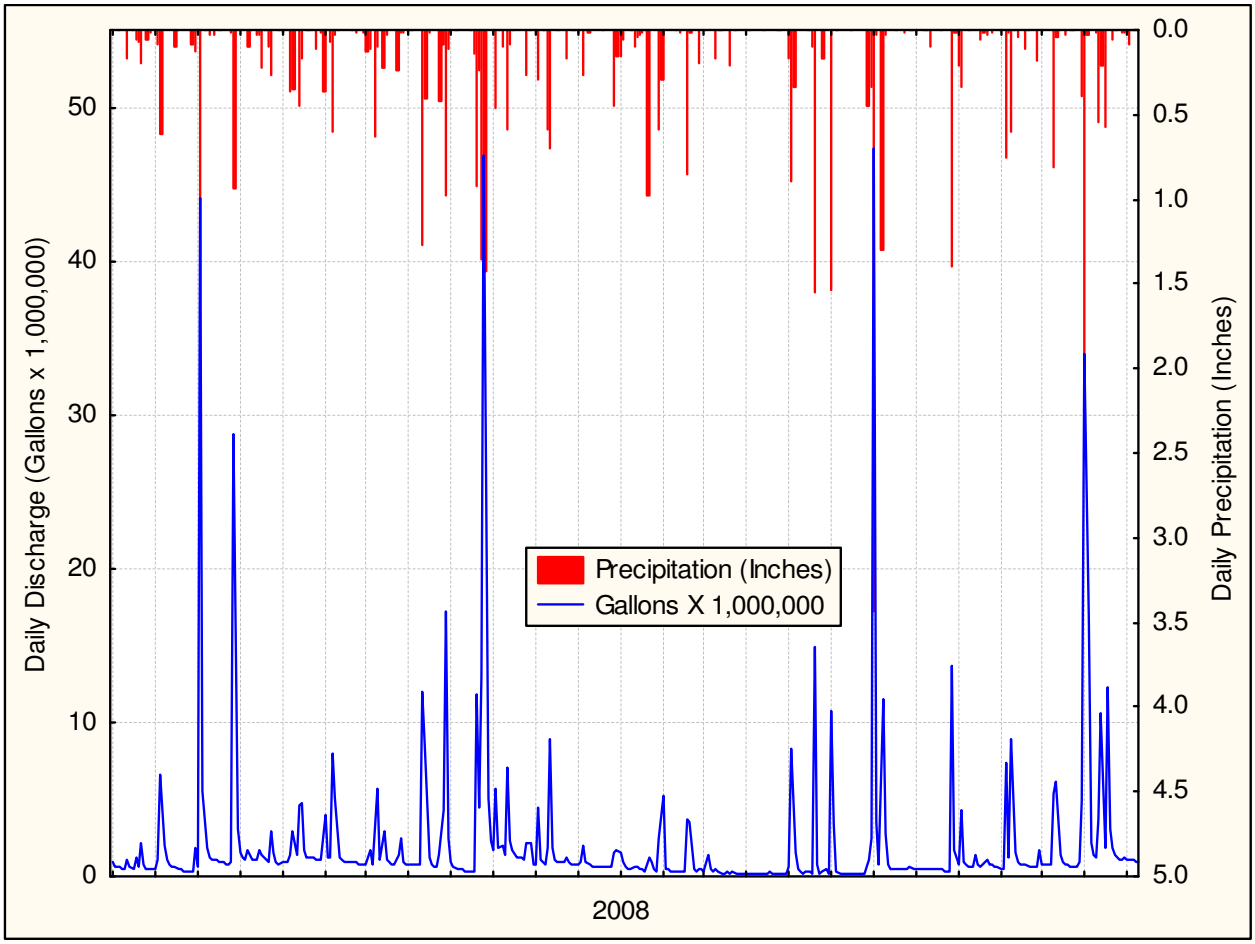


Figure 8-5: Calendar year 2008 Daily Precipitation and Discharge

Using this set of data for the 46 storms, the runoff coefficient was calculated for each storm. The average runoff coefficient was .214, with a maximum of .605 and a minimum of .031.

The 125 storm data set was further analyzed to determine the proportion of runoff to total precipitation, and the relative proportions of baseflow and storm event runoff. These data were analyzed by season for calendar year 2008. The results are presented in Table 8-5.

Table 8-5: Seasonal Precipitation and Runoff Characteristics

Parameter	Fall	Winter	Spring	Summer	Total
Precipitation Amount	14.08	8.13	12.43	9.04	43.68
Precipitation %	32.2 %	18.6 %	28.5 %	20.7 %	---
% of precipitation volume accounted for by Runoff	30.1%	41.5%	32.8%	16.8%	31.2%
% of precipitation volume accounted for by Evapotranspiration	69.9 %	58.5%	67.2%	83.2%	68.8 %
% of stream flow accounted for by Storm flow	82.0%	65.6%	74.5%	75.7%	74.8%
% of stream flow accounted for by Baseflow %	18.0%	34.4%	25.5%	24.3%	25.2 %

For calendar year 2008 the precipitation was about evenly distributed. The fall and spring exhibited higher precipitation than the spring and summer. About thirty-one percent of the precipitation was accounted for by stream flow while the balance was assumed to be evapotranspiration. The evapotranspiration is the result of the evaporation of water, which is temperature dependant and the transpiration of water due to plants. Thus the expectation is that winter should exhibit the lowest evapotranspiration rates and summer the highest rate. The results for Scotts Level Branch bear this out with 58.5% and 83.2% evapotranspiration rates for winter and summer, respectively. As is characteristic of urban watersheds, Scotts Level Branch exhibits a shift in runoff from baseflow dominated to storm flow dominated. For the year, 74.8% of the flow was determined to be storm flow using the criteria described above, while only 25.2% was characterized as baseflow.

8.3.2 Chemical Monitoring

The data analysis for chemical monitoring includes three components, storm event monitoring (8.3.2.1), baseflow monitoring (8.3.2.2), and the calculation of pollutant loads (8.3.2.3)

8.3.2.1 Storm Event Monitoring Results

The chemical results from the storm event monitoring at the Scotts Level Branch in-stream monitoring site was analyzed in conjunction with the discharge data recorded by the DPW gage. Both the chemical and the discharge data were $\log_{10}$ transformed prior to regression analysis. The data for the regression equations was censored by removing any chemical data that was below the detection limit for any constituent. Regression equations were determined for Total Suspended Solids, TKN, Nitrate/Nitrite, Total Nitrogen, and Total Phosphorus, Total Copper, Total Lead, Total Zinc, Chloride and Sodium. The results are displayed in Table 8-6 and graphically in Figures 8-6 through 8-15.

Table 8-6: Regression Equations Relationship Between Discharge (CFS) and Pollutant Concentrations

Parameter	Regression Equation
Total Suspended Solids	0.8469+0.5636*(log cfs)
Total Kjeldahl Nitrogen	-0.2288+0.12*(log cfs)
Nitrate/Nitrite	-0.2595-0.1348*(log cfs)

Total Nitrogen	0.0973+0.0177*(log cfs)
Total Phosphorus	-1.2931+0.2991*(log cfs)
Total Copper	-2.3728+0.3096*(log cfs)
Total Lead	-3.2392+0.4466*(log cfs)
Total Zinc	-2.3304+0.5702*(log cfs)
Chloride	1.5722+0.0066*(log cfs)
Sodium	1.475+0.1008*(log cfs)

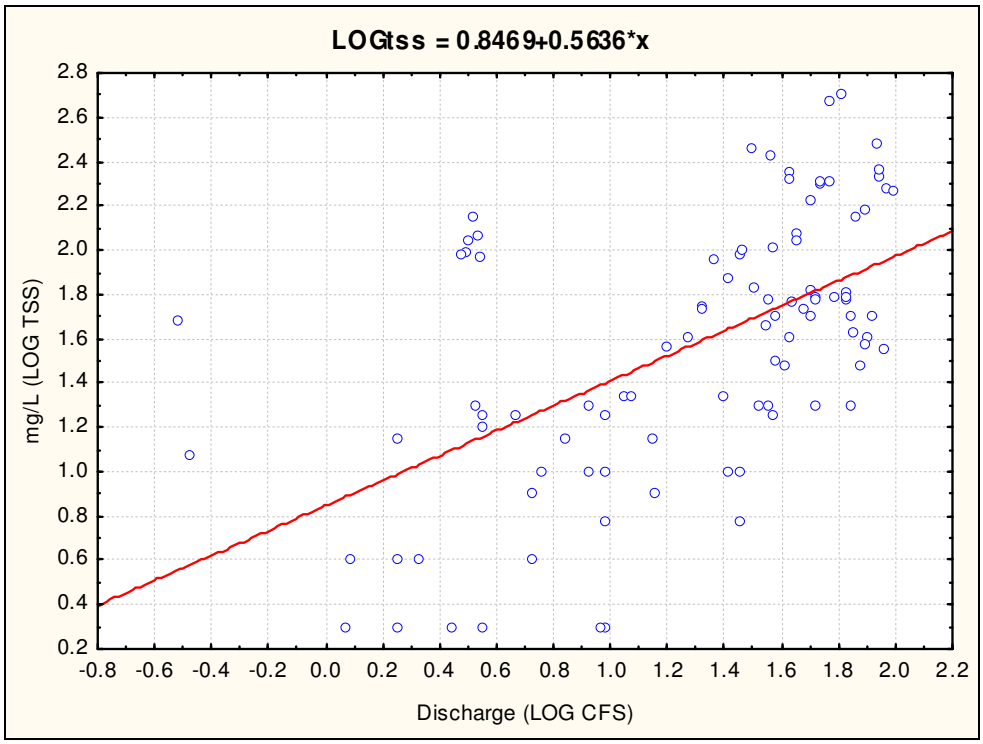


Figure 8-6: Total Suspended Solids (TSS) Data and Regressions for 2005-2009.

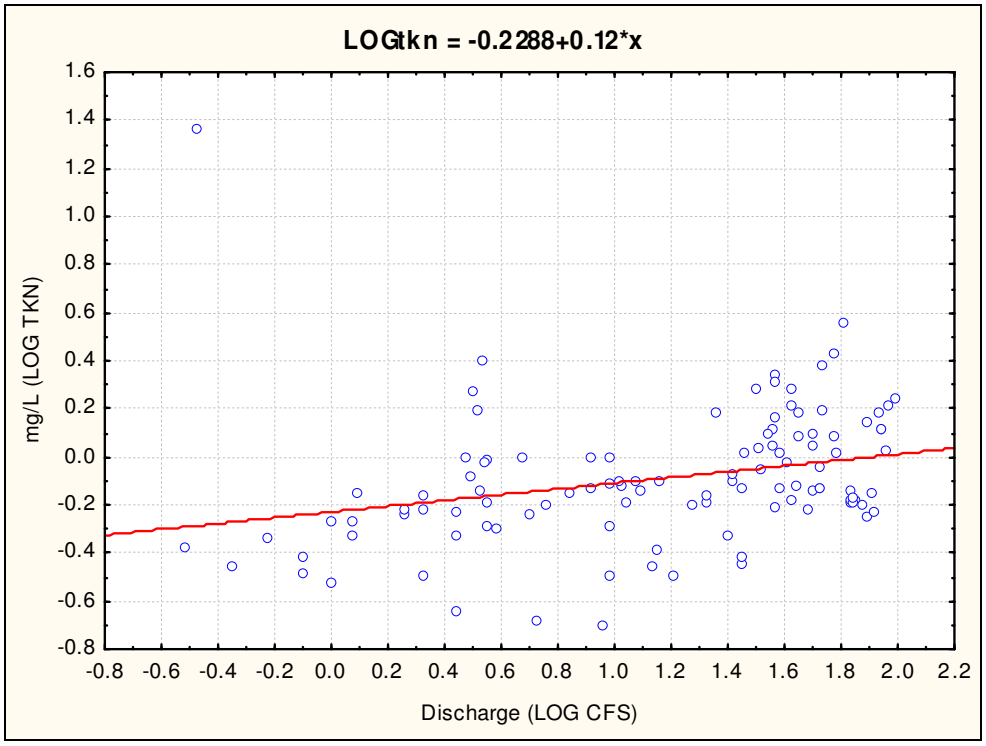


Figure 8-7: Total Kjeldahl Nitrogen (TKN) Data and Regressions for 2005-2009.

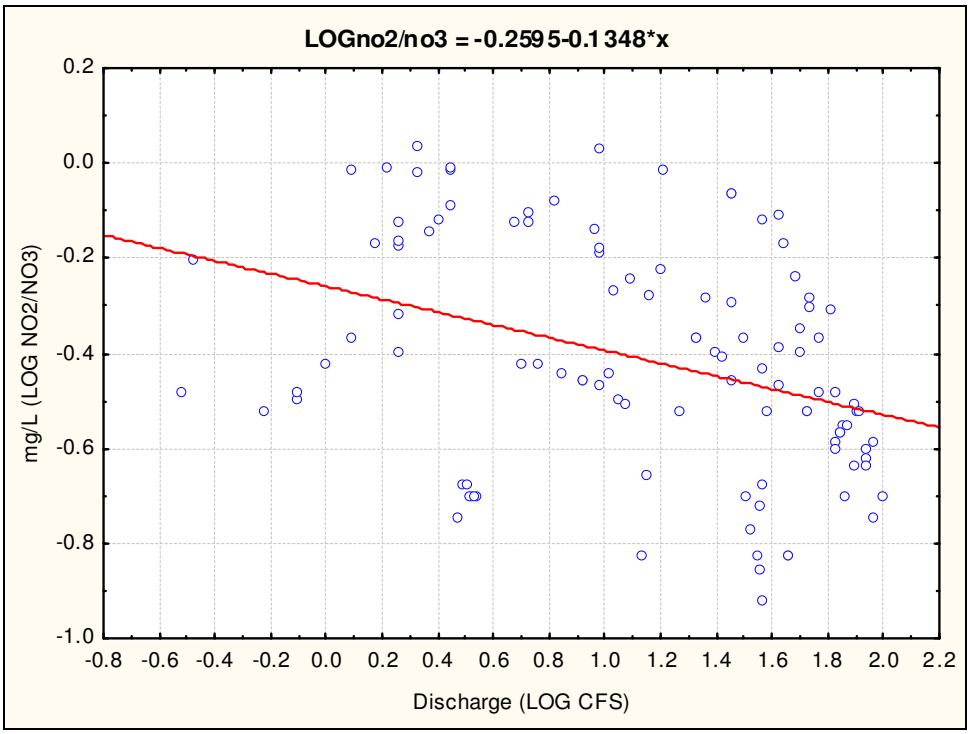


Figure 8-8: Nitrate/Nitrite (NO_2/NO_3) Data and Regressions for 2005-2009.

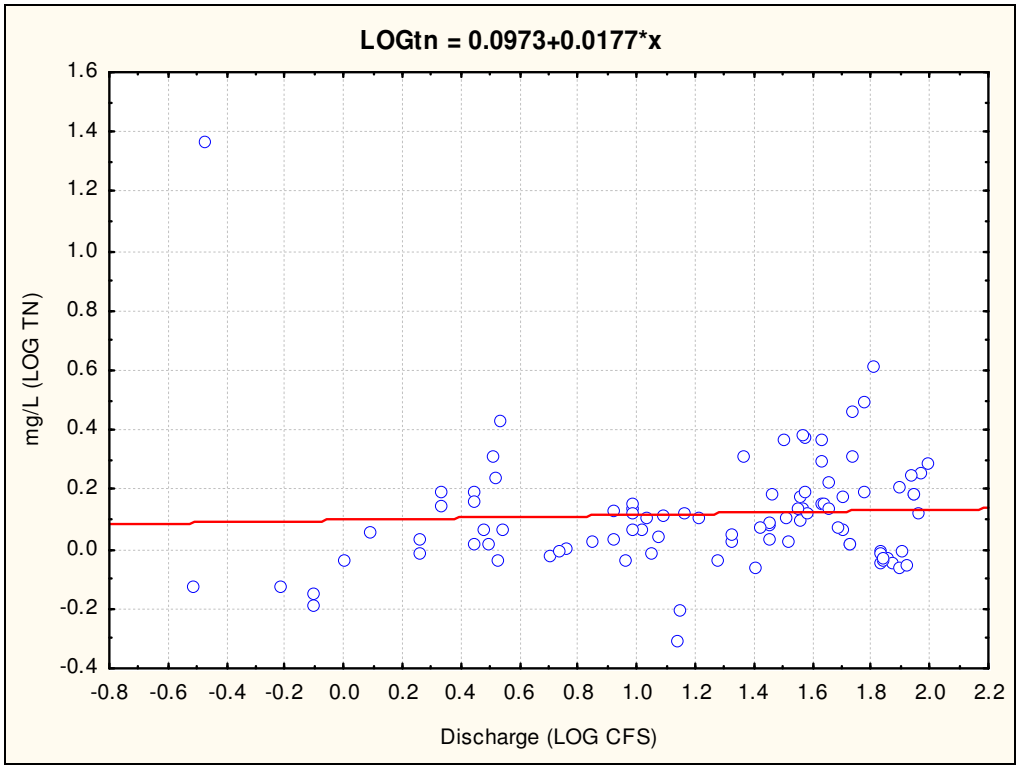


Figure 8-9: Total Nitrogen (TN) Data and Regressions for 2005-2009.

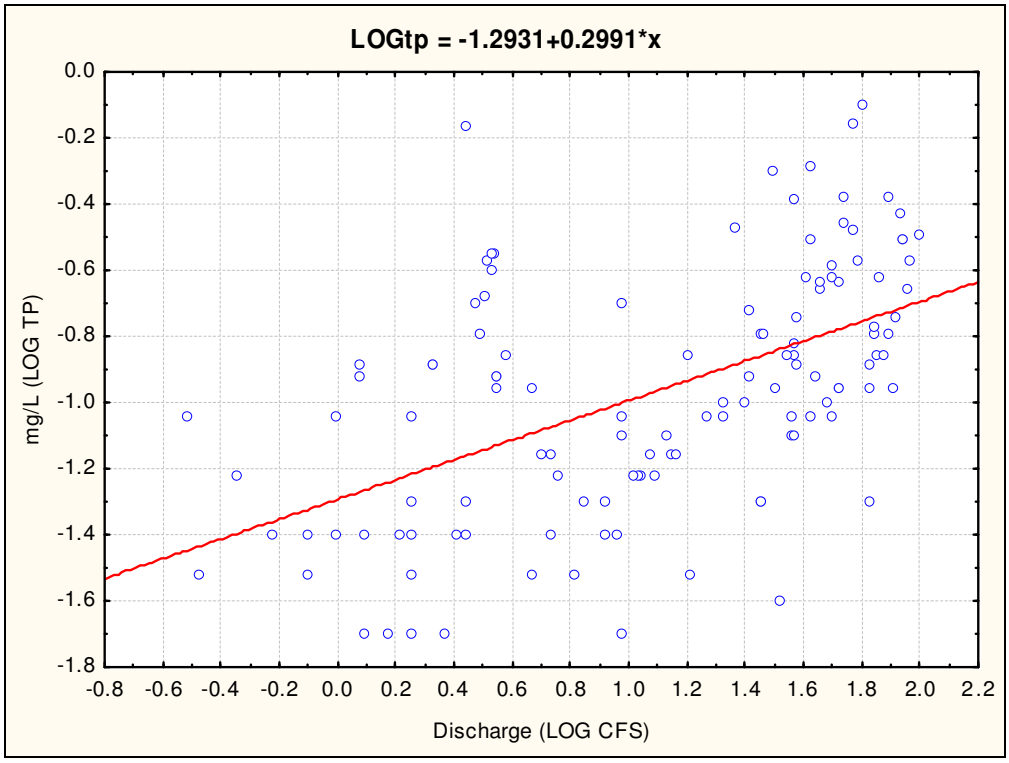


Figure 8-10: Total Phosphorus (TP) Data and Regressions for 2005-2009.

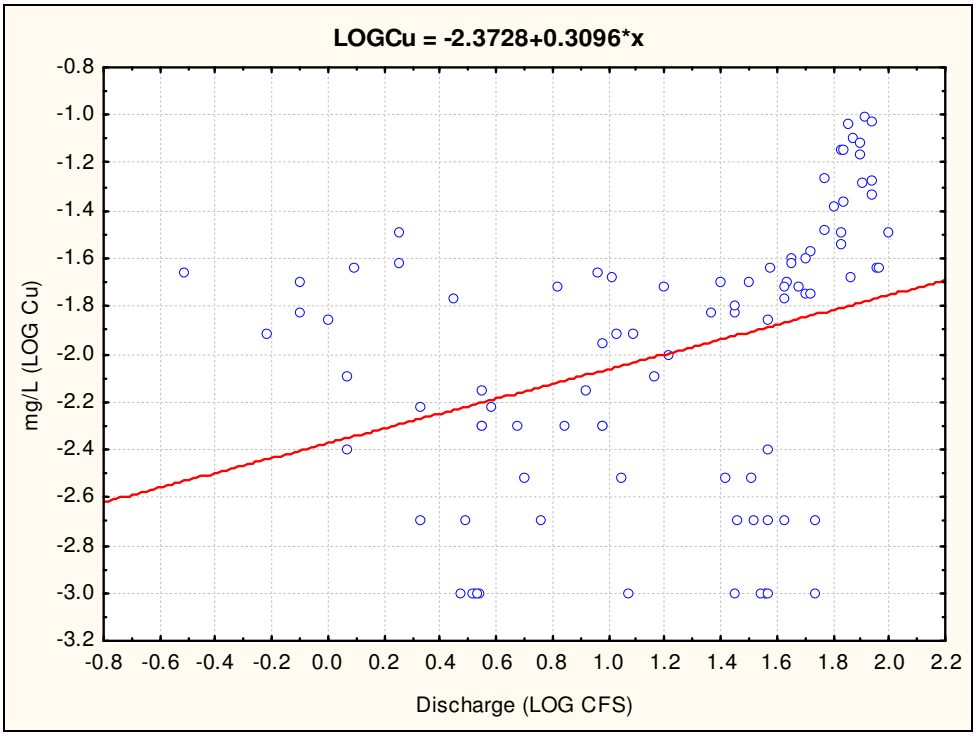


Figure 8-11: Total Copper (Cu) Data and Regressions for 2005-2009.

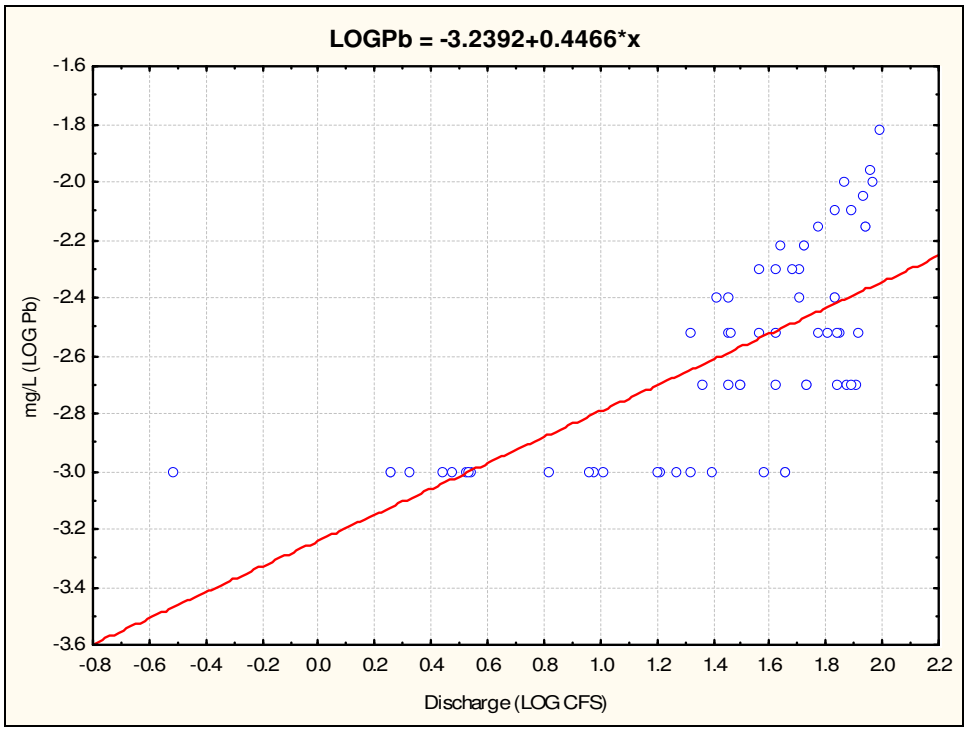


Figure 8-12: Total Lead (Pb) Data and Regressions for 2005-2009.

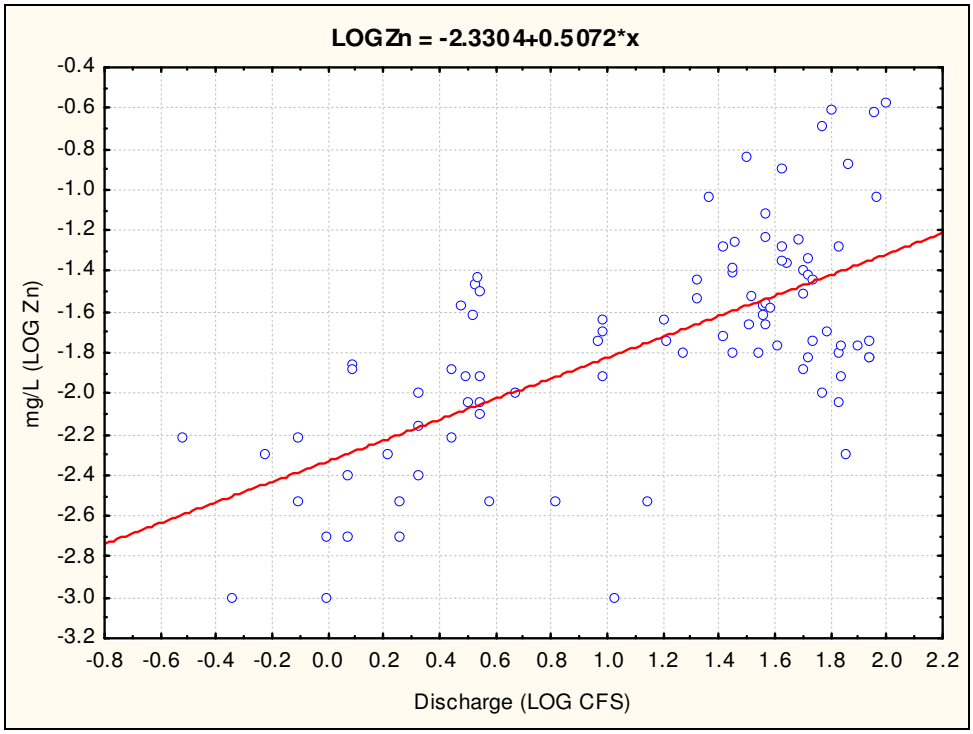


Figure 8-13: Total Zinc (Zn) Data and Regressions for 2005-2009.

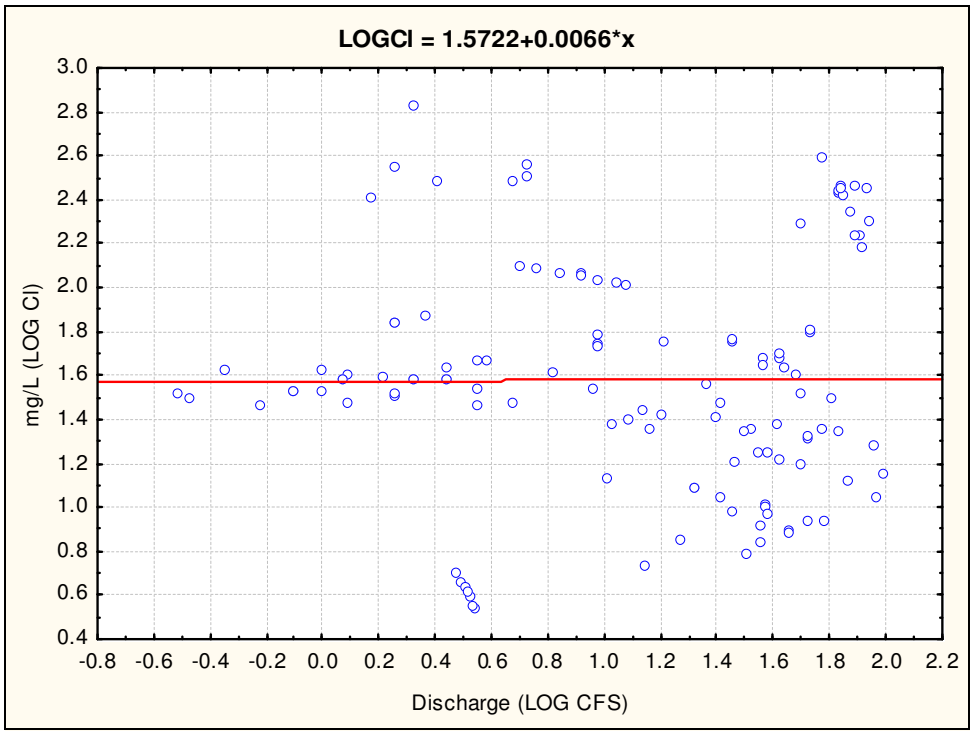


Figure 8-14: Chloride (Cl) Data and Regressions for 2005-2009.

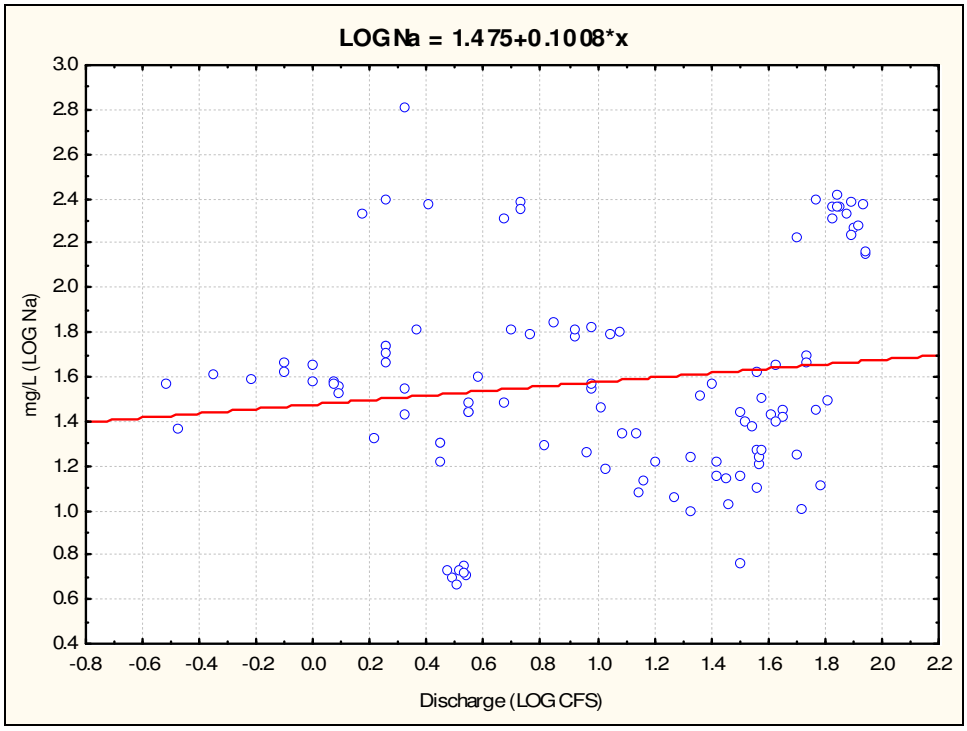


Figure 8-15: Sodium (Na) Data and Regressions for 2005-2009.

Total Suspended Solids, Total Phosphorus, Total Copper, Total Lead and Total Zinc exhibited strong positive relationships with discharge, while Nitrate/Nitrite displayed a strong negative relationship with discharge. The TKN, TN (TKN+Nitrate/Nitrite Nitrogen) Chloride and Sodium relationship with discharge was relatively weak and positive.

The regression equations were used to calculate the chemical concentrations for each 15-minute interval for recorded discharge. The log chemical concentrations were then back transformed. This permitted the calculation of the flow weighted Event Mean Concentrations for each of the 371 storms identified in the USGS gage data record. Figures 8-16a through 8-25b show the Event Mean Concentrations for Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), Nitrate/Nitrite, Total Nitrogen (TN), and Total Phosphorus (TP), Total Copper, Total Lead, Total Zinc, Chloride, and Sodium.

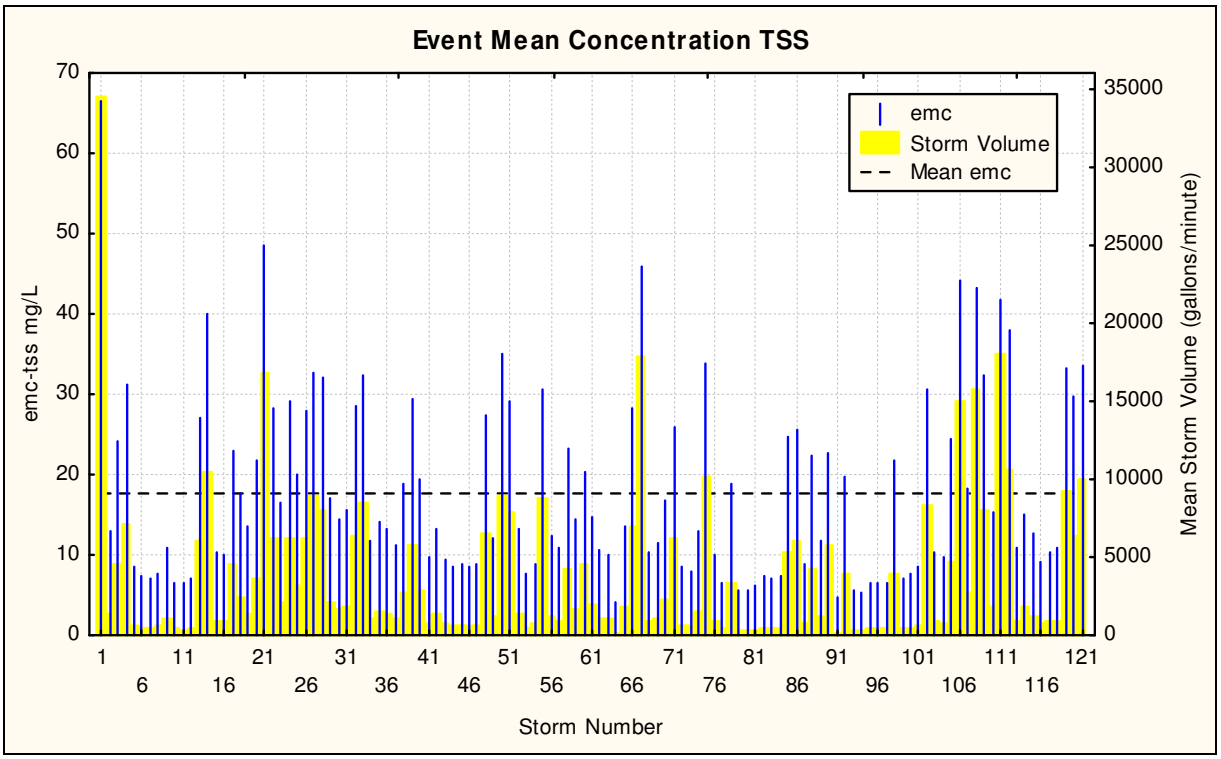


Figure 8-16a: Event Mean Concentration for Total Suspended Solids (TSS) 2005-2006

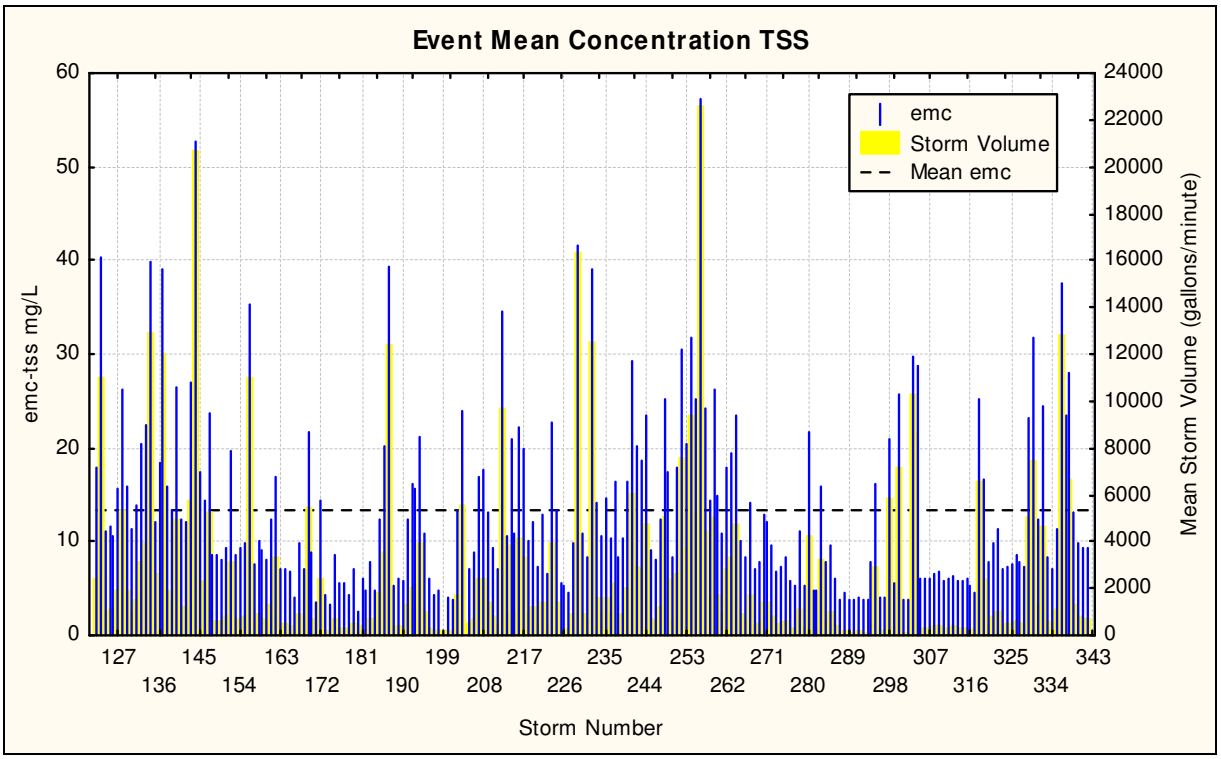


Figure 8-16b: Event Mean Concentration for Total Suspended Solids (TSS) 2007-2008

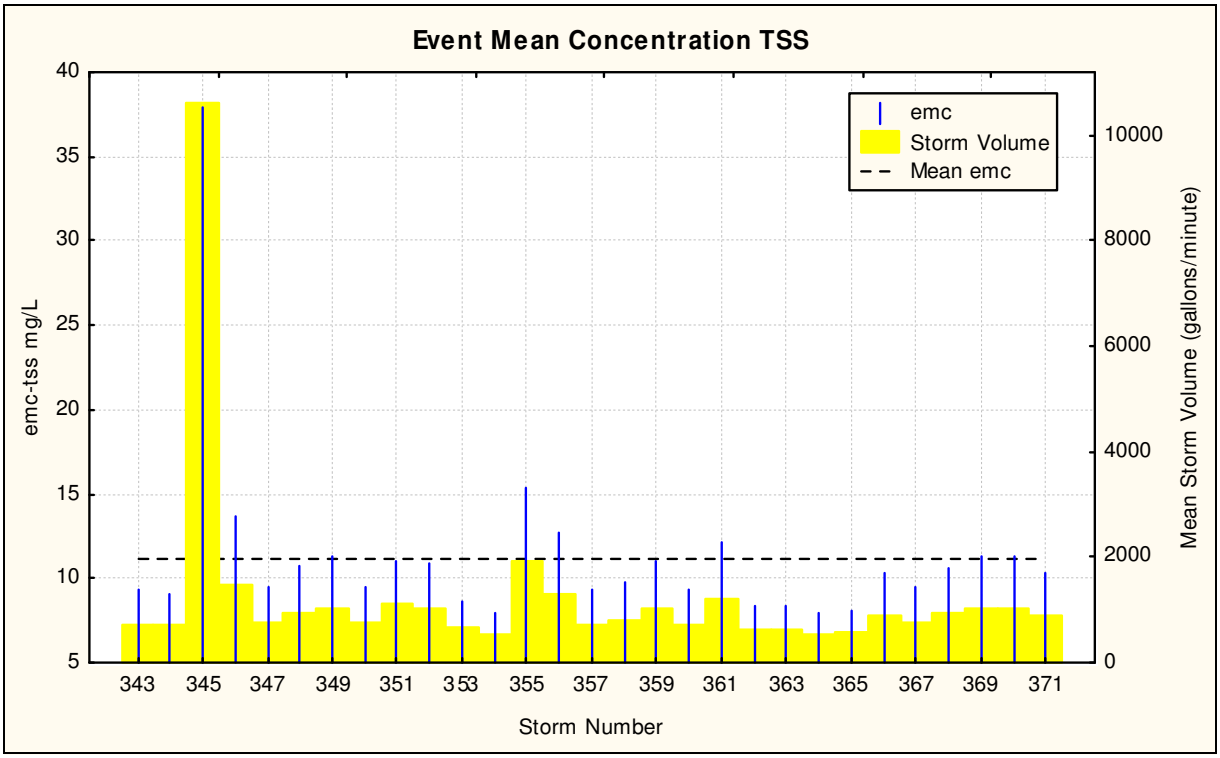


Figure 8-16c: Event Mean Concentration for Total Suspended Solids (TSS) 2009

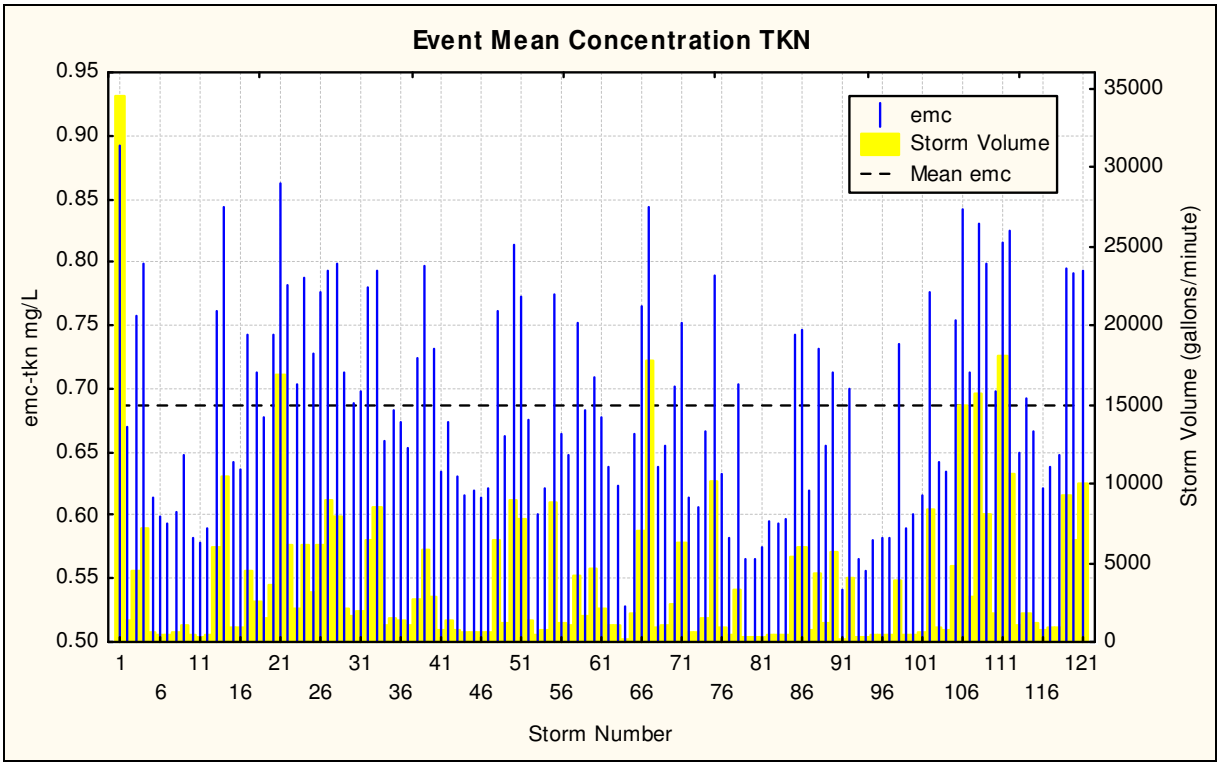


Figure 8-17a: Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2005-2006

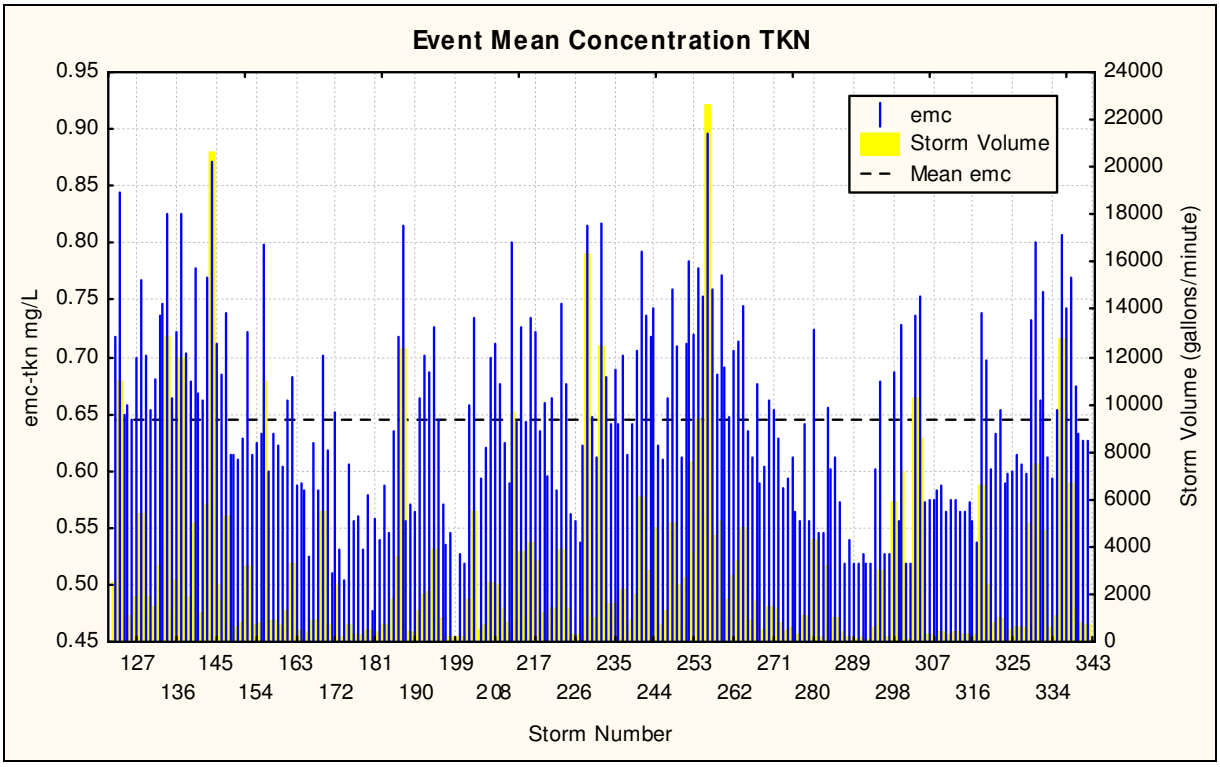


Figure 8-17b: Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2007-2008

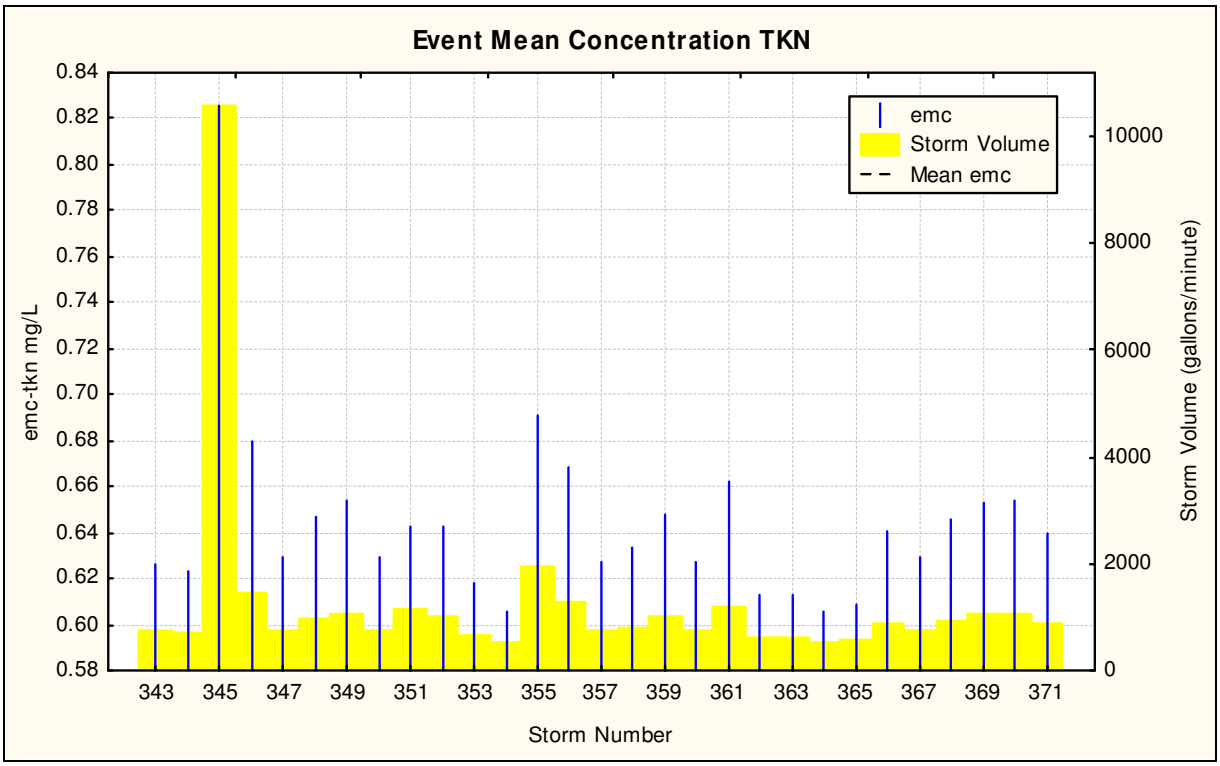


Figure 8-17c: Event Mean Concentration for Total Kjeldahl Nitrogen (TKN) 2009

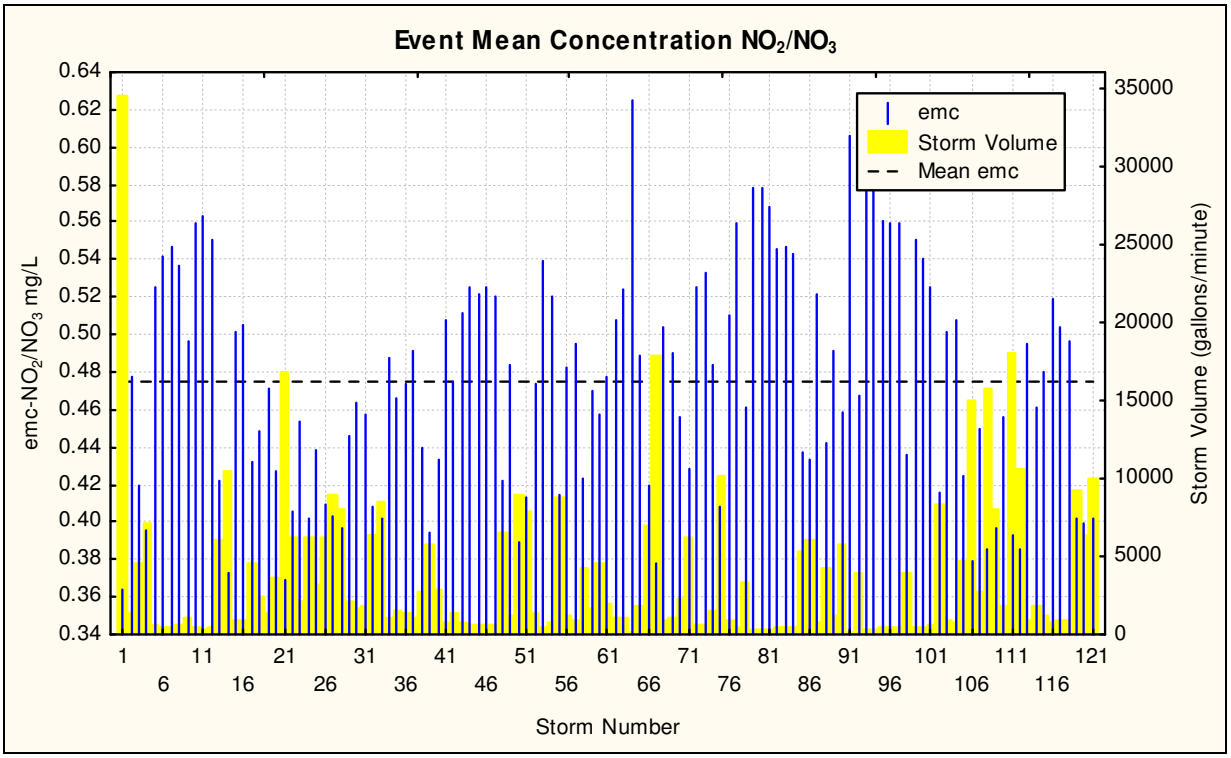


Figure 8-18a: Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2005-2006

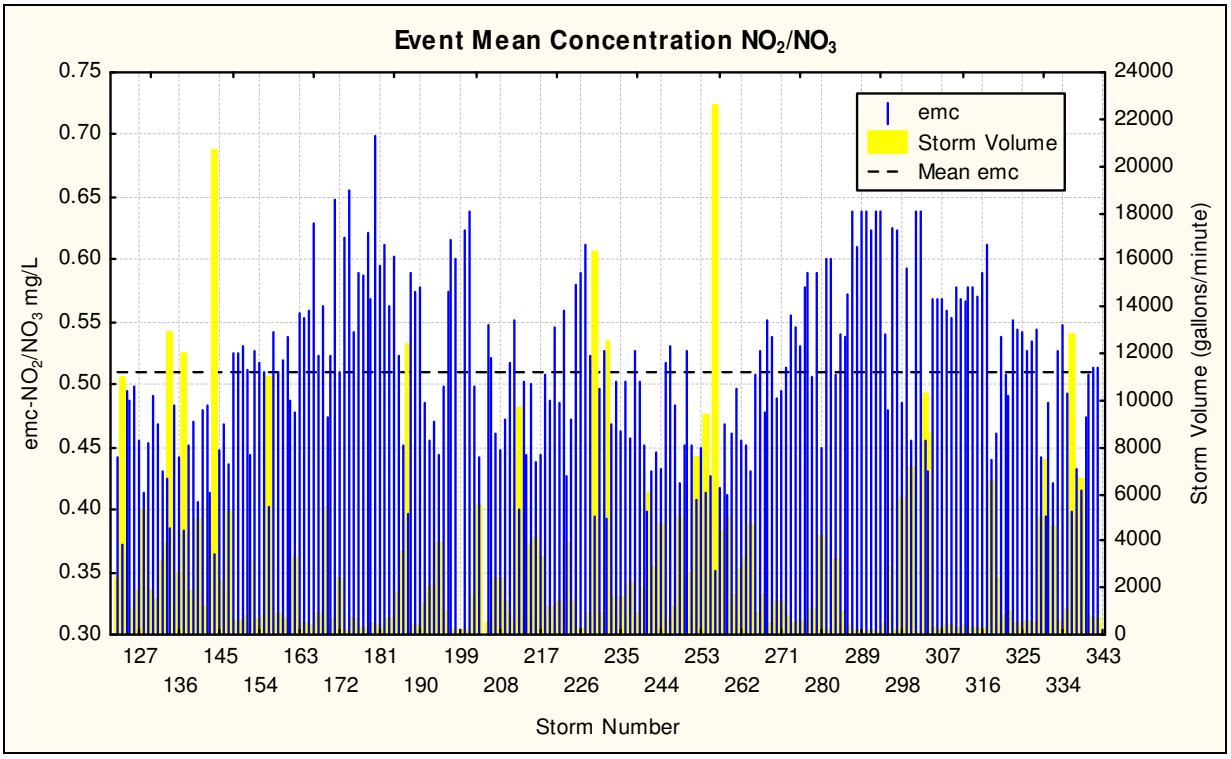


Figure 8-18b: Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2007-2008

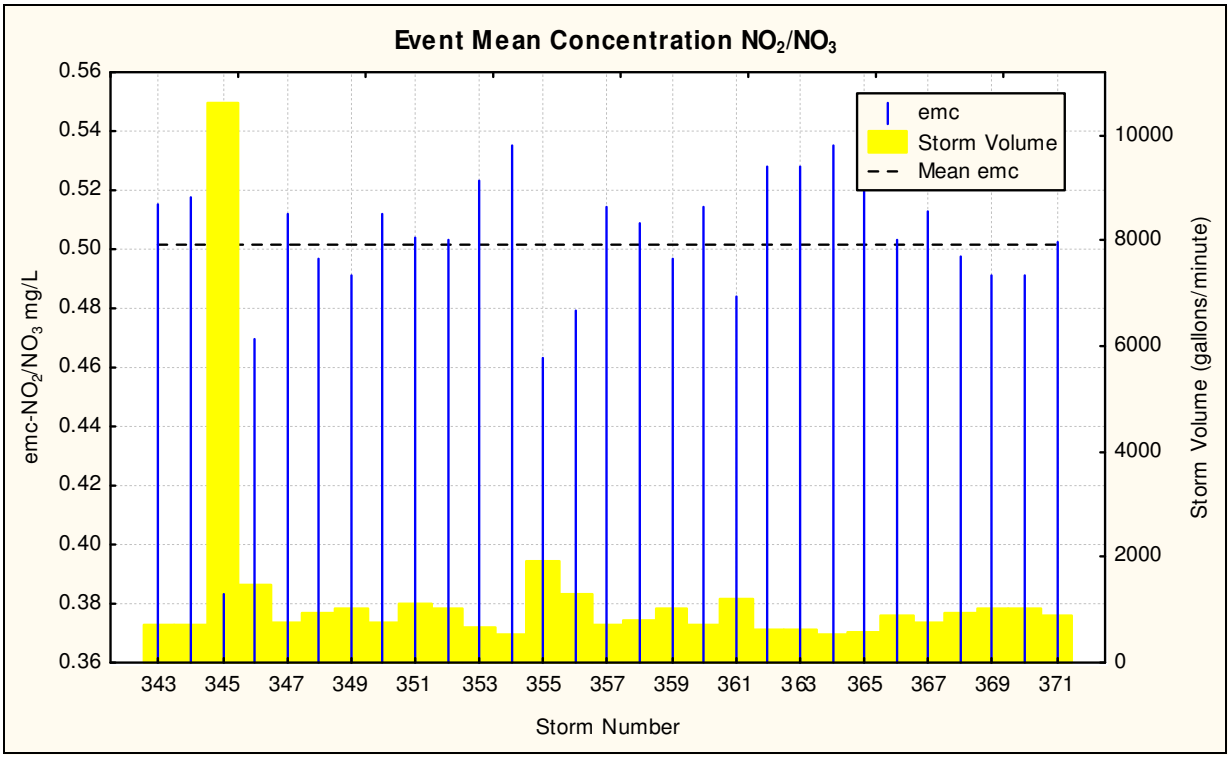


Figure 8-18c: Event Mean Concentration for Nitrate/Nitrite (NO_2/NO_3) 2009

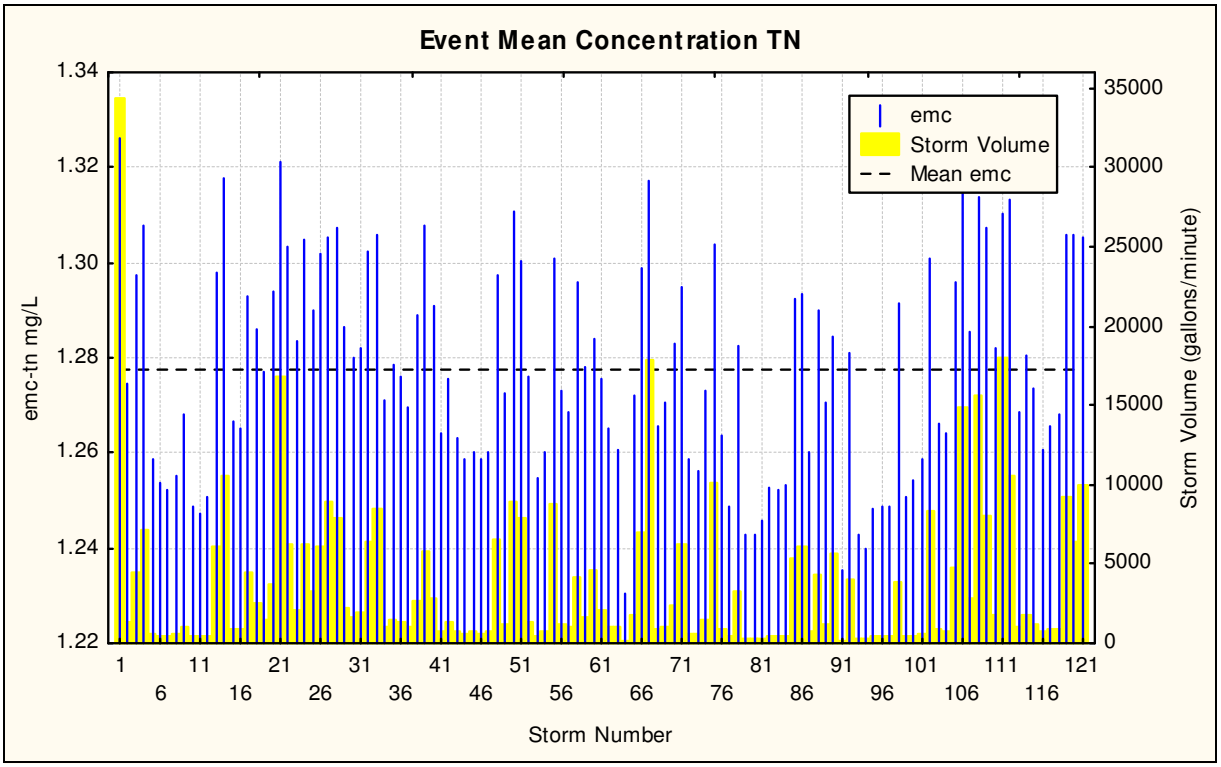


Figure 8-19a: Event Mean Concentration for Total Nitrogen (TN) 2005-2006

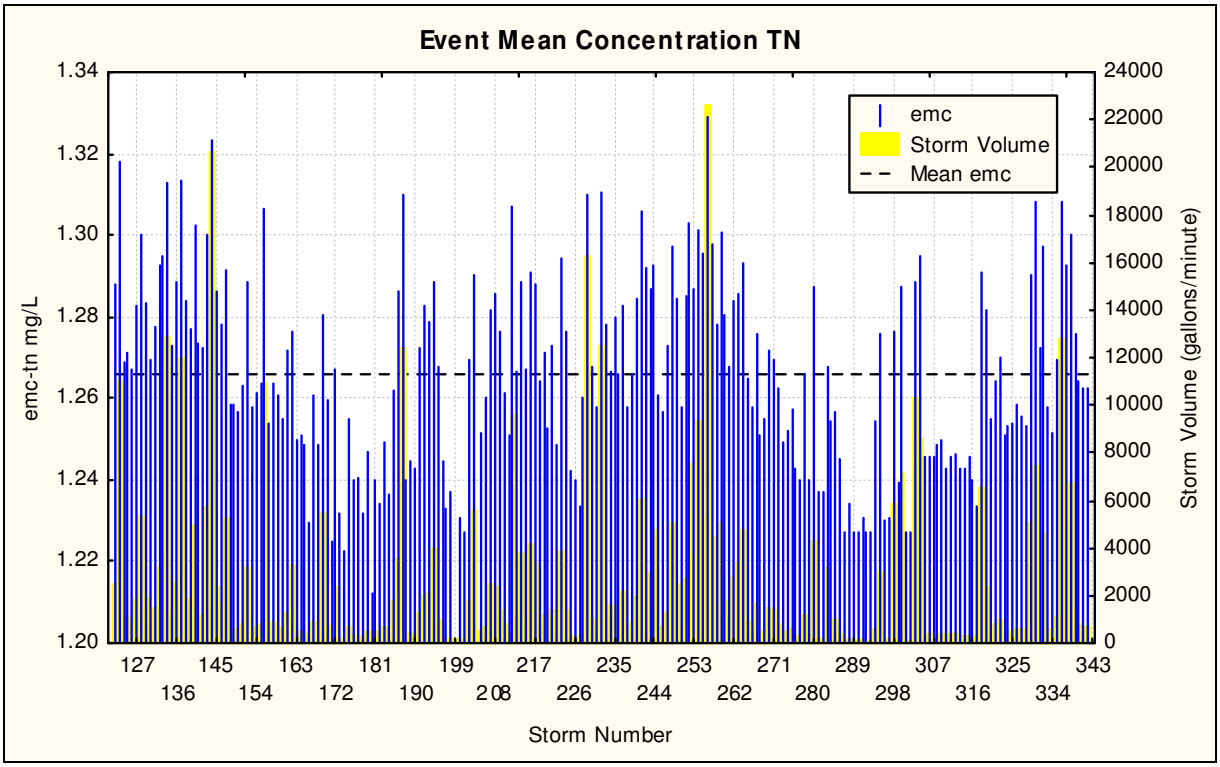


Figure 8-19b: Event Mean Concentration for Total Nitrogen (TN) 2007-2008

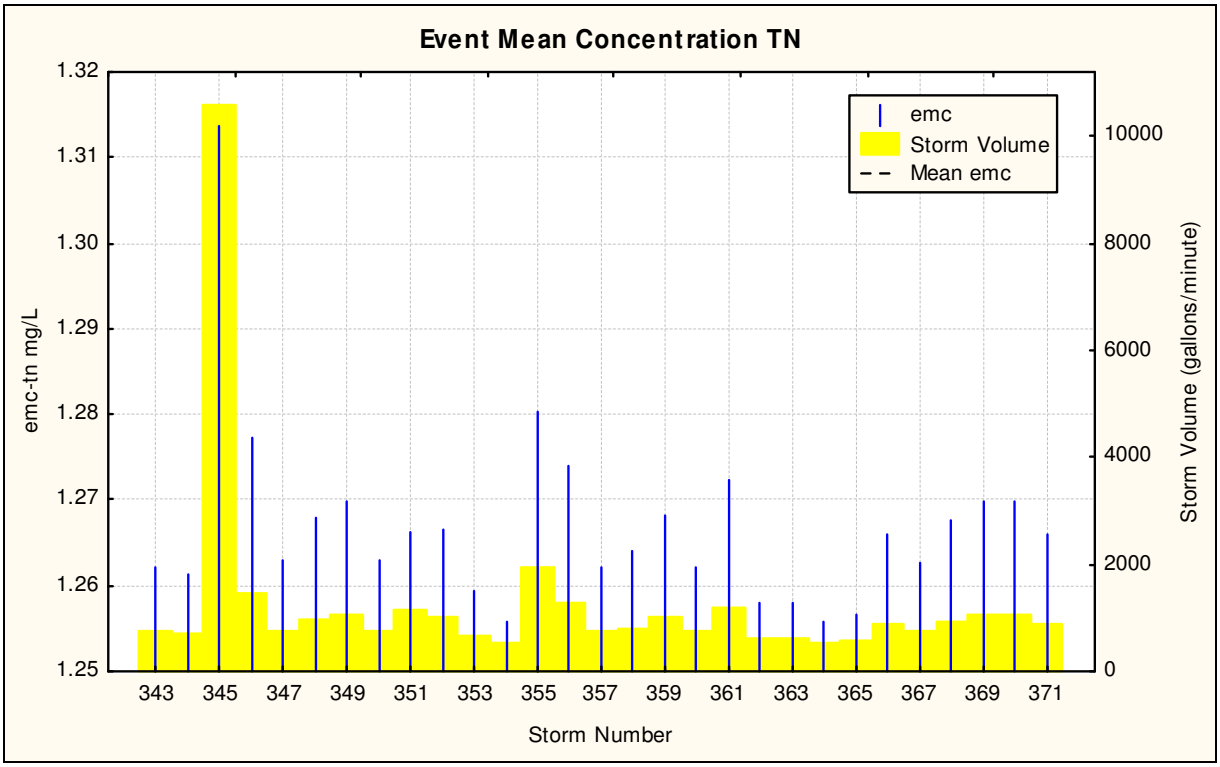


Figure 8-19c: Event Mean Concentration for Total Nitrogen (TN) 2009

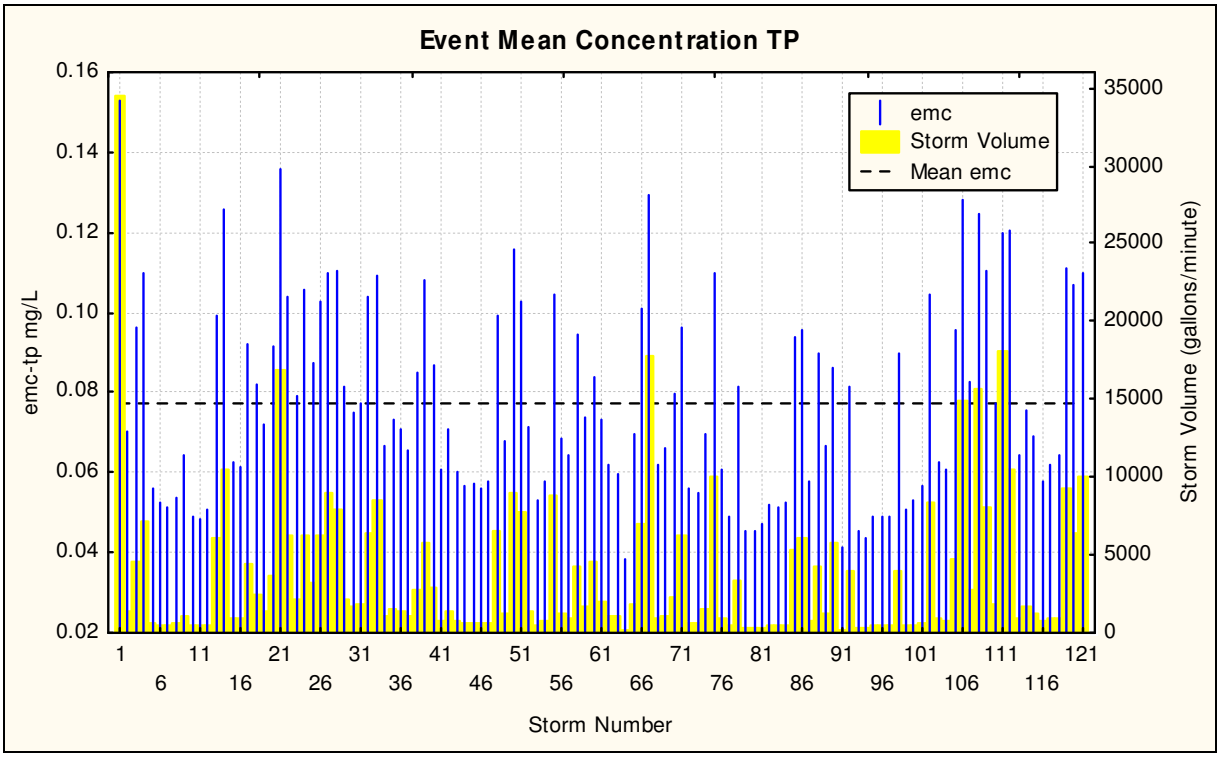


Figure 8-20a: Event Mean Concentration for Total Phosphorus (TP) 2005-2006

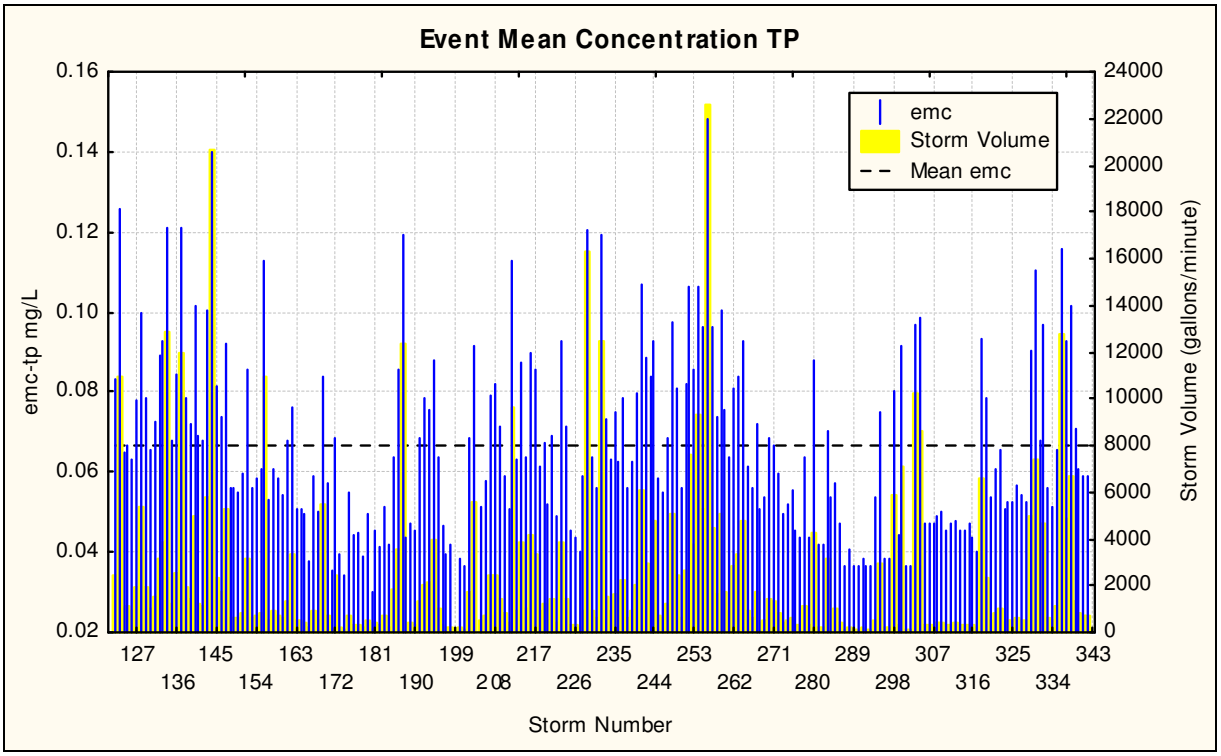


Figure 8-20b: Event Mean Concentration for Total Phosphorus (TP) 2007-2008

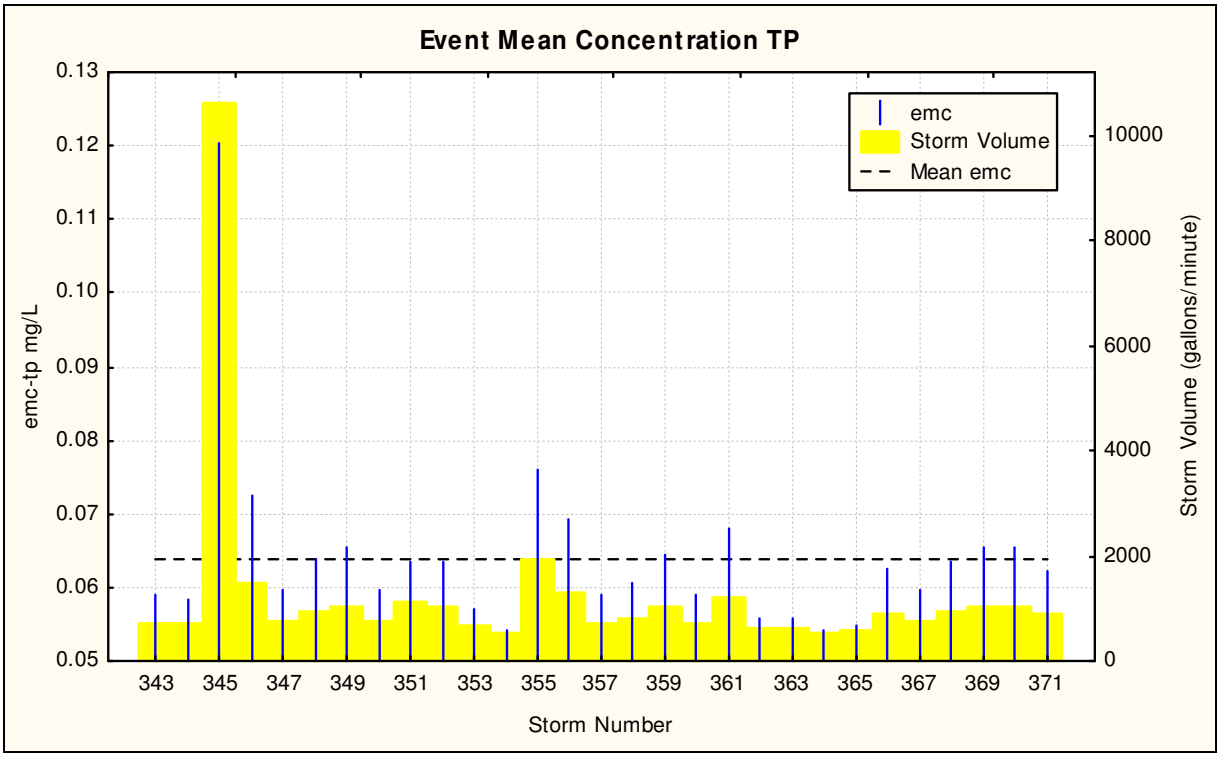


Figure 8-20c: Event Mean Concentration for Total Phosphorus (TP) 2009

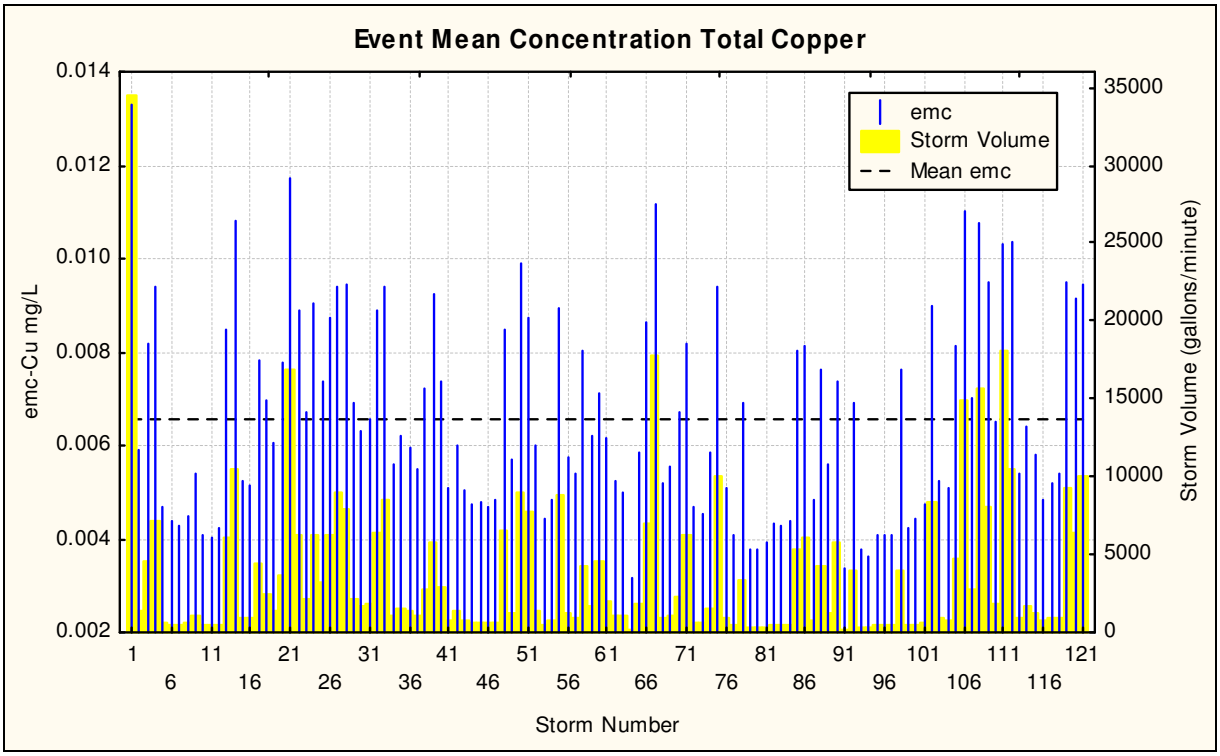


Figure 8-21a: Event Mean Concentration for Total Copper 2005-2006

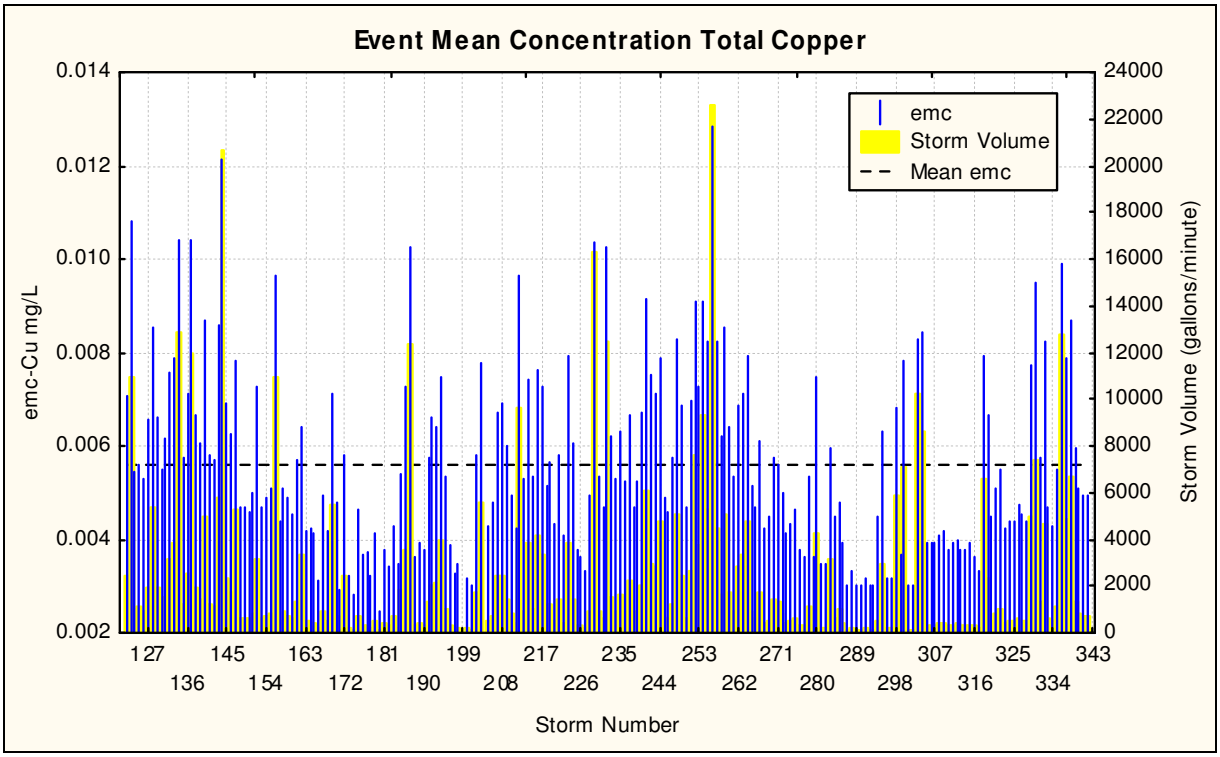


Figure 8-21b: Event Mean Concentration for Total Copper 2007-2008

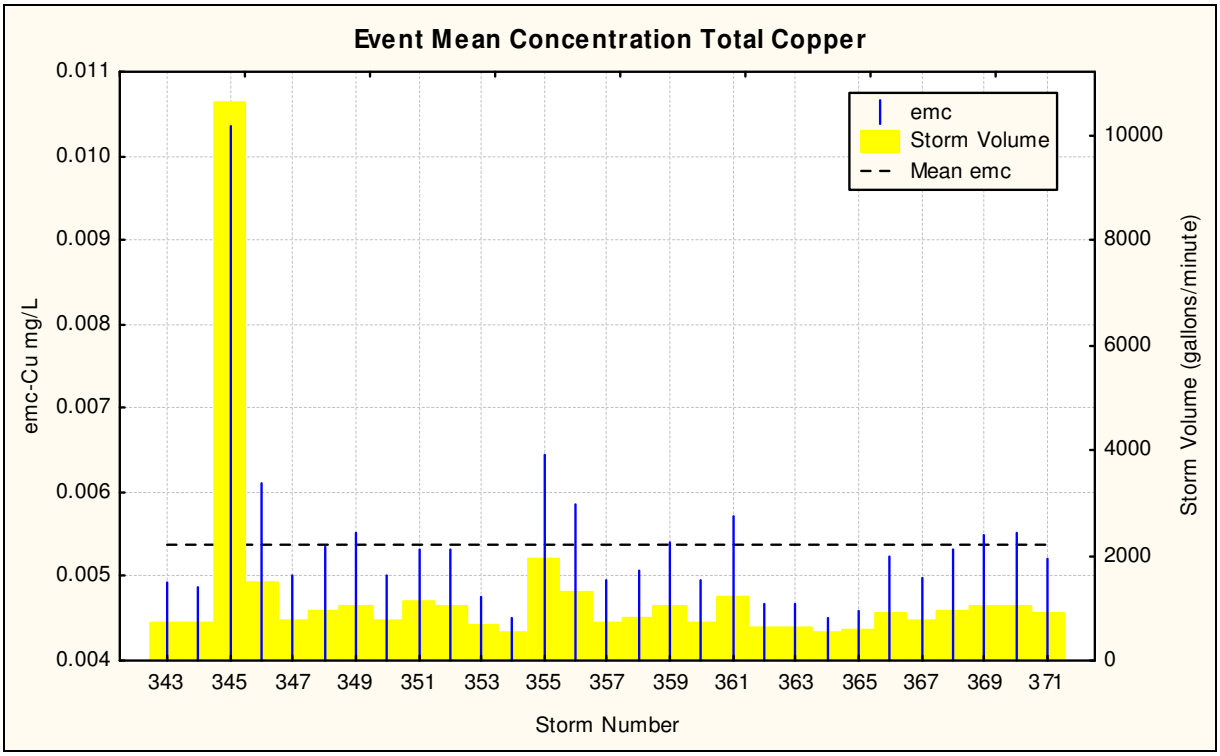


Figure 8-21c: Event Mean Concentration for Total Copper 2009

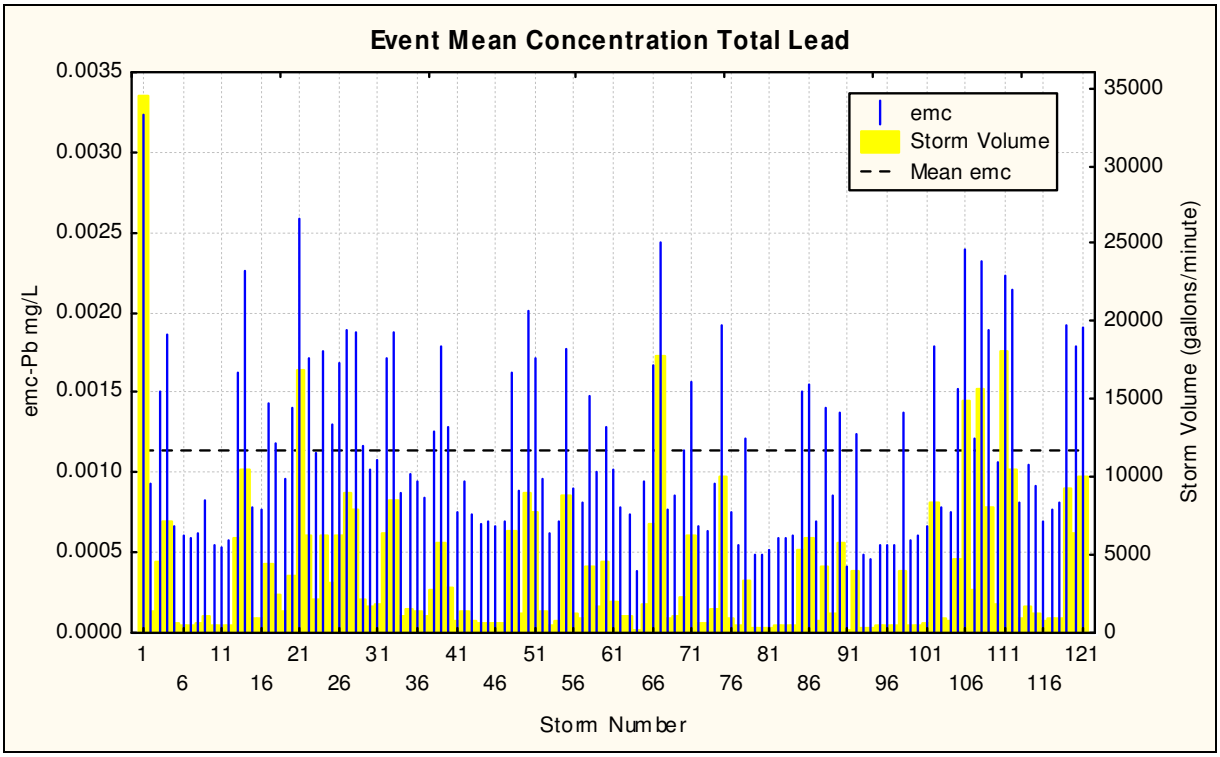


Figure 8-22a: Event Mean Concentration for Total Lead 2005-2006

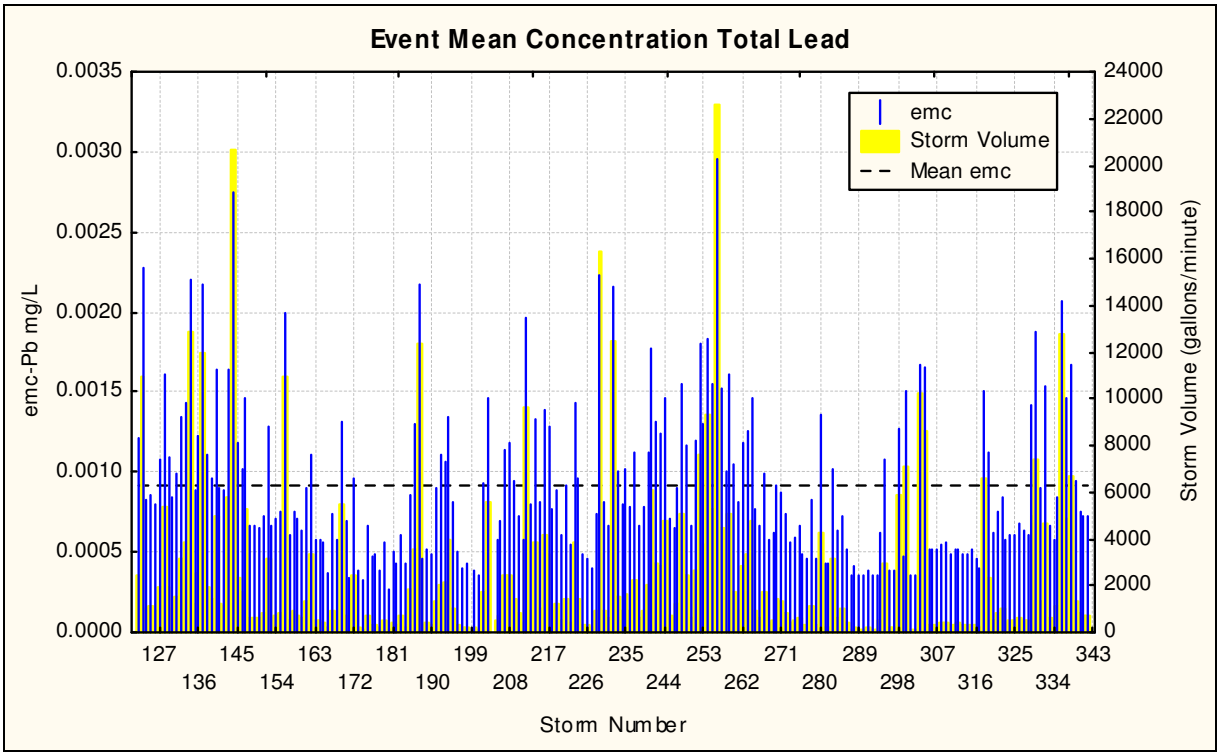


Figure 8-22b: Event Mean Concentration for Total Lead 2007-2008

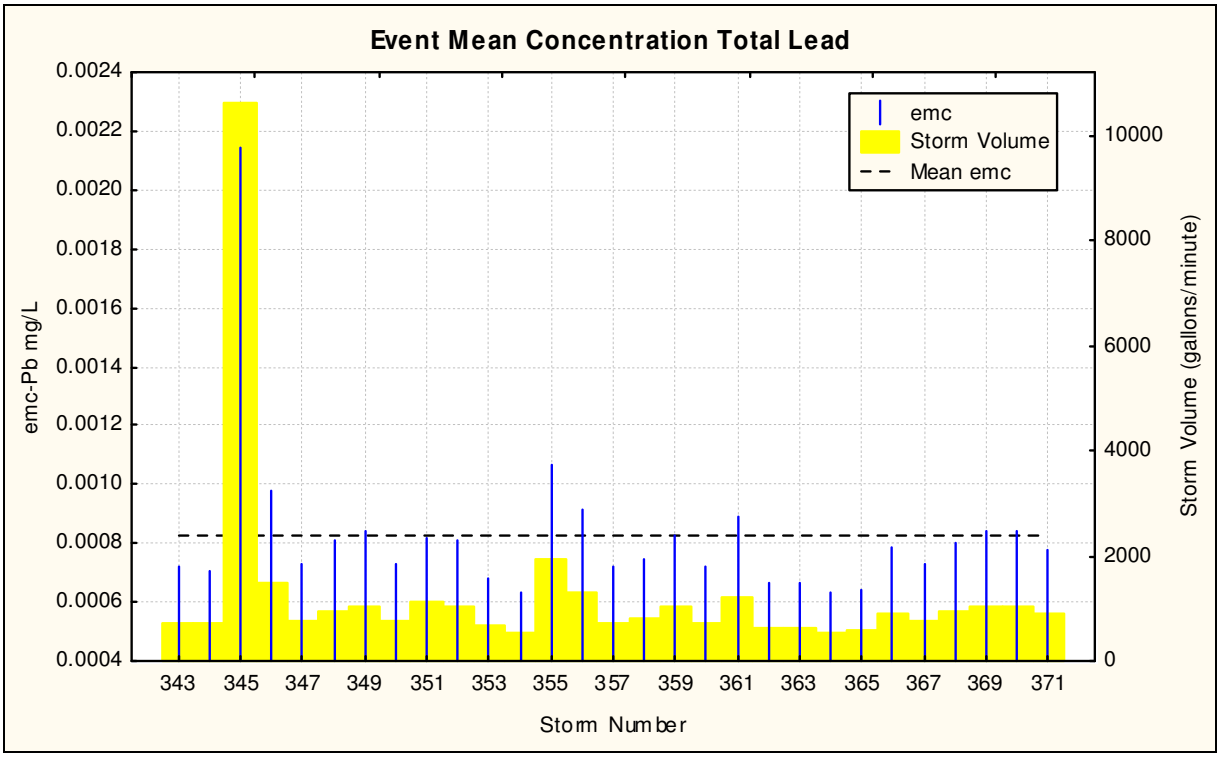


Figure 8-22c: Event Mean Concentration for Total Lead 2009

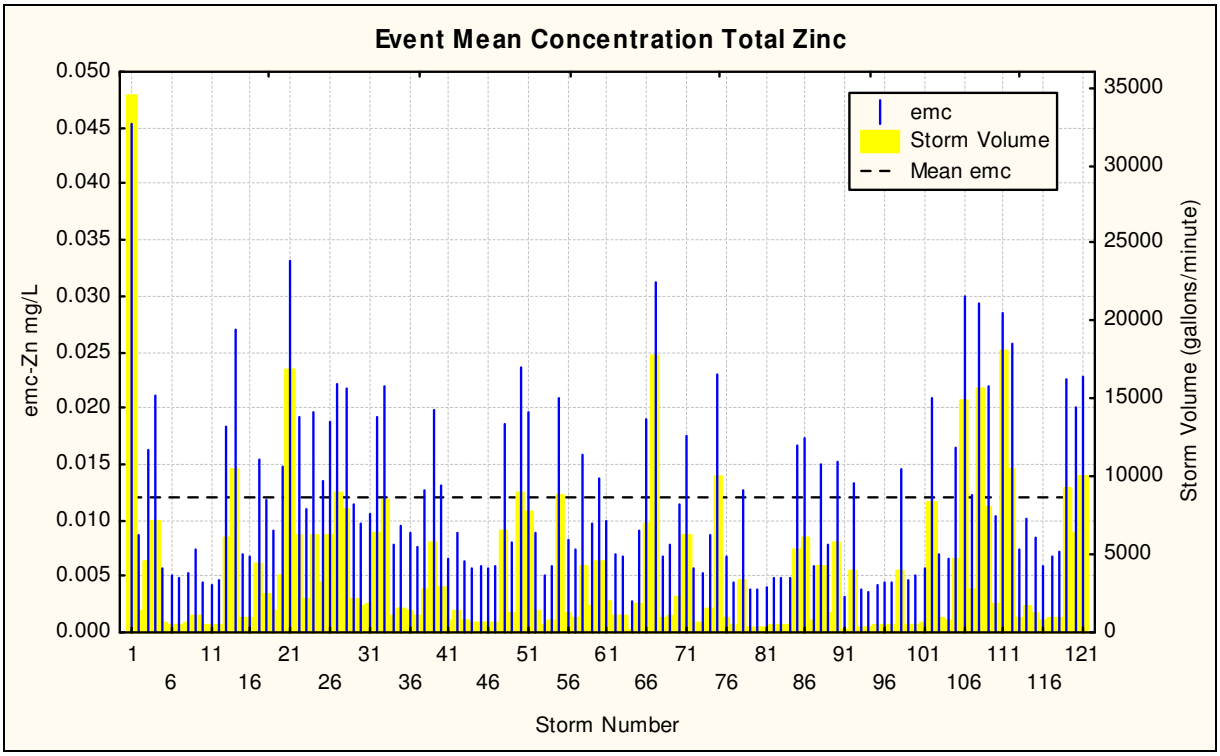


Figure 8-23a: Event Mean Concentration for Total Zinc 2005-2006

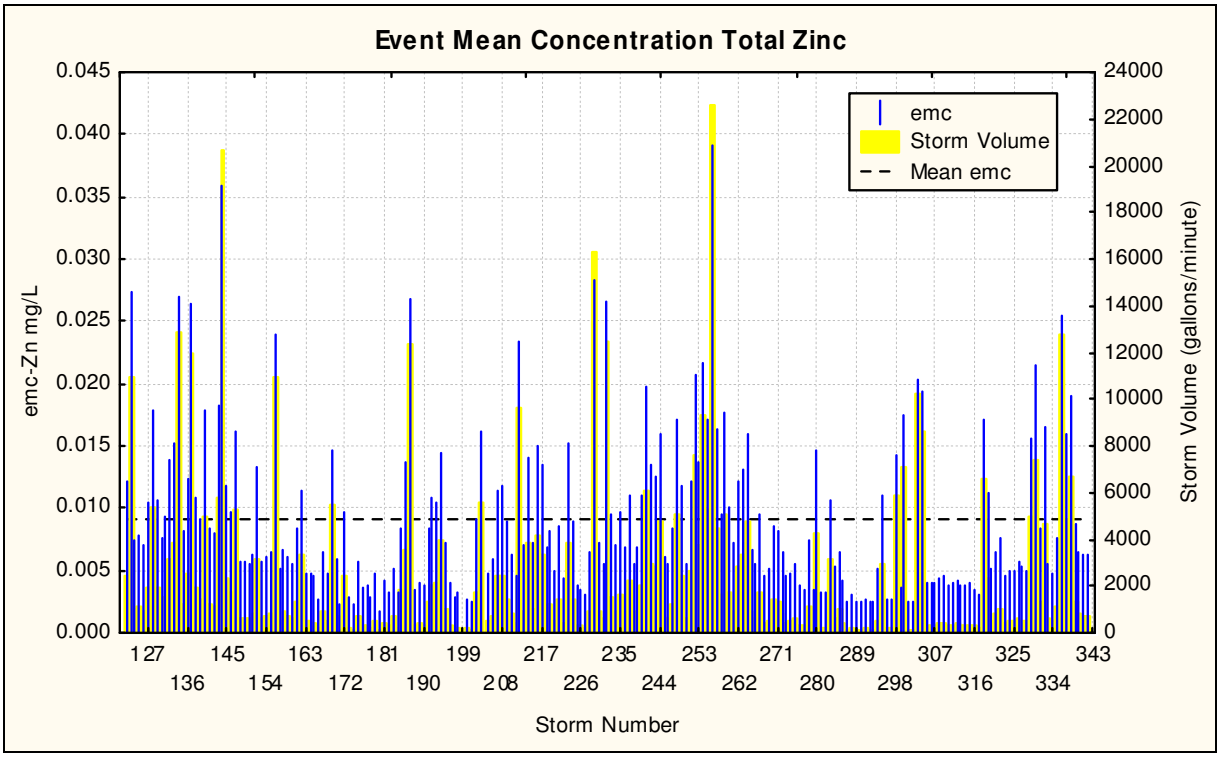


Figure 8-23b: Event Mean Concentration for Total Zinc 2007-2008

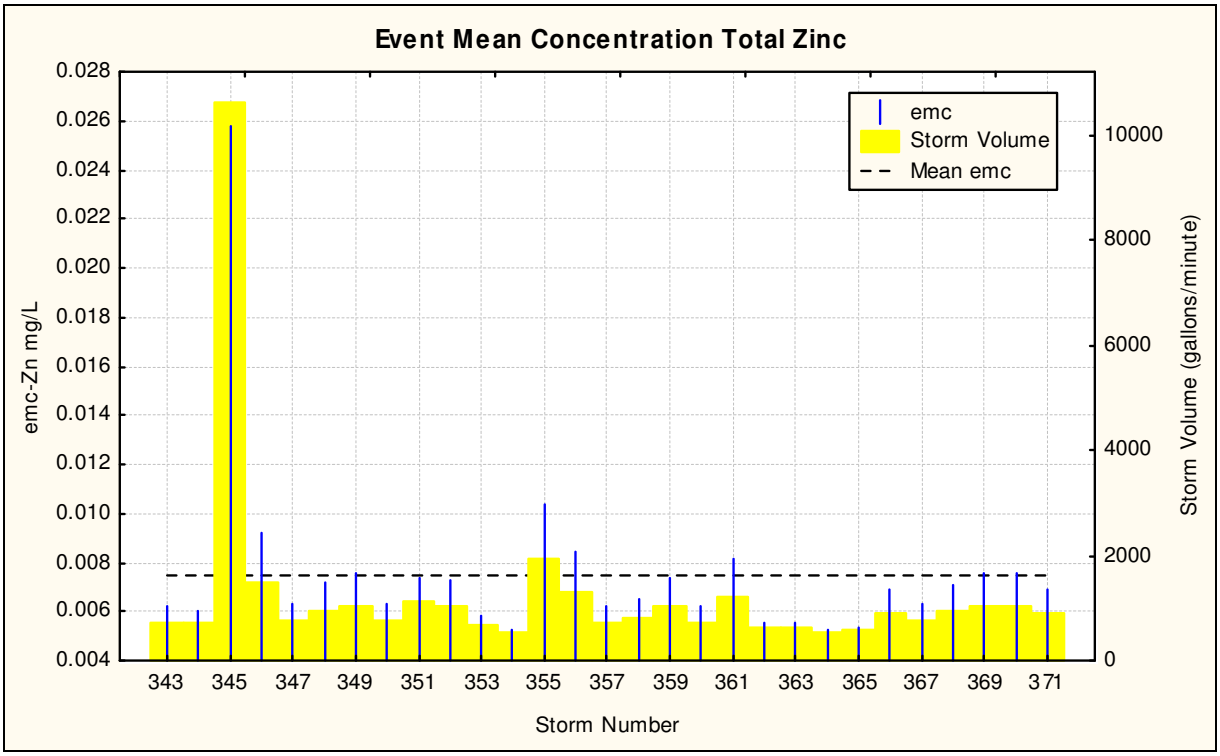


Figure 8-23c: Event Mean Concentration for Total Zinc 2009

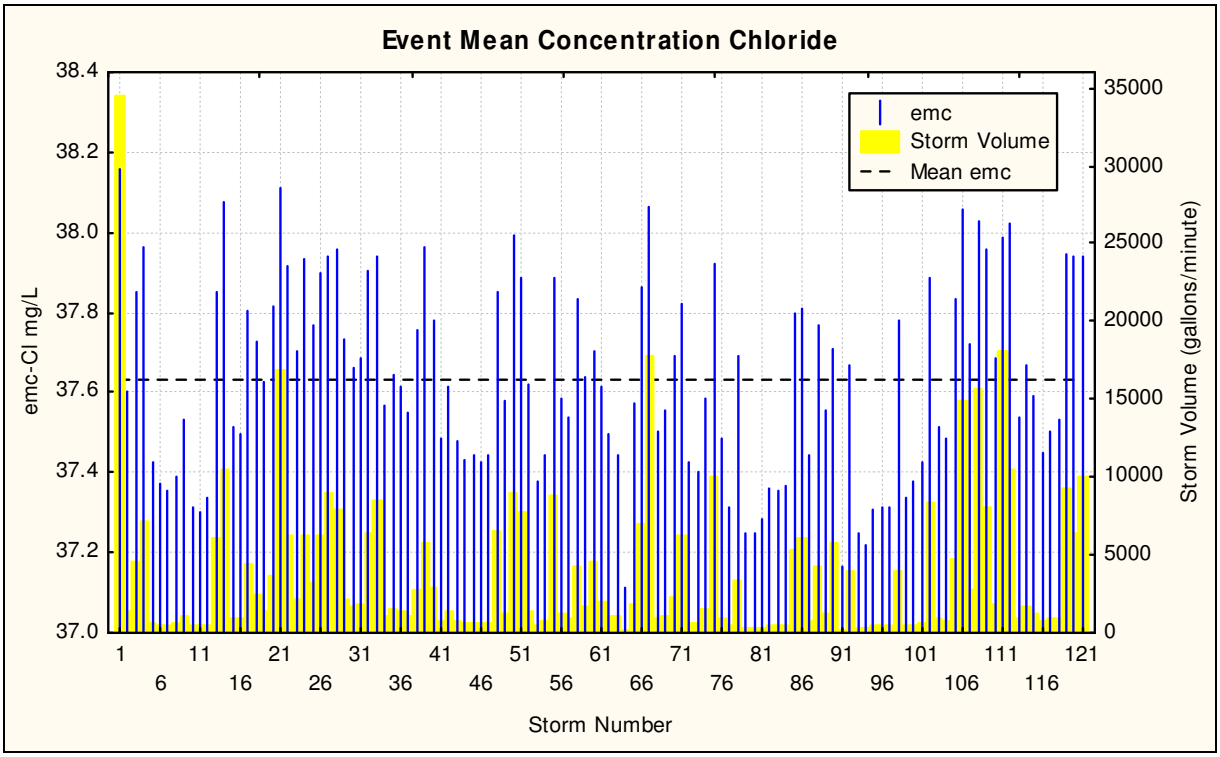


Figure 8-24a: Event Mean Concentration for Chloride 2005-2006

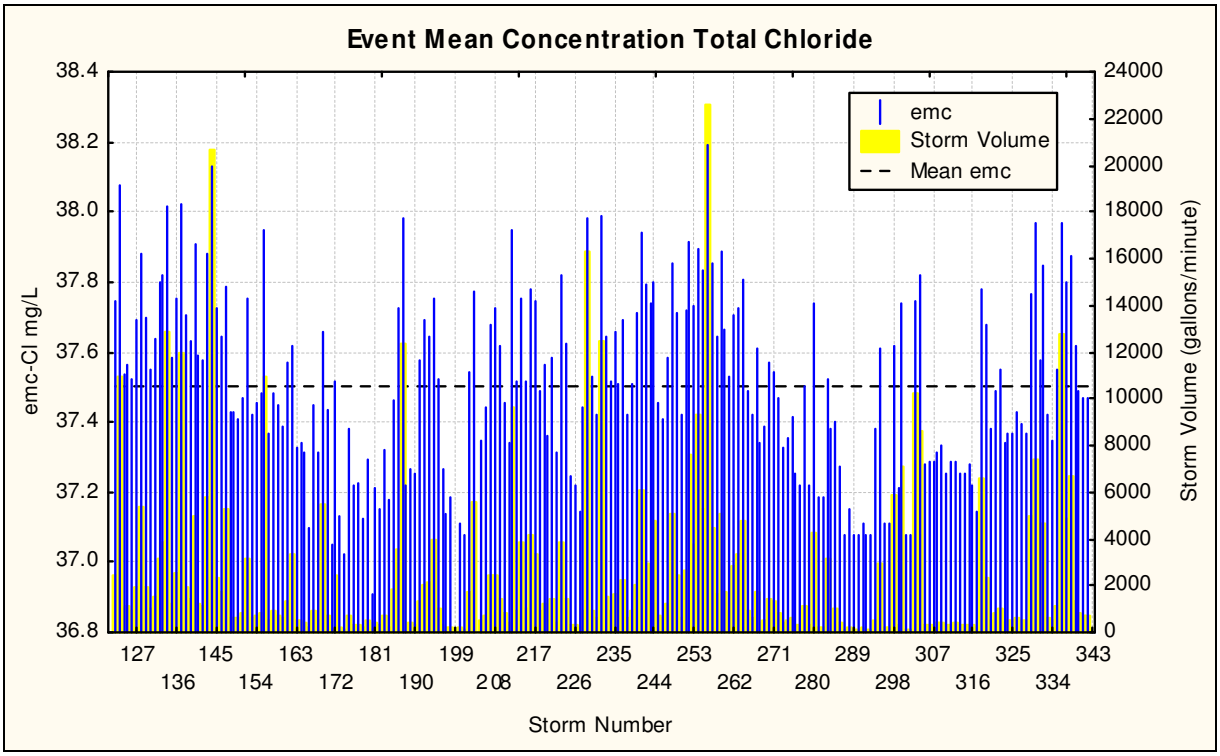


Figure 8-24b: Event Mean Concentration for Chloride 2007-2008

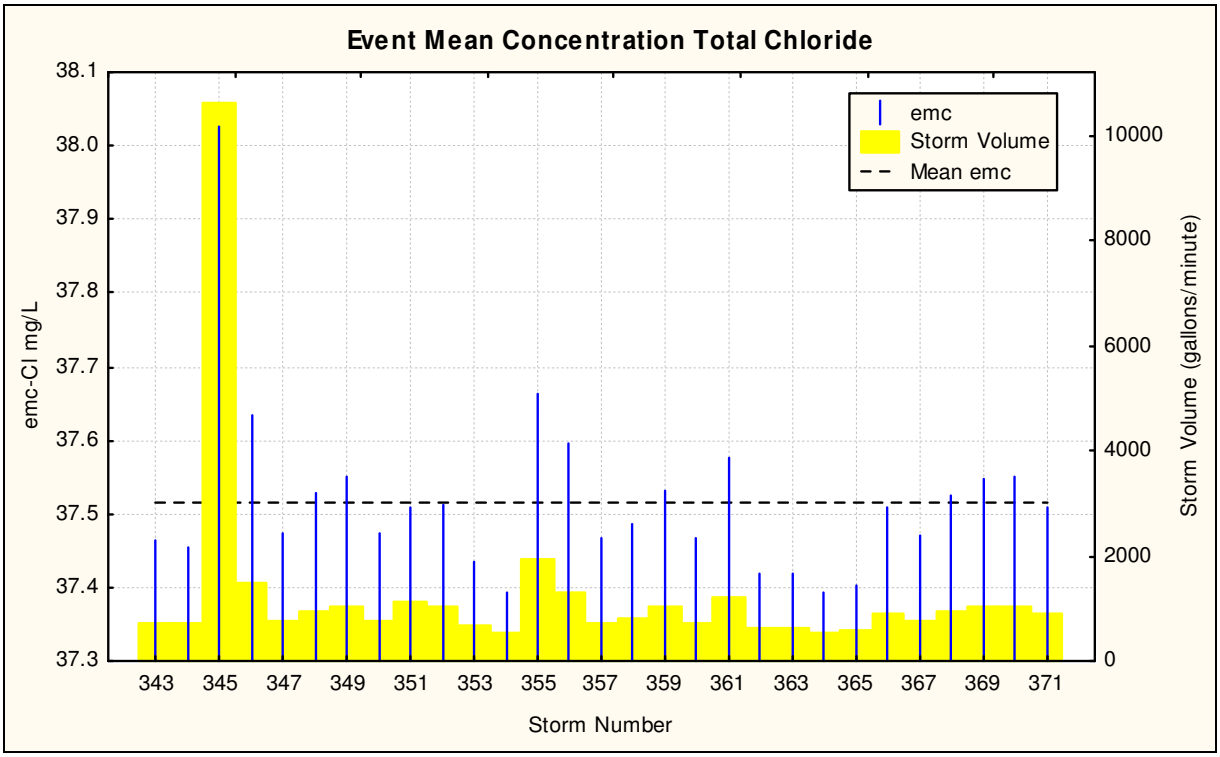


Figure 8-24c: Event Mean Concentration for Chloride 2009

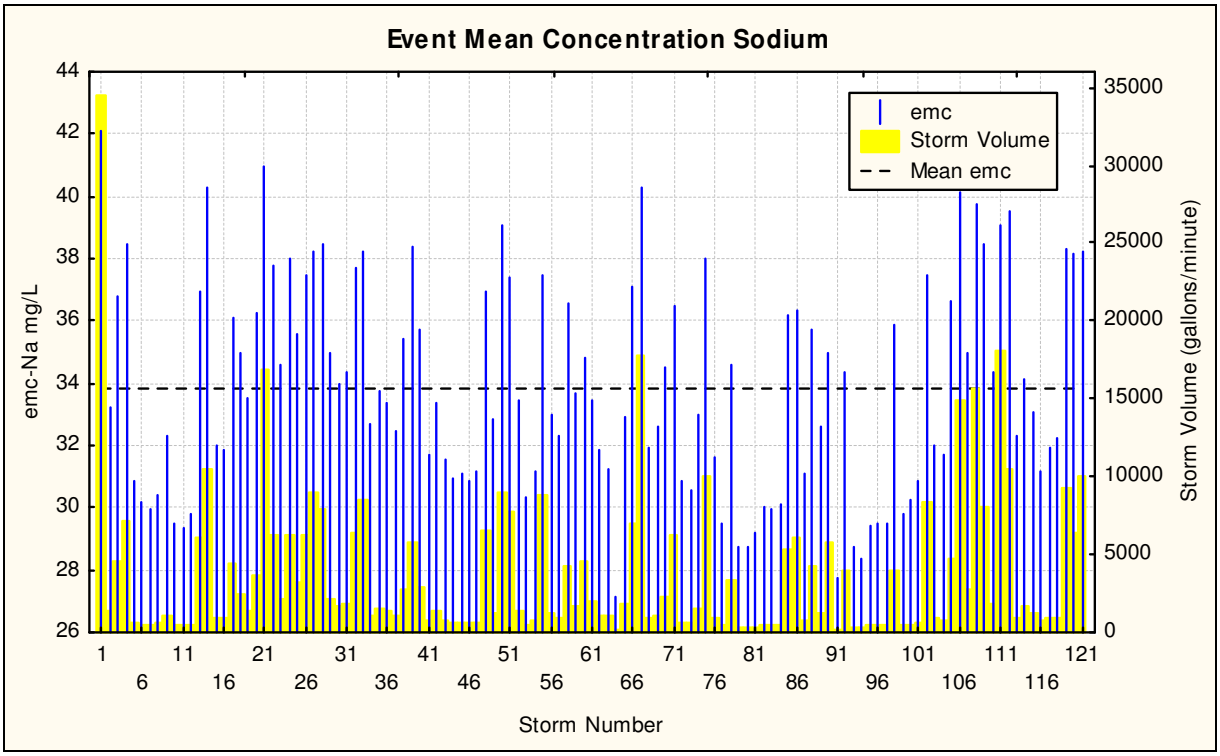


Figure 8-25a: Event Mean Concentration for Sodium 2005-2006

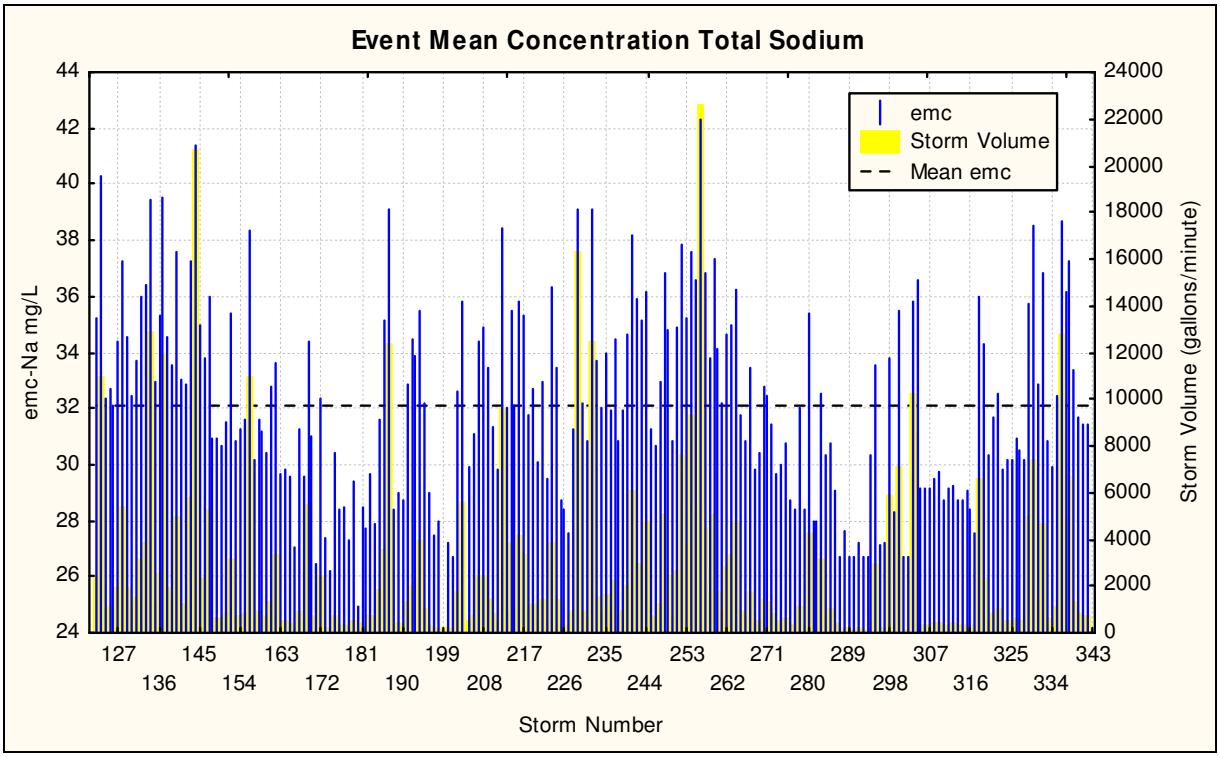


Figure 8-25b: Event Mean Concentration for Sodium 2007-2008

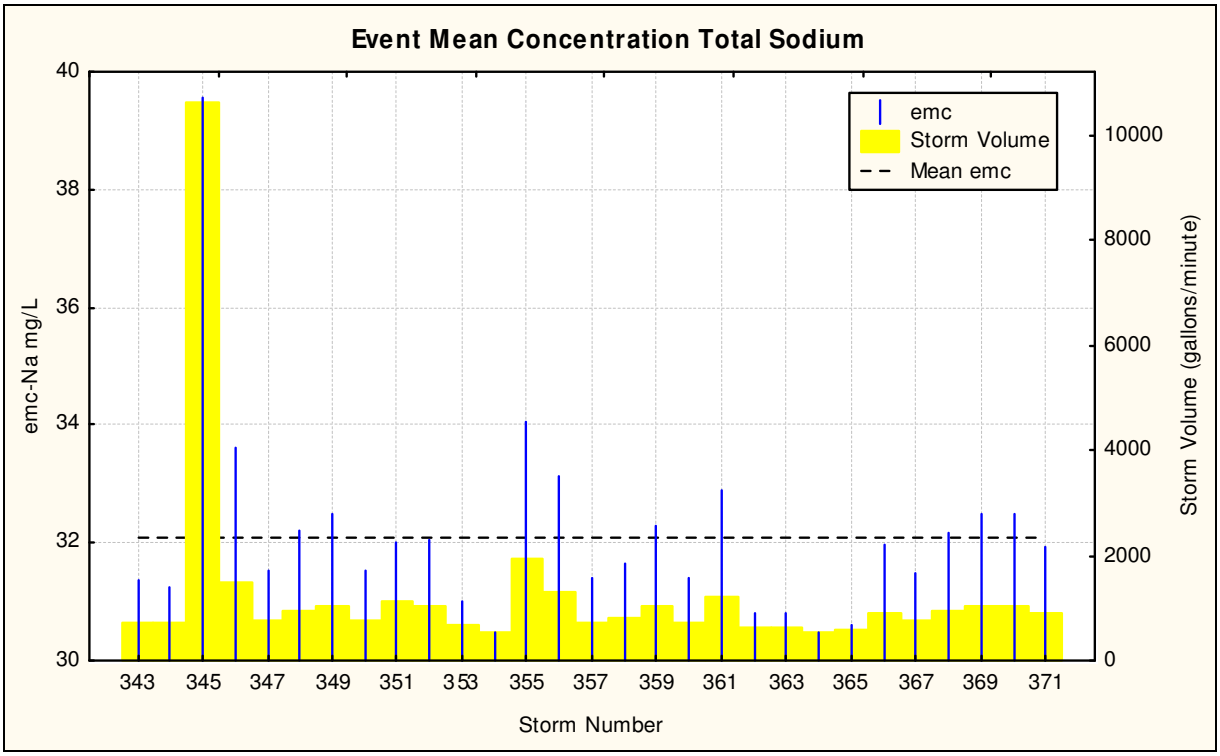
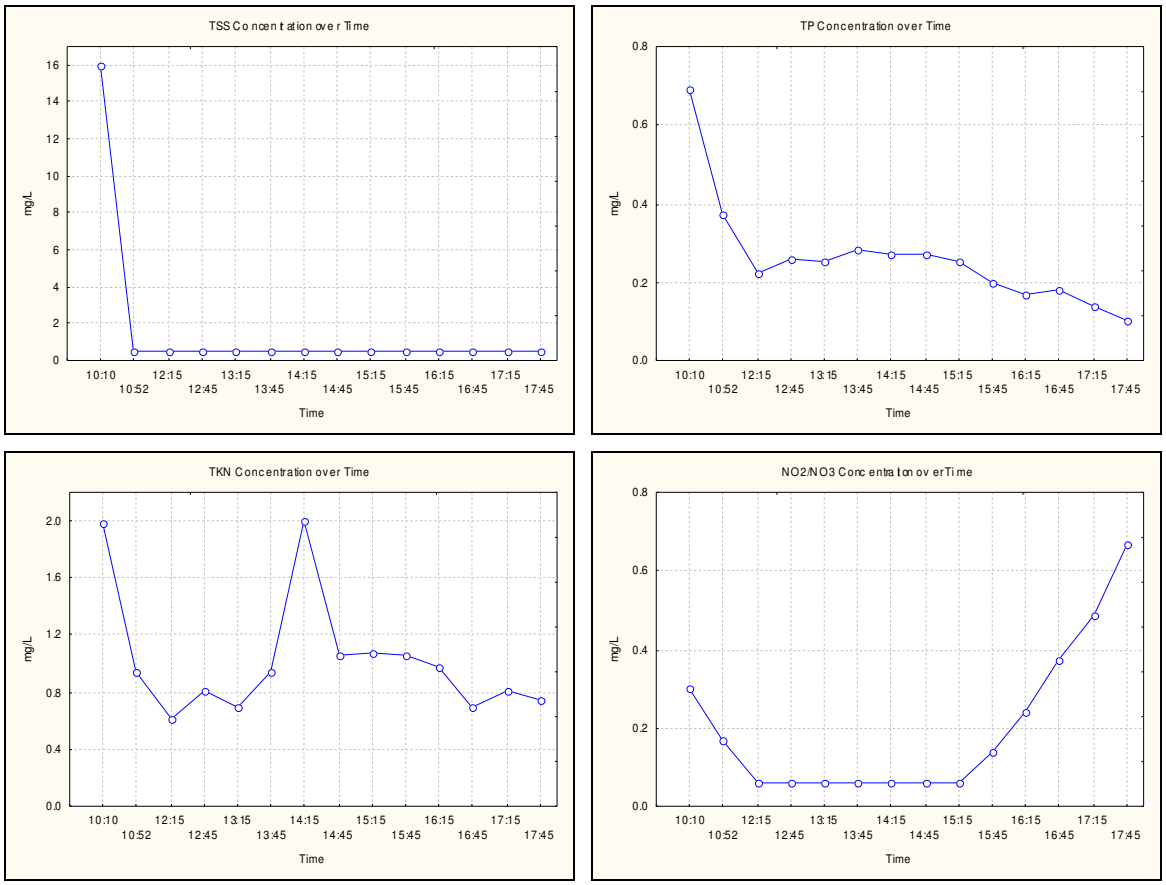


Figure 8-25c: Event Mean Concentration for Sodium 2009

Although we do not yet have a relationship between concentration and discharge at the outfall site, we have been collecting storm event samples at the outfall. Figure 8-26 shows one storm as an example of how the concentration for TSS, TP, TKN, Nitrate/Nitrite, and Total Copper changes over time during the storm. The precipitation started at 9:15 and ended at 13:15. The 10:10 and 12:15 samples are rising stages and the rest are falling stages. The total rainfall for the storm was 0.72 inches. Levels for all five parameters are high at the beginning of the storm. TSS showed the biggest drop, with all but the first sample being below the detection limit. Total Copper was also below detection limit for all but the first and last sample. When the problems with the discharge rating curve at the outfall are resolved, EMCs and pollutant loads will be reported.



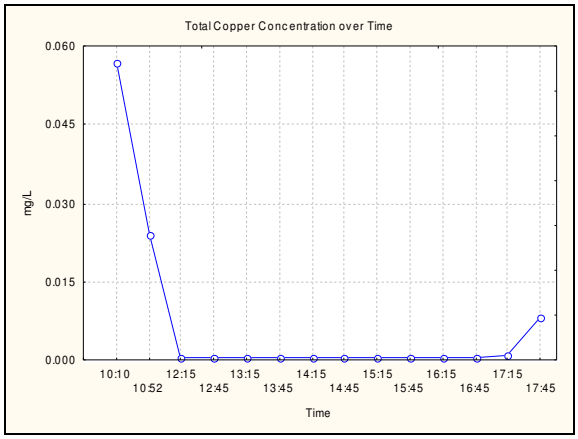


Figure 8-26: Concentration over Time for TSS, TP, TKN, NO2/NO3, Total Copper during storm event on 11/13/08

8.3.2.2 Baseflow Monitoring Results

Scotts Level Branch baseflow monitoring occurred at the outfall (SL-9), two tributary locations, and six mainstem locations for a total of 10 baseflow monitoring sites (Figure 8-2). Within Powder Mill Run baseflow monitoring took place at the USGS gage and two up-stream sites that are representative of each major branch (one in the County and one in the City). Baseflow monitoring in Upper Gwynns Falls occurred only at the USGS gage site. The baseflow sites in Scotts Level Branch, Powder Mill Run, and Upper Gwynns Falls should be monitored quarterly during baseflow conditions (preceded by a minimum of 72 hours dry weather). Baseflow sampling occurred three times for Scott's Level and once for Powder Mill Run.

Analysis of baseflow pollutants is especially important in relation to nitrogen. Research conducted by the County indicates that ~50% of the nitrogen load occurs during dry weather conditions. The baseflow sampling was used in conjunction with the storm event sampling to partition the annual discharge and pollutant load between baseflow (dry weather) conditions and storm event conditions.

Pollutant loads were examined for each of the baseflow sites. SL-09 was excluded because flow data was missing for most of the samples. Total Suspended solids were excluded from the baseflow analyses because limited conclusions can be drawn from this parameter during a baseflow sample. Many factors can affect the total suspended solids including small construction projects and car washing. These factors may only affect the stream for the limited time the sample is taken and can be misleading if extrapolated for a longer period of time. The results obtained were standardized to both daily pollutant load for drainage area and a daily load per acre and are shown in table 8-7.

Table 8-7: 2008 Daily Baseflow Pollutant Loads for Scott's Level Branch Sites

Site	Acres	TKN (mg/L)	TKN Daily Load (#s)	TKN Daily Load (#s per acre)	NO_2/NO_3 (mg/L)	NO_2/NO_3 Daily Load (#s)	NO_2/NO_3 Daily load (#s per acre)
SL-01	2,186	0.32	1.2254	0.0006	0.70	3.59	0.0016
SL-02	1,908	0.29	1.0941	0.0006	0.75	3.38	0.0018
SL-03	1,434	0.22	0.1921	0.0001	0.85	2.04	0.0014
SL-04	1,167	0.25	0.4019	0.0003	0.83	1.92	0.0016
SL-05 - Trib	202	0.94	0.0476	0.0002	2.42	0.85	0.0042

SL-06	742	0.40	0.2963	0.0004	0.92	1.03	0.0014
SL-07 - Trib	62	0.22	0.0340	0.0005	0.95	0.33	0.0053
SL-08	451	0.19	0.2863	0.0006	0.98	1.59	0.0035
SL-10	265	0.21	0.2869	0.0011	1.13	1.07	0.0040
Site	**Acres**	**TN (mg/L)**	**TN Daily Load (#s)**	**TN Daily Load (#s per acre)**	**TP (mg/L**	**TP Daily Load (#s)**	**TP Daily Load (#s per acre)**
SL-01	2,186	1.09	4.81	0.0022	0.056	0.20	0.00009
SL-02	1,908	1.12	4.47	0.0023	0.042	0.08	0.00004
SL-03	1,434	1.19	2.23	0.0016	0.040	0.04	0.00003
SL-04	1,167	1.23	2.33	0.0020	0.044	0.07	0.00006
SL-05 Trib.	202	3.70	0.90	0.0045	0.147	0.02	0.00010
SL-06	742	1.46	1.33	0.0018	0.042	0.03	0.00004
SL-07 Trib.	62	1.18	0.36	0.0058	0.016	0.00	0.00000
SL-08	451	1.26	1.87	0.0041	0.029	0.04	0.00009
SL-09 - Outfall							
SL-10	265	1.38	1.36	0.0051	0.048	0.06	0.00023

A number of observations are possible based on the information in Table 8-7. First, site SL-05, a tributary with a drainage area of 202 acres has disproportionately high concentrations of all nutrient parameters. These high concentrations are suspected to be from the stormwater management pond in which this tributary originates or from small sewage leakages. The investigation into this is still ongoing. Second, there is in general a decrease in nitrate/nitrite concentrations in a downstream direction (SL-10 → SL-1). The same pattern of decrease in a downstream direction is exhibited by total phosphorus and total nitrogen. This could be the result of nutrient uptake by biota in the stream as the water passes downstream.

8.3.2.3 Pollutant Load Calculations

Data from the USGS gage was recorded at 15-minute intervals from October 1, 2005 through March 3, 2009 resulting in 120,575 individual discharge readings. The regression equations determined above from the storm event samples, relating pollutant concentration to discharge, were used to determine the pollutant concentration for each 15-minute interval. From this data the load was calculated for each 15-minute interval using the following formula:

$P_L = (P_C * .000008345) * (CFS * 448.8 * 15)$, where

P_L = Pollutant Load,
P_C = Pollutant Concentration,
.000008345 = Conversion factor to convert mg/L to pounds per gallon,
CFS = Cubic feet per second,
448.8 = Conversion factor to convert cubic feet per second to gallons per minute
15 = number of minutes in the interval.

The results obtained by the above formula were standardized to both an annual pollutant load for the drainage area and an annual pollutant load per acre. In addition, the data were analyzed for seasonal loads, storm event pollutant loads, and the percent of the load delivered during baseflow conditions (Table 8-8).

Table 8-8: Pollutant Load Characteristics for USGS gaged site (SL-01) Calendar Year 2008

Parameter	Pounds/ Year	Pound/Acre	% by Season	Storm Event lbs.	% Load as Storm Flow	Baseflow lbs.	% Load as Baseflow
TSS							
Fall	122,441	56.01	24.0%	119,340	97.5%	3,101	2.5%
Winter	77,775	35.58	15.2%	71,933	92.5%	5,842	7.5%
Spring	90,279	41.30	17.7%	85,586	94.8%	4,693	5.2%
Summer	27,781	12.71	5.4%	26,812	96.5%	969	3.5%
Total	**510,481**	**233.52**		**472,382**	**92.5%**	**38,099**	**7.5%**
TKN							
Fall	1,825	0.83	33.7%	1,596	87.5%	229	12.5%
Winter	1,354	0.62	25.0%	990	73.1%	364	26.9%
Spring	1,660	0.76	30.6%	1,340	80.7%	320	19.3%
Summer	581	0.27	10.7%	480	82.6%	101	17.4%
Total	**5,420**	**2.48**		**4,406**	**81.3%**	**1,014**	**18.7%**
NO_2/NO_3							
Fall	790	0.36	30.3%	588	74.4%	202	25.6%
Winter	684	0.31	26.2%	390	57.0%	294	43.0%
Spring	802	0.37	30.8%	534	66.6%	268	33.4%
Summer	330	0.15	12.7%	221	67.0%	109	33.0%
Total	**2,606**	**1.19**		**1,733**	**66.5%**	**873**	**33.5%**
TN							
Fall	2,772	1.27	32.3%	2,298	82.9%	474	17.1%
Winter	2,185	1.00	25.5%	1,458	66.7%	727	33.3%
Spring	2,645	1.21	30.8%	1,996	75.5%	649	24.5%
Summer	978	0.45	11.4%	751	76.8%	227	23.2%
Total	**8,580**	**3.92**		**6,503**	**75.8%**	**2,077**	**24.2%**
TP							
Fall	302	0.14	35.9%	281	93.0%	21	7.0%
Winter	205	0.09	24.4%	170	82.9%	35	17.1%
Spring	252	0.12	30.0%	222	88.1%	30	11.9%
Summer	82	0.04	9.8%	74	90.2%	8	9.8%
Total	**841**	**0.38**		**747**	**88.8%**	**94**	**11.2%**
Total Copper							
Fall	26.1	0.0119	36.0%	24.4	93.5%	1.7	6.5%
Winter	17.7	0.0081	24.4%	14.8	83.6%	2.9	16.4%
Spring	21.7	0.0099	29.9%	19.2	88.5%	2.5	11.5%
Summer	7.1	0.0032	9.8%	6.4	90.1%	0.7	9.9%
Total	**72.6**	**0.0332**		**64.8**	**89.3%**	**7.8**	**10.7%**
Total Lead							
Fall	6.1	0.0028	37.2%	5.9	96.7%	0.2	3.3%
Winter	4.0	0.0018	24.4%	3.6	90.0%	0.4	10.0%
Spring	4.8	0.0022	29.3%	4.4	91.7%	0.4	8.3%
Summer	1.5	0.0007	9.1%	1.4	93.3%	0.1	6.7%
Total	**16.4**	**0.0075**		**15.3**	**93.3%**	**1.1**	**6.7%**
Total Zinc							
Fall	83.8	0.0383	38.6%	81.7	97.5%	2.1	2.5%
Winter	53.1	0.0243	24.4%	49.2	92.7%	3.9	7.3%
Spring	61.5	0.0281	28.3%	58.4	95.0%	3.1	5.0%
Summer	18.9	0.0086	8.7%	18.3	96.8%	0.6	3.2%
Total	**217.3**	**0.0994**		**207.6**	**95.5%**	**9.7**	**4.5%**

Sodium							
Fall	79,939	36.57	32.2%	65,835	82.4%	14,104	17.6%
Winter	63,456	29.03	25.5%	41,897	66.0%	21,559	34.0%
Spring	76,672	35.07	30.8%	57,401	74.9%	19,271	25.1%
Summer	28,536	13.05	11.5%	21,718	76.1%	6,818	23.9%
Total	**248,603**	**113.73**		**186,851**	**75.2%**	**61,752**	**24.8%**
Chloride							
Fall	86,442	39.54	33.4%	74,935	86.7%	11,507	13.3%
Winter	64,887	29.68	25.1%	46,687	72.0%	18,200	28.0%
Spring	79,387	36.32	30.7%	63,358	79.8%	16,029	20.2%
Summer	28,050	12.83	10.8%	22,877	81.6%	5,173	18.4%
Total	**258,766**	**118.37**		**207,857**	**80.3%**	**50,90**	**19.7%**

There are distinct seasonal differences in the delivery of nutrient and total suspended solids pollutant loads, with summer being the season of reduced load delivery for all pollutants analyzed. Approximately 20.7% of the precipitation fell during the fall season, 24.3% of this precipitation was reflected in the stream flow (Table 8-5). This summer decrease in stream flow results in a decrease in the delivery of pollutants.

Baseflow accounts for a negligible amount of the pollutant load delivery for Total Suspended Solids (7.5%), Total Phosphorus (11.2%), Total Zinc (4.5%) and Total Lead (6.7%), and Total Copper (10.7%). The Nitrite/Nitrate load has about one-third of its load delivered during baseflow conditions. TKN (ammonia and organic nitrogen) has 18.7% of its load delivered during baseflow conditions. Organic nitrogen will be mobilized both within the stream channel and washed into the stream during storm events.

8.3.3 Geomorphological Monitoring Results

Streambank Soil Sampling: Two sets of Stream bank and bed core samples were collected in the vicinity of the permanent cross sections for laboratory analysis of bulk density, particle size distribution, total nitrogen, and total phosphorus and other constituents. One of the two sets was taken in the vicinity of Scotts Level Cross Section # 13, and the other set was taken from Powder Mill Cross Section # 2. Eventually, it is planned to sample each of the 30 cross sections of both streams. The samples will be one-time sample collections, with 10% of the sites, randomly selected, for a second round of sample collection to provide an analysis of annual variability. The data from each cross section will allow either positive or negative loading estimates to be made for the cross sections. These estimates, if extended to represent their respective stream segments may provide information helpful in understanding the sediment and chemical flux of the stream system. Based on the annual and long term change, and the results of the core samples, the estimated annual sediment, total nitrogen, and total phosphorus loads will be calculated for comparison with the chemical monitoring results derived from the in-stream monitoring site.

Scotts Level Branch Geomorphological Monitoring Results: Overlays of the 18 randomly selected cross sections show the changes that occurred in 2007-2008 and 2005-2008. Figure 8-27 shows an overlay of CX #1. Table 8-9 presents the amount of aggradation (filling) or degradation (cutting) within the active channel, and Table 8-10 (listed from upstream to downstream) summarizes Table 8-9. Data in Table 8-9 were annualized to standardize aggradation and degradation estimates. The data files and plots can be viewed on the separate

data CD accompanying this report. All of the random cross sections remained relatively unchanged during 2007-2008 in terms of net change (Table 8-10). Cross Section #1 showed a larger net change (fill) during 2005-2008. This reach is characterized by a steep gradient leading into a flatter depositional zone at the cross section. The reach also integrates the sediment fluxes from the entire upstream study area, which may explain the more pronounced fill as compared to the other cross sections.

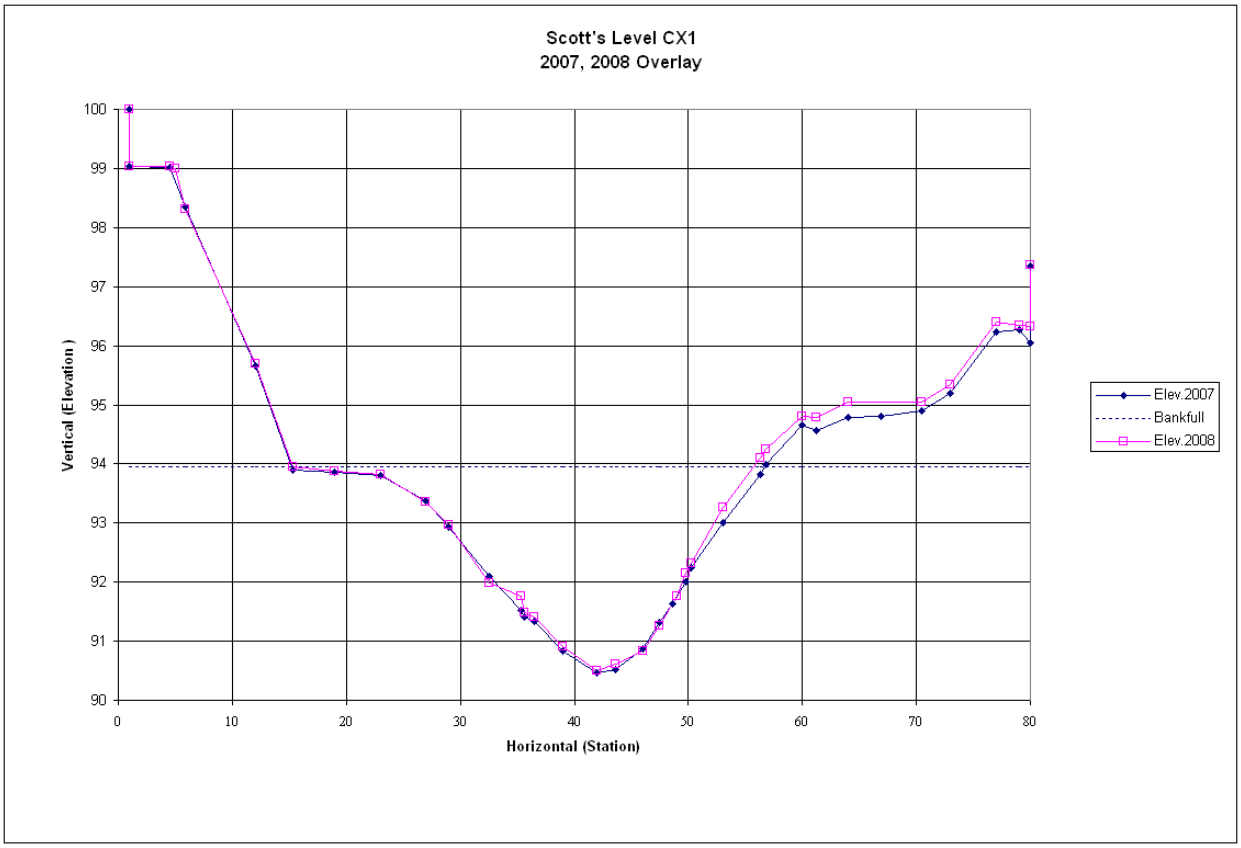


Figure 8-27: Scotts Level Branch Geomorphological Cross Section 1 Overlay showing net deposition especially on the right channel side between the 2007 and 2008 surveys.

Since most of the input hydrology to Scotts Level is from impervious area, the sediment fluxes within the stream channel are most likely part of the process of the stream reworking its surrounding legacy flood plain sediments and ultimately transporting them into the Gwynns Falls mainstem and beyond. The data now being collected should serve as an important baseline prior to monitoring the effects of future stream channel and stormwater management improvements in the watershed. The results of the initial cross-section measurements are found on the separate data CD accompanying this report.

Table 8-9: Scotts Level Branch Cross Sections - Annualized Cut and Fill Amounts

SL 20: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008	SL 10: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008
Total Cut	-0.4	-0.2	Total Cut	-1.9	-0.5

Total Fill	2.9	1.1	Total Fill	0.7	0.6
Total Change	3.3	1.3	Total Change	2.6	1.1
Net Change	2.5	0.9	Net Change	-1.2	0.1
SL19: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 9: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-0.4	0.0	Total Cut	-4.3	-0.8
Total Fill	3.3	1.8	Total Fill	0.7	0.7
Total Change	3.7	1.8	Total Change	5.0	1.5
Net Change	2.9	1.8	Net Change	-3.6	-0.1
SL 18: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 8: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-6.9	-2.2	Total Cut	-5.1	-2.0
Total Fill	3.0	0.2	Total Fill	0.2	0.2
Total Change	9.9	2.4	Total Change	5.3	2.2
Net Change	-3.9	-2.0	Net Change	-4.9	-1.8
SL 17: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 7: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-1.6	-0.7	Total Cut	-1.0	-1.8
Total Fill	0.6	0.2	Total Fill	6.5	0.2
Total Change	2.2	0.9	Total Change	7.5	2.0
Net Change	-1.0	-0.5	Net Change	5.5	-1.6
SL 16: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 6: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-2.7	-0.5	Total Cut	-0.3	-0.7
Total Fill	0.1	0.6	Total Fill	2.3	0.1
Total Change	2.8	1.1	Total Change	2.6	0.8
Net Change	-2.6	0.1	Net Change	2.0	-0.6
SL 15: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 5*: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-2.4	-0.3	Total Cut	NA	NA
Total Fill	0.8	0.9	Total Fill	NA	NA
Total Change	3.2	1.2	Total Change	NA	NA
Net Change	-1.6	0.6	Net Change	NA	NA
SL 14: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 4*: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-3.5	-1.1	Total Cut	NA	NA
Total Fill	0.6	0.6	Total Fill	NA	NA
Total Change	4.1	1.7	Total Change	NA	NA
Net Change	-2.9	-0.5	Net Change	NA	NA
SL 13: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 3: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-0.6	-0.7	Total Cut	0.0	0.0
Total Fill	2.2	0.8	Total Fill	2.2	0.9
Total Change	2.8	1.5	Total Change	2.2	0.9
Net Change	1.6	0.1	Net Change	2.2	0.9
SL 12: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**SL 2: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-0.2	-2.9	Total Cut	-1.0	-0.7
Total Fill	2.5	1.9	Total Fill	1.6	0.5
Total Change	2.7	4.8	Total Change	2.6	-1.2
Net Change	2.3	-1.0	Net Change	0.6	-0.2

SL 11: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008	SL 1: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008
Total Cut	-0.5	-0.5	Total Cut	-0.2	-1.2
Total Fill	2.6	1.4	Total Fill	6.1	7.6
Total Change	3.1	1.9	Total Change	6.3	8.8
Net Change	2.1	0.9	Net Change	5.9	6.4

* Permission from private property owners for sampling SL 5 and SL 4 has not yet been obtained, therefore there are no results.

Table 8-10: Scotts Level Branch Stream Channel Changes Over Time.

SL #	CX 2007-2008	CX 2005-2008
20	a	a
19	a	a
18	d	d
17 (Trib.)	d	d
16	d	a
15	d	a
14	d	d
13	a	a
12	a	d
11	a	a
10	d	a
9	d	d
8	d	d
7	a	d
6	a	d
5	NA	NA
4	NA	NA
3	a	a
2	a	d
1	a	a

Symbols: a: aggradation, d: degradation

The aggradation/degradation and stream bank soil chemistry data, when combined with water chemistry data, allows examination of pollutant loads for various components of the Scotts Level Branch watershed. The expectation is that instream water quality estimates are equal to the sum of stream bank and watershed wash-off estimates. Table 8-11 shows loads for Total Nitrogen, Total Phosphorus, and Sediment from the instream and stream bank components of the Scotts Level Branch watershed for 2006 and 2007. Estimates of sediment loads were based on Total Suspended Solids for instream water quality and stream bank soil weights for geomorphology. Instream water quality data were taken from the 2007 NPDES Report. The pollutant load for Total Phosphorus was highest in stream bank soils, because soil particles bind phosphorus. Therefore streams typically have elevated phosphorus concentrations during stormflow. The load for Total Nitrogen was highest for instream water quality. Groundwater contributes most of the nitrogen (as baseflow) in a watershed. Sediment loads were greatest in stream bank soils in both years. Missing from this discussion is the watershed wash-off estimate, which will be made using the Scotts Level Branch outfall. The United States Geological Survey is developing a

flow-rating curve for the outfall. Pollutant loads for the outfall will be included in the 2010 NPDES report, after the rating curve is complete.

Table 8-11: Pollutant Load Estimates- Comparison between Water Quality Monitoring and Geomorphology for Scotts Level Branch, 2006 - 2008

	2006		2007		2008	
Parameter	Instream Water Quality Pollutant Load (lbs/yr)	Geomorphology Pollutant Load (lbs/yr)	Instream Water Quality Pollutant Load (lbs/yr)	Geomorphology Pollutant Load (lbs/yr)	Instream Water Quality Pollutant Load (lbs/yr)	Geomorphology Pollutant Load (lbs/yr)
TN	9,747	3,634	6,804	3,201	8,580	2,282
TP	944	1,134	582	999	841	712
Sediment	362,882	1,608,633	192,205	1,416,805	510,481	1,010,274

Extending this analysis to the entire watershed (geomorphology station SL-1), which includes the portion below the gage, for stream bank soils shows loads of 1,943 lbs/yr and 772 lbs/yr for Total Nitrogen in 2007 and 2008, respectively. Total Phosphorus loads are 606 and 241 lbs/yr for 2007 and 2008, respectively. Sediment loads are 859,906 lbs/yr and 341,818 lbs/yr in 2007 and 2008, respectively. In 2007 and 2008, both nitrogen and phosphorus were processed in the stream reach upstream of Rolling Road. The sediment load was lower for the entire subwatershed than it was for the Rolling Road reach, suggesting deposition in the Rolling Road reach, which is the furthest downstream site. This analysis has begun to show patterns of nutrient and sediment loading to Scotts Level Branch. Continued water quality and stream bank soil sampling, along with estimates of loads from the outfall, should provide more refined estimates of the relative contribution of each of these components to the pollutant loads within the watershed, as well as estimates of export from the watershed. These data will allow DEPRM to more accurately determine the contribution of the various flow components to overall pollutant load estimates, and will form the basis for more accurate determination of benefits from future stream restoration.

Powder Mill Run Geomorphological Monitoring Results: Overlays of the 10 randomly selected cross sections show the changes that occurred during 2007 and 2008. Table 8-12 presents a quantification of these changes in terms of aggradation (filling) or degradation (cutting) within the active channel, and Table 8-13 summarizes Table 8-12. The data suggest that Powder Mill is more actively aggrading and degrading than Scott's Level Branch. Four of the ten cross sections showed net change greater than 5 cubic feet per year. The largest change (aggradation) occurred at Cross Section #6. The stream channel at this location is flat and would be expected to act as a depositional area. It is likely that one of the larger storms during the measurement interval removed a large amount of sediment from upstream and deposited it here. Cross Sections #1, #2, and #5 experienced relatively large amounts of degradation in 2007-2008. These cross sections are located just downstream of high gradient stream reaches. Cross Section #5 is downstream of a paved road and bridge abutment, and illustrates localized stream response to upstream

impervious cover. In contract, Cross Sections #9 and #10 are measured within a gabion-lined channel, which buffers the specific locations from large changes in cut and fill. However, the next downstream cross section (#8), which experienced degradation, may illustrate the effects of this stream bank and bed armoring. The imperviousness of the upstream channel likely concentrates high flows and causes downstream channel instability. All data files and plots can be viewed on the separate data CD accompanying this report.

Table 8-12: Powder Mill Run Cross Sections - Cut and Fill Amounts

PM 10: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008	PM 5: Change (cu ft)	Period: 2007 – 2008	Period: 2005 – 2008
Total Cut	-2.1	-3.3	Total Cut	-6.8	-3.2
Total Fill	1.0	0.2	Total Fill	0.7	0.9
Total Change	3.1	3.5	Total Change	7.5	4.1
Net Change	-1.1	-3.1	Net Change	-6.1	-2.3
PM 9: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**PM 4: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-1.3	-3.4	Total Cut	-2.3	-0.9
Total Fill	1.2	1.9	Total Fill	1.8	0.6
Total Change	2.4	5.3	Total Change	4.1	1.5
Net Change	-0.1	-1.5	Net Change	-1.5	-0.3
PM 8: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**PM 3: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-4.7	-0.4	Total Cut	-1.6	-1.4
Total Fill	0.5	1.1	Total Fill	1.9	0.0
Total Change	5.2	1.5	Total Change	3.5	1.4
Net Change	-4.1	0.7	Net Change	0.3	-1.4
PM 7: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**PM 2: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-3.0	-8.3	Total Cut	-6.0	-3.3
Total Fill	0.7	0.0	Total Fill	0.2	0.0
Total Change	3.7	8.3	Total Change	6.2	3.3
Net Change	-2.3	-8.3	Net Change	-5.8	-3.3
PM 6: Change (cu ft)	**Period: 2007 – 2008**	**Period: 2005 – 2008**	**PM 1: Change (cu ft)**	**Period: 2007 – 2008**	**Period: 2005 – 2008**
Total Cut	-0.1	-0.8	Total Cut	-4.5	-7.3
Total Fill	8.3	0.6	Total Fill	11.8	1.2
Total Change	8.4	1.4	Total Change	16.3	8.5
Net Change	8.2	-0.2	Net Change	-7.3	-6.1

Table 8-13: Powder Mill Run, 2007-2008 and 2005-2008 Stream Channel Changes

PM #	CX 2007-2008	CX 2005-2008
10	d	d
9	d	d
8	d	a
7	d	d
6	a	d
5	d	d
4	d	d

3	a	d
2	d	d
1	d	d

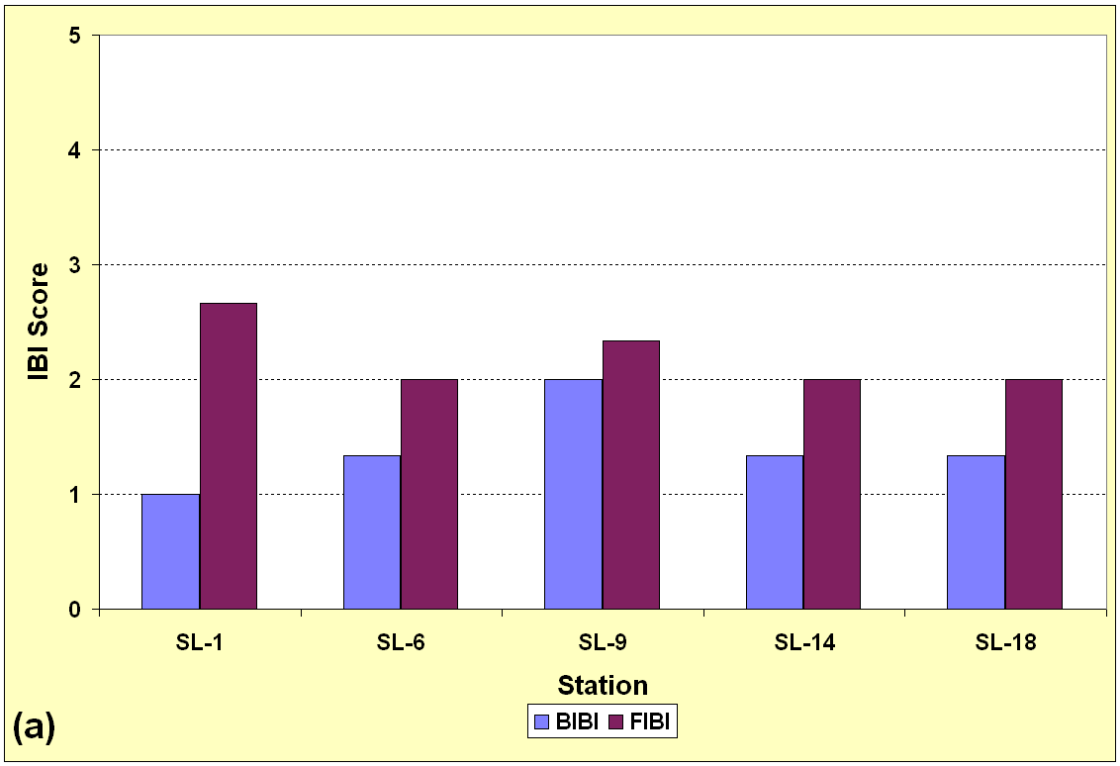
Symbols: a: aggradation, d: degradation

8.3.4 Biological Monitoring Results

Benthic macroinvertebrate and fish sampling were conducted as per MBSS protocols. Benthic macroinvertebrates were sampled between March 18th and March 25th, and fish were sampled between July 18th and September 11th. Scotts Level Branch was sampled at SL-1, SL-6, SL-9, SL-14, and SL-18. Powder Mill Run was sampled at PM-1, PM-4, and PM-10. The Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI) were calculated using metrics developed by MBSS for Piedmont streams. The BIBI and FIBI scoring criteria are: 1.00-1.99 (Very Poor), 2.00-2.99 (Poor), 3.00-3.99 (Fair), and 4.00-5.00 (Good). Stream physical habitat was assessed when macroinvertebrates and fish were collected using the MBSS Physical Habitat Index. The protocol measured components of stream physical habitat, including fish habitat quality, macroinvertebrate habitat quality, stream depth and velocity diversity, riffle quality, pool quality, the percentage of sediment surrounding stream bottom substrates, and the percentage of shading in the stream reach. Each parameter was estimated on a scale of 0-20, except for sediment and shading, which were percentage estimates. Physical habitat data were converted to physical habitat index (PHI) scores and rated using criteria from Southerland et al (2005). Minimally degraded stations had PHI scores of 81-100, partially degraded stations had PHI scores of 66-80, degraded stations had PHI scores of 51-65, and severely degraded stations had PHI scores of 0-50.

The IBI scores are shown in Figure 8-28. All BIBIs were in the Very Poor condition category, except for SL-9, which was rated Poor. The FIBI scores for all sites in Scotts Level were Poor. The FIBI scores in Powder Mill were Poor at PM-1 and PM-4 and Very Poor at PM-10. FIBI scores were always higher than BIBI scores. Fish in both Scotts Level Branch and Powder Mill Run are better able than benthic macroinvertebrates to survive the acute and chronic water quality problems within both streams. The mobility of fish likely allows them to better exploit good habitat and avoid such episodic events as high storm flows. The PHI scores are shown in Figure 8-29. Scotts Level Branch physical habitat condition was degraded at SL-1 and SL-6, and severely degraded at SL-9, SL-14, and SL-18. Powder Mill Run physical habitat was degraded at PM-1, partially degraded at PM-4, and severely degraded at PM-10. Physical habitat was scored lowest at the upstream sites in both streams.

The benthic and fish communities of Scotts Level Branch and Powder Mill Run show the effects of environmental stress. Both are low in diversity and are primarily composed of pollution tolerant organisms. Stream habitat is degraded and provides poor living space for both benthos and fish. Results of biological monitoring have been consistent since monitoring began in 2005, which suggests that the baseline biological condition has been identified. These baseline data will be useful in monitoring and identifying the effects of stream restoration.



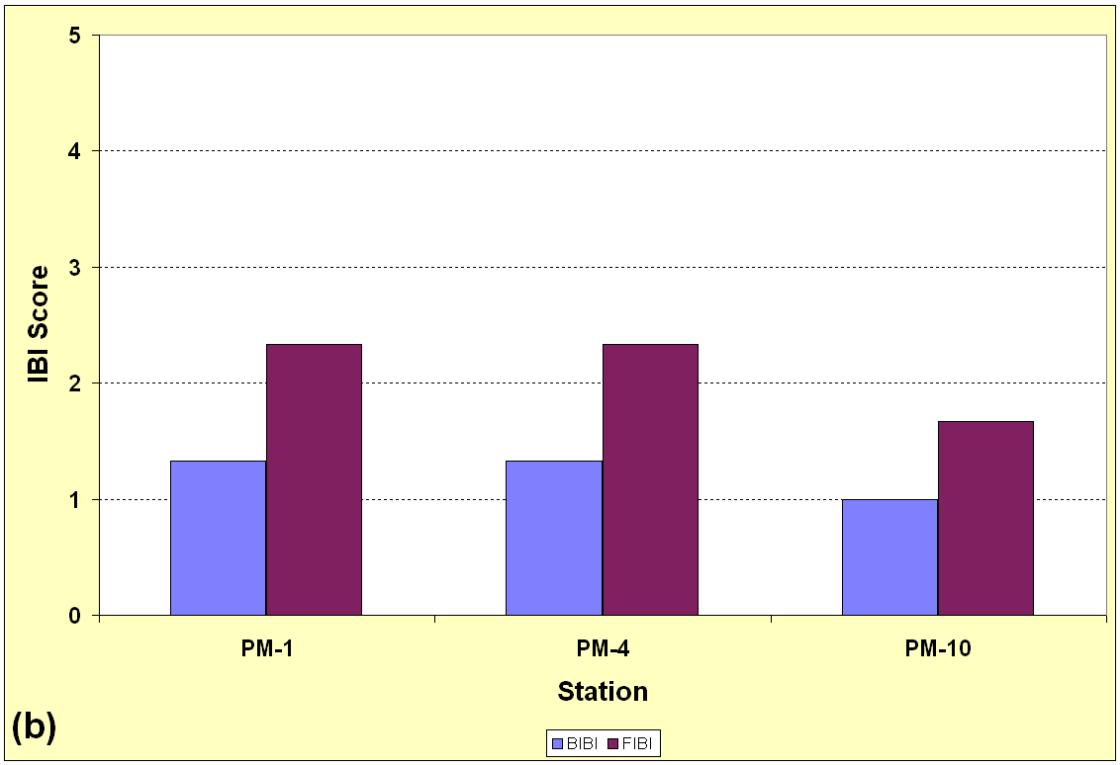
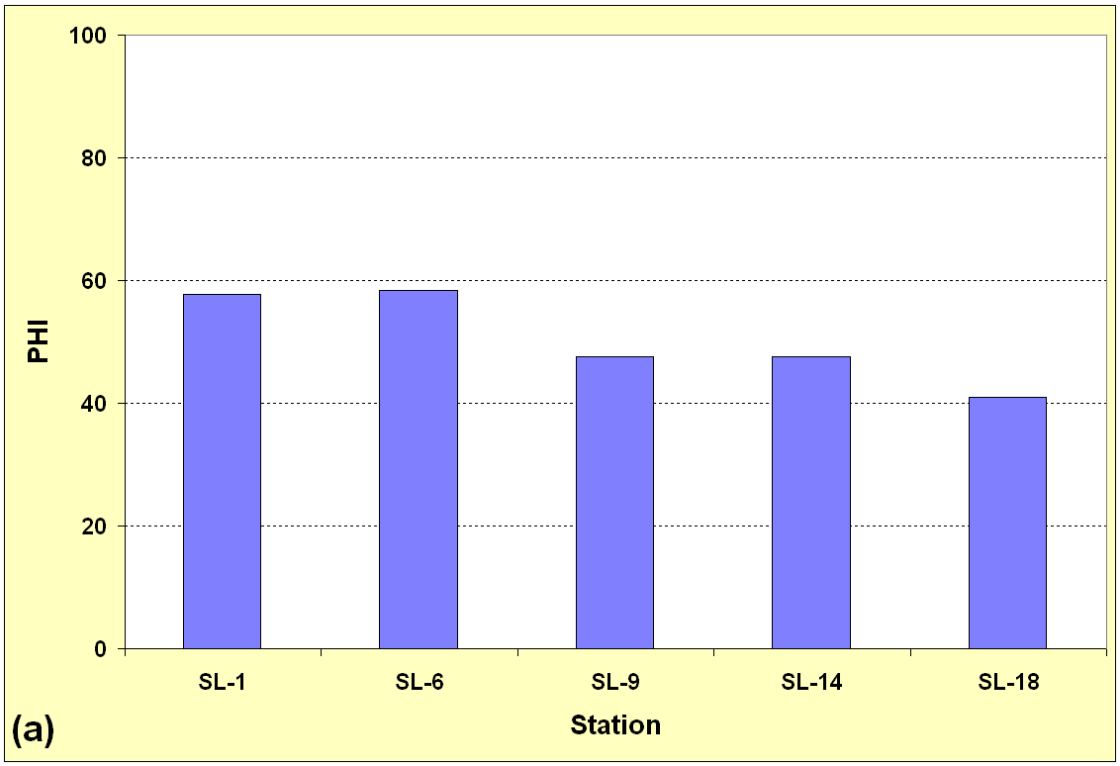


Figure 8-28: (a) Scotts Level Branch and (b) Powder Mill Run IBI Scores



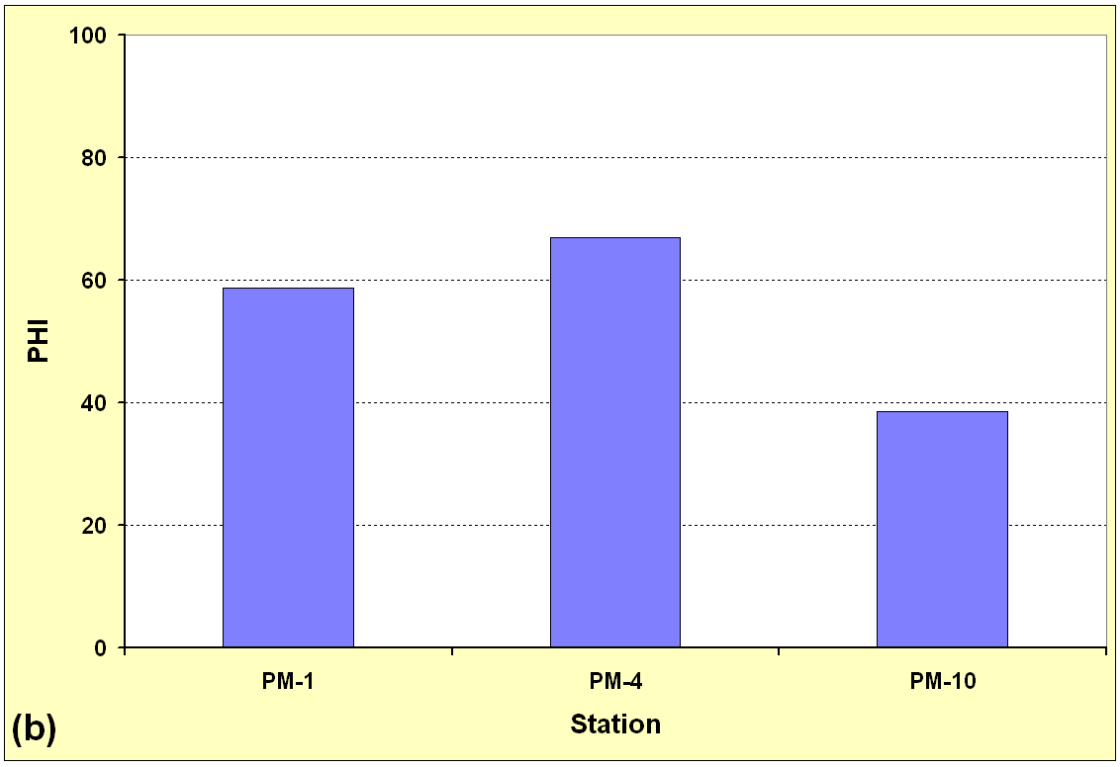


Figure 8-29: (a) Scotts Level Branch and (b) Powder Mill Run PHI Scores

8.4 Windlass Run Monitoring – Stormwater Management Assessment

Baltimore County's National Pollutant Discharge Elimination System (NPDES) permit requires the monitoring of a subwatershed for geomorphological impacts resulting from development under the revised Stormwater Management Design Manual. In order to comply with this component of the permit, Baltimore County conducted a comprehensive review of the available land for development. An analysis using geographic information systems (GIS) was used for selection of the monitoring subwatershed. The characteristics for determination of the selected subwatershed were:

- 1) an area of open undeveloped land, and
- 2) an area with a zoning category that would lead to development.

Nearly all new development and redevelopment will be effected by the guidelines in the new stormwater design manual, but the denser developments are expected to show a more dramatic change to the stream system. Therefore the study area must have a zoning category of sufficient density to affect the stability of the stream system. The results of a countywide screening, followed by field verification led to the selection of Windlass Run as the monitoring subwatershed.

The Windlass Run subwatershed is 1,926 acres, and has the potential for a large amount of future development. The level of imperviousness in the subwatershed is currently about 3 % and is expected to increase to well over 20%. Much of the undeveloped land is zoned for manufacturing. The development in this subwatershed is beginning to occur now that the extension of MD route 43 has been completed. This roadway is the primary access to these new properties and is needed for the intense level of development expected in this subwatershed. If this high-density development is not controlled, it is expected to have a severe impact on the water quality and stability of Windlass Run. The protection provided by the new stormwater management regulations should be easily visible through monitoring of the stream conditions.

Windlass Run is a Coastal Plain stream system typified by a stable, low gradient, sinuous, unconfined, silt and sand channel within well-developed floodplains. Average Rosgen bankfull width and corresponding bankfull depths are 10 and 2 feet, respectively. The Windlass Run system is very stable, and there are no areas of moderate or severe streambank erosion. One year of stream gage data was recorded by U.S.G.S. in 1992 – 1993. Well-vegetated stream buffers surround the stream. The upper portion exhibits multiple channels, which are stable and meander through non-tidal wetlands. These conditions are reflective of those described in the Bird River watershed plan that was completed in 1995.

Monitoring in the Windlass Run watershed includes stream geomorphological monitoring, and biological monitoring. The Baltimore County NPDES Municipal Stormwater Discharge Permit only requires the stream stability geomorphological monitoring. In 2002, a water level sensor was installed on the mainstem at Bird River Road and downstream of the Route 43 road construction and the area of future major development.

8.4.1 Stream Geomorphologic Monitoring

Six (6) sites in the Windlass Run subwatershed have been selected for monitoring and are shown in Figure 8-30 below. The site selection process took into consideration the location of future development and the extension of MD Route 43. Three sites are located along the mainstem: two above (WR3, WR5) and one below (WR2) the crossing of the proposed MD Route 43 extension. One site (WR4) is on a tributary (WR4) within the area of proposed industrial and high-density development, and down stream of Route 43. Another cross section (WR6) is located on a tributary within the area of proposed development. The last cross section (WR1) is a reference site on a tributary near the bottom of the subwatershed. This tributary is within an area zoned for agricultural uses and should not be affected by the other development activities in the watershed. Sites WR1 and WR6 are not down slope or downstream of any of the Route 43 construction.

The geomorphic monitoring consists of a channel cross-section measurement, a channel slope/ profile measurement, and a Wolman pebble count. Cross sections were selected on the reach between meander bends and where the conditions best represented confined flow. Rebar was placed above the banks of the stream for permanently marking the end points of the six selected cross sections. Profiles were also surveyed at all of the cross section reaches and include the cross sections. The procedures outlined by D. Rosgen (1996) were generally used for channel classification and stability assessment at each of the six permanent site locations. In spring 2002-2008, the six cross sections and profiles were surveyed. Note, however, that no profile was done at Cross Section #6 in 2002 and 2003 due to heavy vegetation. Pebble counts, sinuosity, and a Rosgen Level 3 assessment were also completed at each site. The monitoring will continue yearly.

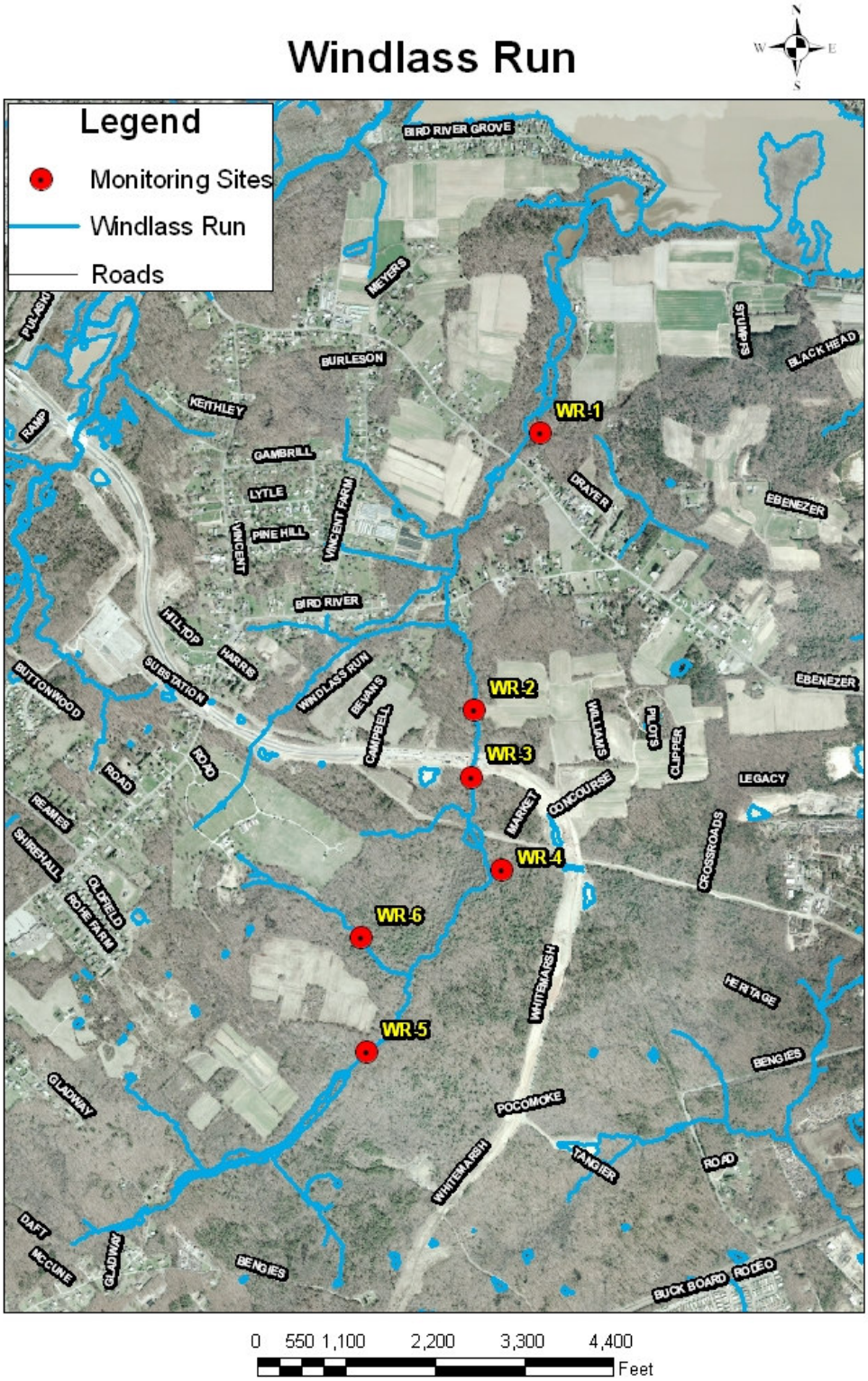


Figure 8-30: Windlass Run Aerial Photograph Showing Monitoring Station Locations.

Figures 8-31 through 8-34 show the progression of development in Windlass Run, from 1995-2007, in years for which orthophotographs were available. Development occurring in the interval between years is summarized below. Changes in geomorphology and biology related to the land disturbance caused by development are discussed in the results for each monitoring component.

1995 – 2002:

- A small housing development was built 2,850 feet northwest of WR-5.
- Two driveways were cleared 1,520 feet west of WR-2.

2002 – 2005:

- The roadbed for the Route 43 extension was cleared.

2005 – 2007:

- The Route 43 extension was paved.
- A roadway was cleared 2,470 feet southwest of WR-5.
- Land clearing and grading for commercial/industrial complexes occurred 1,330 feet east of WR-6, 95 feet east of WR-2, WR-3, and WR-4, and 380 feet west of WR-1.

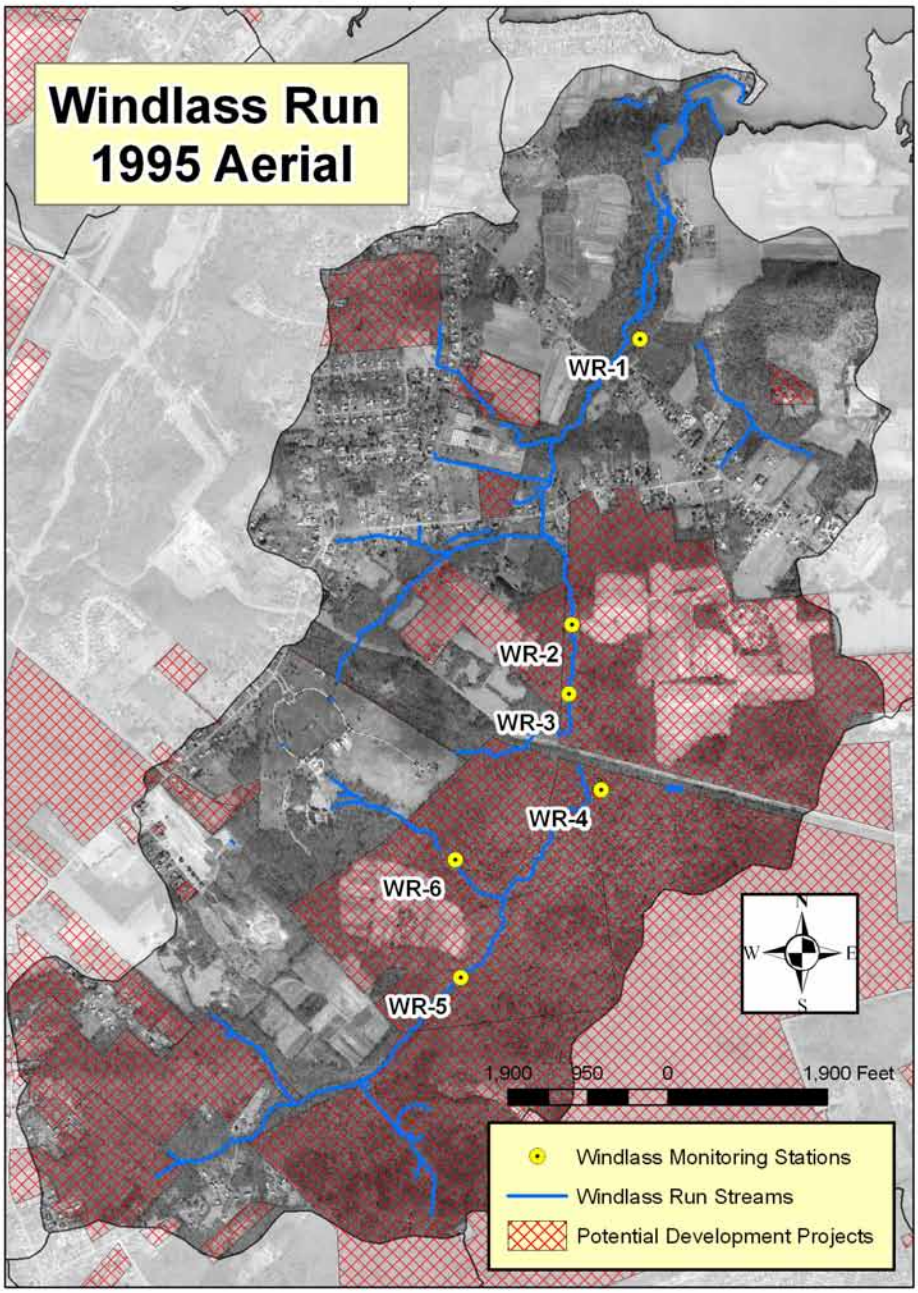


Figure 8-31: Orthophotograph of Windlass Run watershed, 1995.

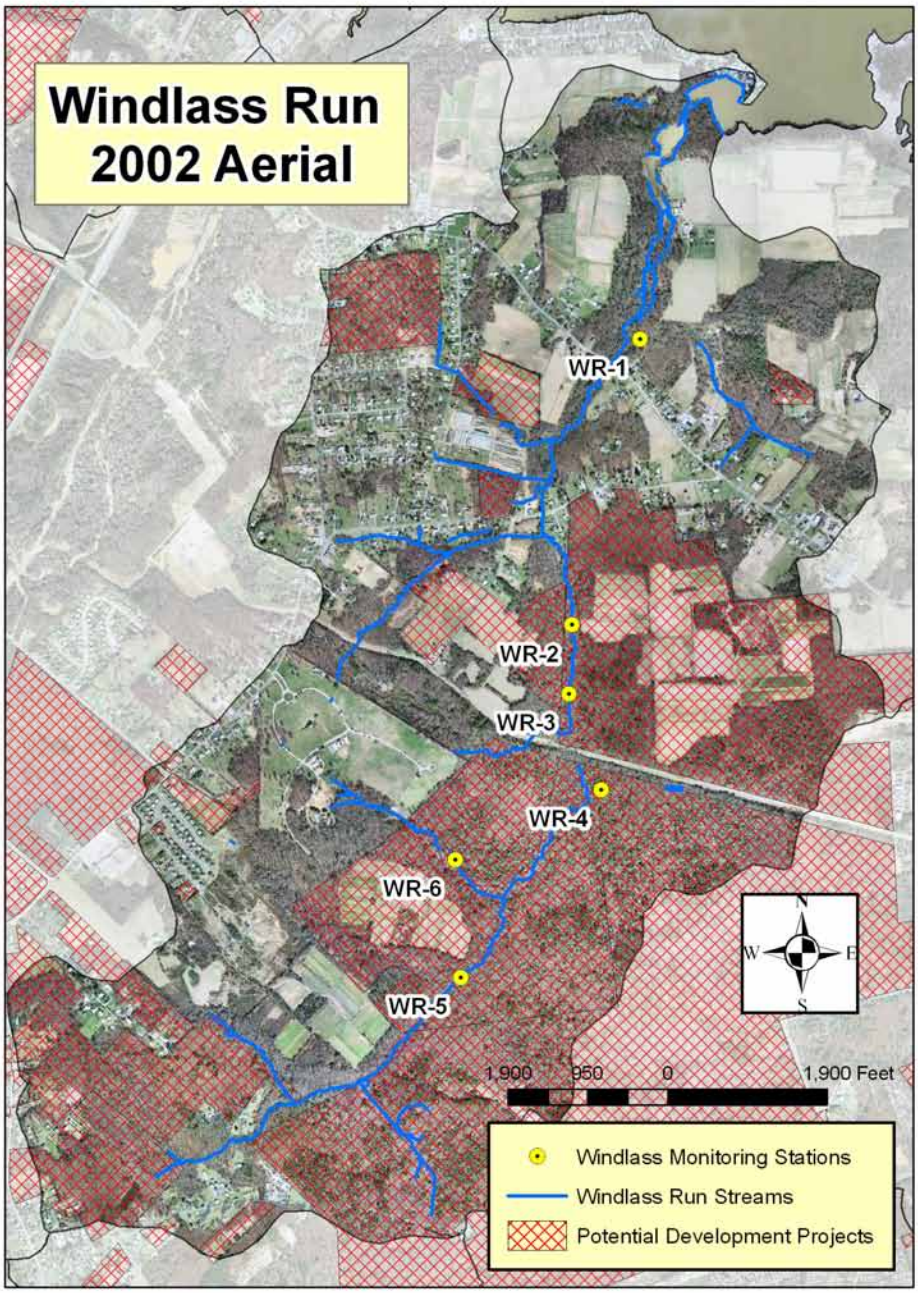


Figure 8-32: Windlass Run watershed orthophotograph, 2002.

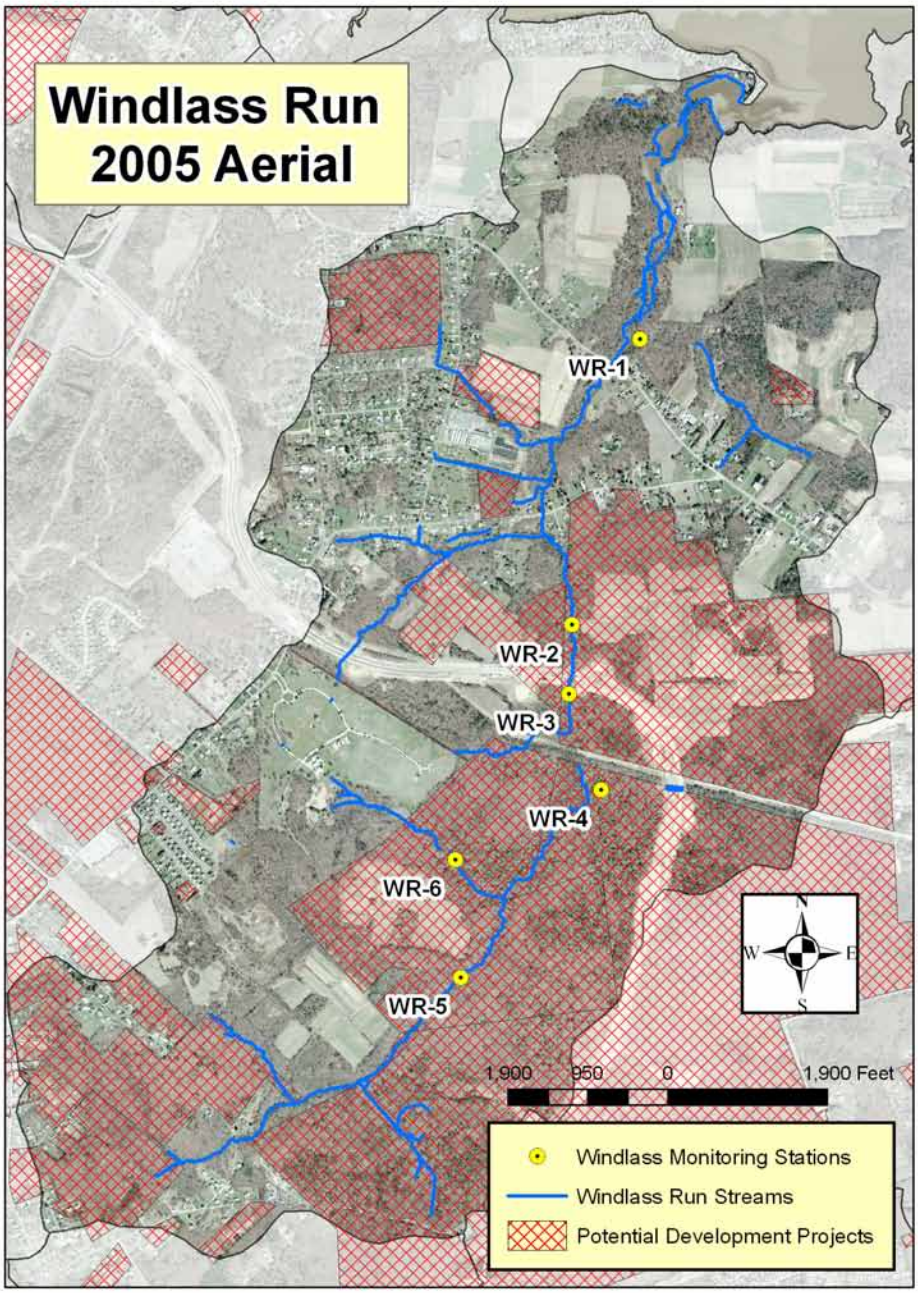


Figure 8-33: Windlass Run orthophotograph, 2005.

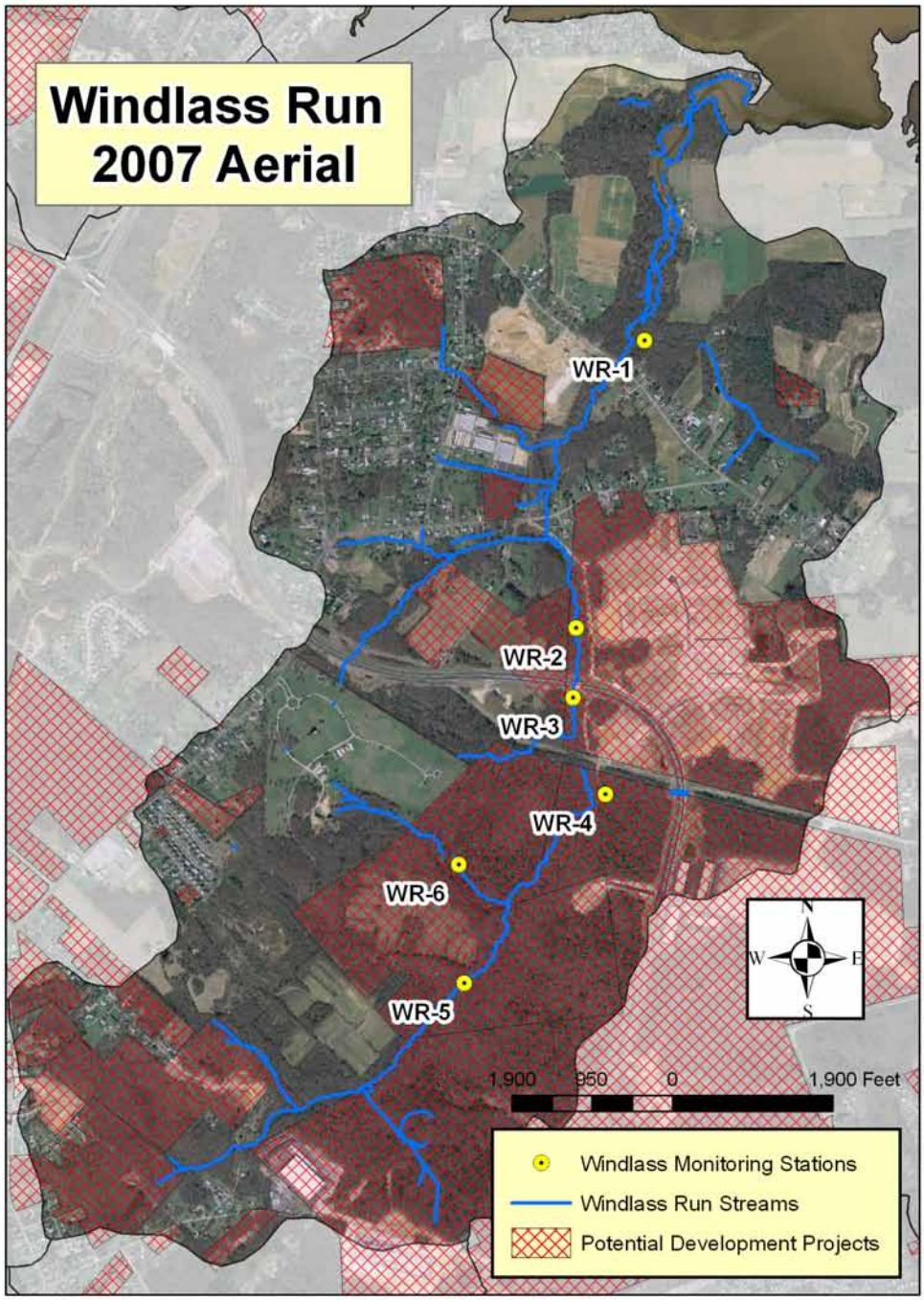


Figure 8-34: Windlass Run orthophotograph, 2007.

Windlass Run Monitoring Results:

The cross sections were overlaid to reveal any morphological changes between 2008-2009 and 2002-2009. The change in the reaches over the two study intervals are discussed below and summarized in Figure 8-35 and Tables 8-14 and 8-15.

Reach 1 (Reference reach on a tributary)

- There was no change in the profile during 2008-2009, but it aggraded between 2002-2009.
- The substrate fined during 2008-2009, but coarsened overall between 2002-2009.
- Approximately 1.5 feet of localized incision (scour hole) occurred in 2003 in the channel bed, however no changes occurred in the banks, the overbank area or the rest of the thalweg profile. There was no apparent causal factor for the scour hole right at the cross section, however tropical storm Isabel (Fall, 2003) is believed to be the precipitating event. Since 2002 the overall gradient over the longitudinal profile has flattened due to a 0.2 – 0.3-foot decrease in the upstream elevation of the thalweg profile.

Reach 2 (On the mainstem below the Route 43 crossing)

- Note: 2004 was the last year of active agriculture in the fields east of Reach 2. During 2005-2007, mass grading supplanted the agricultural activity. In late 2007, development began in the reach and has continued to the present.
- A slight fill was observed in the cross section's left bank during 2007-2008.
- The thalweg has been active in the profile since 2002 with both aggradation and degradation over time and over the thalweg length. It incised overall in 2008-2009, but aggraded between 2002-2009. The active nature of this reach over the study period makes it unlikely that recent changes in the profile are due to development.
- The substrate coarsened during both 2008-2009 and 2002-2009. The stream channel's native sediment is fine clay and sand; therefore it is probable that the coarsening has been caused by the soil movement and grading.

Reach 3 (Just above Route 43 crossing)

- A slight channel enlargement occurred during 2002 – 2008, however little change except slight cutting was observed in the cross section during 2007 – 2008. The thalweg degraded overall prior to 2004, and held steady in 2005 – 2006 and 2006 – 2007, but deepened again in 2008-2009. The wavelike cut and fill oscillations of about 0.6 ft amplitude within the profile continued in 2008.
- The pebble count indicated a slight coarsening overall and between 2008-2009. As with WR-2, the change in substrate composition is probably related to development.

Reach 4 (On a tributary below Route 43)

- Very slight aggradation in 2007-2008 and 2002-2008.
- Aggradation in the thalweg over 2002-2009 and during 2008-2009.
- Coarsening of the substrate during 2002-2009, including coarsening over the past year (2008-2009).
- These slight changes are likely related to the completion of a commercial park directly upstream of this reach.

Reach 5 (On mainstem above Route 43)

- The stream channel shifted 1-foot to the left and deepened slightly (0.3 ft) from 2002 – 2008, with some of this occurring during 2004. It continued to be stable in 2007-2008.
- The profile degraded slightly over its entirety during 2008-2009. Overall, degradation occurred during 2002 - 2009.
- Coarsening occurred in Reach 5 over 2002-2009, with slight fining in 2008-2009.

Reach 6 (On a tributary unaffected by Route 43)

- The cross section filled in by 0.7 ft during 2007-2008. This was responsible for overall aggradation during 2002 - 2008.
- The thalweg incised overall from 2004 – 2009, including some additional degradation during 2005 –2007. The lower portion of the channel diverted to the left due to sediment accumulations impinging at the diversion point during 2006-2007. The thalweg experienced some filling between 2008-2009. No data prior to 2004 was collected.
- A marked coarsening of channel material, with the occurrence of many particles in the 0.1 – 0.5 mm grain size, occurred by 2005, but by 2006 the substrate had returned back to its finer original state. A re-coarsening occurred by 2007, followed by fining in 2008 and coarsening in 2009. Overall, substrates have coarsened between 2002-2009.
- It is likely that an active ATV trail, which crosses upstream of the profile, is responsible for the changes in sediment deposition. There has been no appreciable upstream change in land use over the study period.

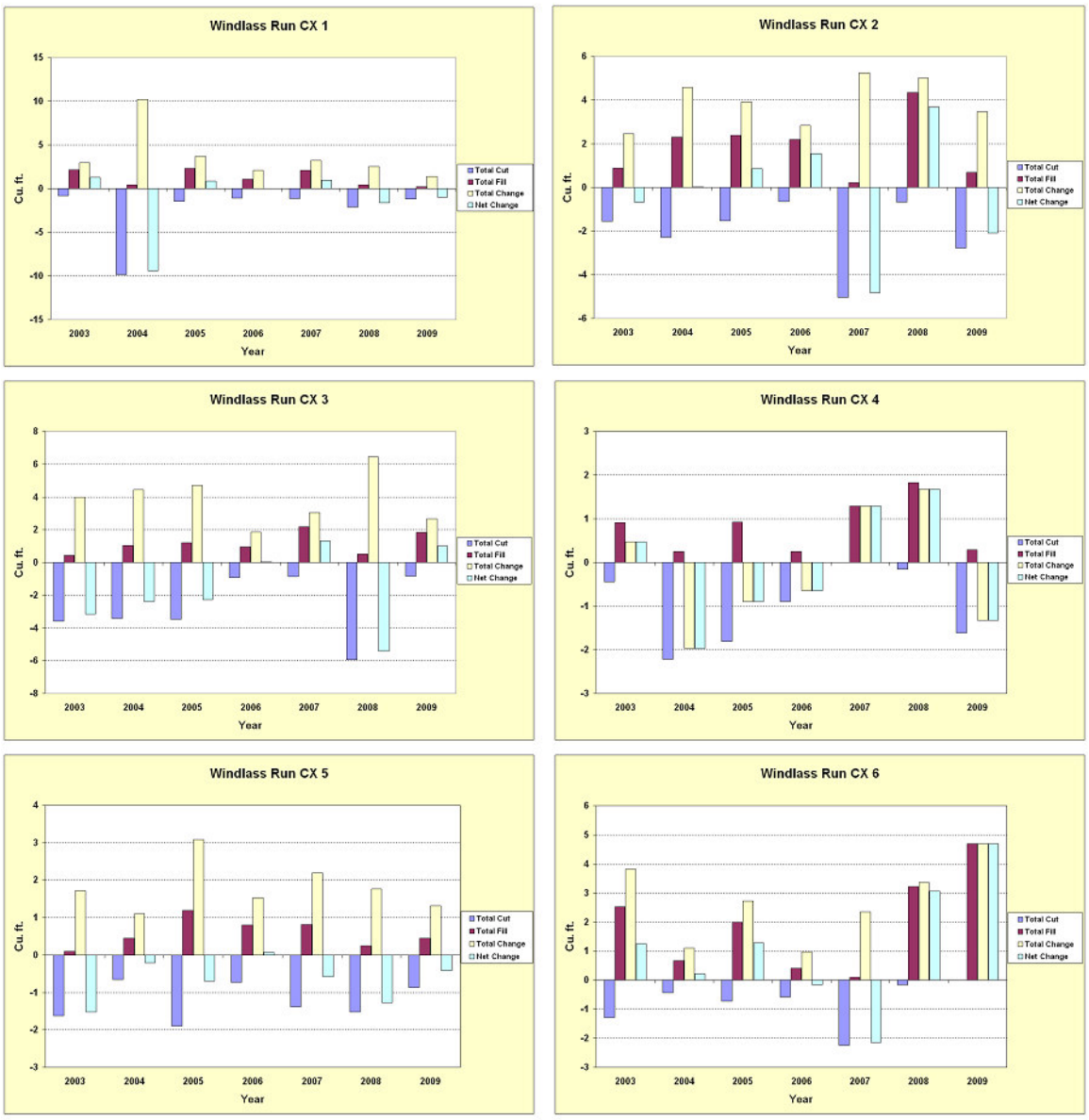


Figure 8-35: Summary of cross-sectional changes in Windlass Run during entire study period.

Table 8-14: Windlass Run Cross Sections - Cut and Fill Amounts

WR 1: Change (cu ft)	Period: 2008 – 2009	Period 2002 – 2009
Total Cut (negative value)	-1.2	-1.3
Total Fill	0.2	0.4
Total Change	1.4	1.7
Net Change	-1.0	-0.9
WR 2: Change (cu ft)	**Period: 2008 – 2009**	**Period 2002 – 2009**
Total Cut (negative value)	-2.8	-0.3
Total Fill	0.7	0.9
Total Change	3.5	1.2
Net Change	-2.1	0.6
WR 3: Change (cu ft)	**Period: 2008 – 2009**	**Period 2002 – 2009**
Total Cut (negative value)	-0.8	-0.9
Total Fill	1.8	0.2
Total Change	2.6	1.1
Net Change	1.0	-0.7
WR 4: Change (cu ft)	**Period: 2008 – 2009**	**Period 2002 – 2009**
Total Cut (negative value)	-1.6	-0.2
Total Fill	0.3	0
Total Change	1.9	0.2
Net Change	-1.3	-0.2
WR 5: Change (cu ft)	**Period: 2008 – 2009**	**Period 2002 – 2009**
Total Cut (negative value)	-0.9	-0.4
Total Fill	0.4	0.4
Total Change	1.3	0.8
Net Change	-0.5	0
WR 6: Change (cu ft)	**Period: 2008 – 2009**	**Period 2002 – 2009**
Total Cut (negative value)	0	-0.2
Total Fill	4.7	0.3
Total Change	4.7	0.5
Net Change	4.7	0.1

Table 8-15: Windlass Run Stream Channel Changes Over Time

WR #	Down slope Of Rt. 43	*CX 02-09*	*CX 08-09*	*TW 02-09*	*TW 08-09*	*Pebble 02-09*	*Pebble 08-09*
2	yes	*sa*	*sd*	*a*	*a*	*c*	*c*
3	yes	*sd*	*sa*	*d*	*d*	*c*	*c*
4	yes	*sd*	*sd*	*a*	*a*	*c*	*c*
5	no	*0*	*sd*	*d*	*d*	*c*	*f*
1	no	*sd*	*sd*	*a*	*d*	*c*	*f*
6	no	*sa*	*a*	*d*	*a*	*c*	*c*

Symbols: a: aggradation, d: degradation, c: coarsening, f: fining, p: planiform change, s:slight, m:moderate

The Windlass Run stream channels are generally low gradient and well connected with their flood plains at bankfull flows. They also have good riparian vegetational coverage along their banks. The stream system is almost entirely within a well-forested setting providing good habitat, erosional resistance, and canopy coverage. Windlass Run presently appears to be in a near pristine condition except the tributary at CX 6 that is being impacted by sediment due to off road RV usage that churns up a large amount of mud just upstream. Some visual evidence of increased hydrology was observed at CX4, however it could be due to rainfall patterns during the

past year. Windlass Run emerged from a record rainfall year including tropical storm Isabel in 2003 with apparently little change in morphology or habitat quality. The major part of construction of the Highway 43 extension occurred in the watershed during 2004, however no significant change that could be attributed to this impact was noted. Cross sections #2, #3, and #4 are the locations that are downstream or down slope of this construction. Construction of several business parks and other industries began in 2007. The several years of completed pre-development monitoring may now be used as the baseline condition to detect any important changes due to development in the subwatershed.

8.4.2 Biological Monitoring

Benthic macroinvertebrates are being used as indicator organisms to monitor the effects of disturbance in the Windlass Run watershed. The condition of the benthic macroinvertebrate community before and after development will help determine the effectiveness of the new stormwater regulations at maintaining the suitability of Windlass Run for aquatic life.

Benthic macroinvertebrate sampling was conducted as per MBSS protocols. Benthic macroinvertebrates were sampled annually, during the spring index period (March 1st - April 30$^{th)}$, at WR-1, WR-2, WR-3, WR-4, and WR-5, as shown in Figure 8-10. WR-1 was not sampled in 2004 and 2006 because a beaver dam downstream of the station, on the Windlass Run mainstem, was causing backwater effects within the station reach. Data for WR-1 from 2005 are missing because the sorted sample had dried before it could be identified. A Benthic Index of Biotic Integrity (BIBI) was calculated using metrics developed by MBSS for Coastal Plain streams. The BIBI scoring criteria are: 1.00-1.99 (Very Poor), 2.00-2.99 (Poor), 3.00-3.99 (Fair), and 4.00-5.00 (Good). The BIBI scores are shown in Figure 8-36 and discussed in relation to the development timeline presented above. Stream physical habitat was assessed when macroinvertebrates were collected. Three different protocols were used for the habitat assessments. In 2002, the Save Our Streams protocol was followed. In 2003, a modified Environmental Protection Agency Rapid Bioassessment protocol was used. Since 2004, MBSS protocols have been followed. The protocols changed as DEPRM's biological assessment program developed and expanded. All protocols measured similar components of stream physical habitat, including fish habitat quality, macroinvertebrate habitat quality, stream depth and velocity diversity, riffle quality, pool quality, the percentage of sediment surrounding stream bottom substrates, and the percentage of shading in the stream reach. Each parameter is visually estimated. Only physical habitat data collected since 2004 are reported here using the MBSS Physical Habitat Index, which converts field measurements to a score from 0-100. Habitat is rated as Minimally Degraded (81-100), Partially Degraded (66-80), Degraded (51-65), or Severely Degraded (0-50). PHI scores are shown in Figure 8-37.

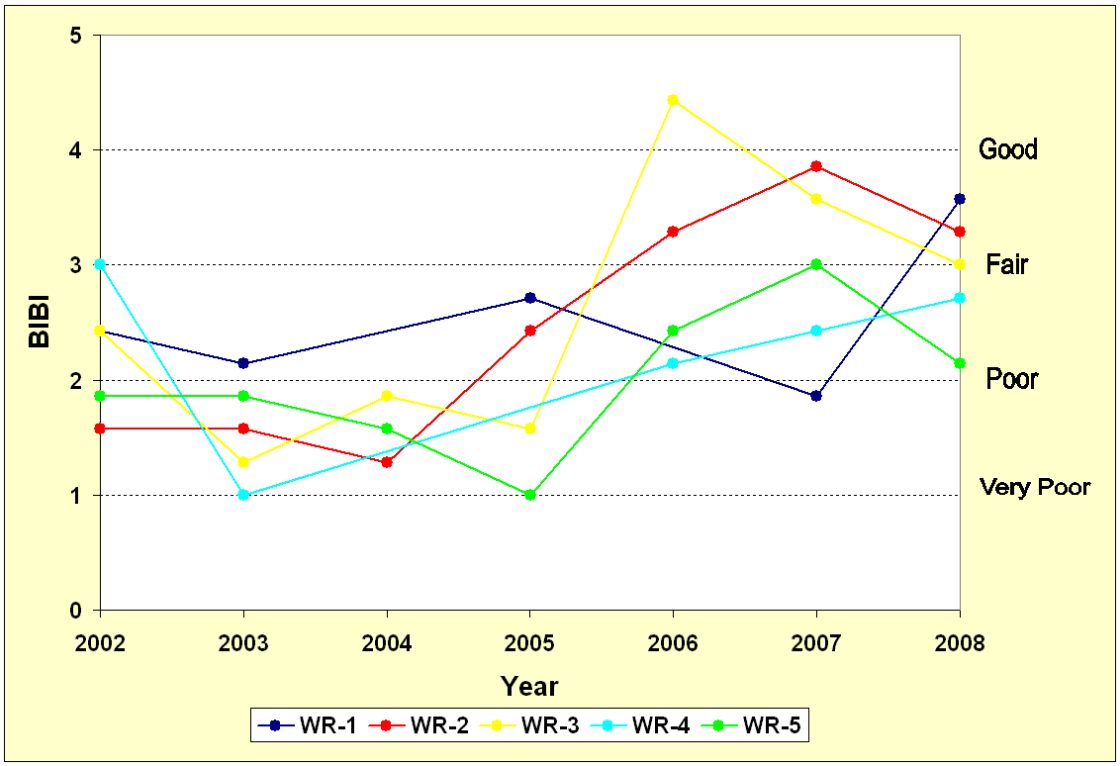


Figure 8-36: Windlass Run BIBI Scores

1995 – 2002:

- Biological condition in 2002 was typical of streams experiencing long periods of agriculture land use.

2002 – 2005:

- Biological condition remained consistent at all stations. Although there were some year-to-year changes in biological condition category, stations were rated Very Poor or Poor. Habitat condition was minimally degraded at all stations, except for WR-4 in 2004 and WR-5 in 2005 (Partially Degraded).

2005 – 2007:

- Biological condition generally improved during this interval, which was the period of greatest construction activity to date. Habitat condition slowly declined from Minimally Degraded to Partially Degraded.

To examine these trends further, functional feeding group composition was calculated. Functional feeding groups are useful because they classify benthic macroinvertebrates according to their feeding mode. Land disturbance may influence functional feeding group composition by changing autochthonous and allochthonous food resources available for benthic macroinvertebrates. Data are presented in Table 8-16. There was a shift in functional group composition from generalist feeders to specialist feeders. The percentage of collectors (which

encompasses a variety of generalist feeding modes) decreased from 2002-2005 to 2005-2007. During the same intervals, the percentage of filterers and predators consistently increased. The small increases in sediment resulting from development were probably responsible for the increase in filterers. The predators responded to the shift in the macroinvertebrate assemblage. The presence of macroinvertebrates with specialized feeding strategies indicates good water quality and diverse habitat conditions.

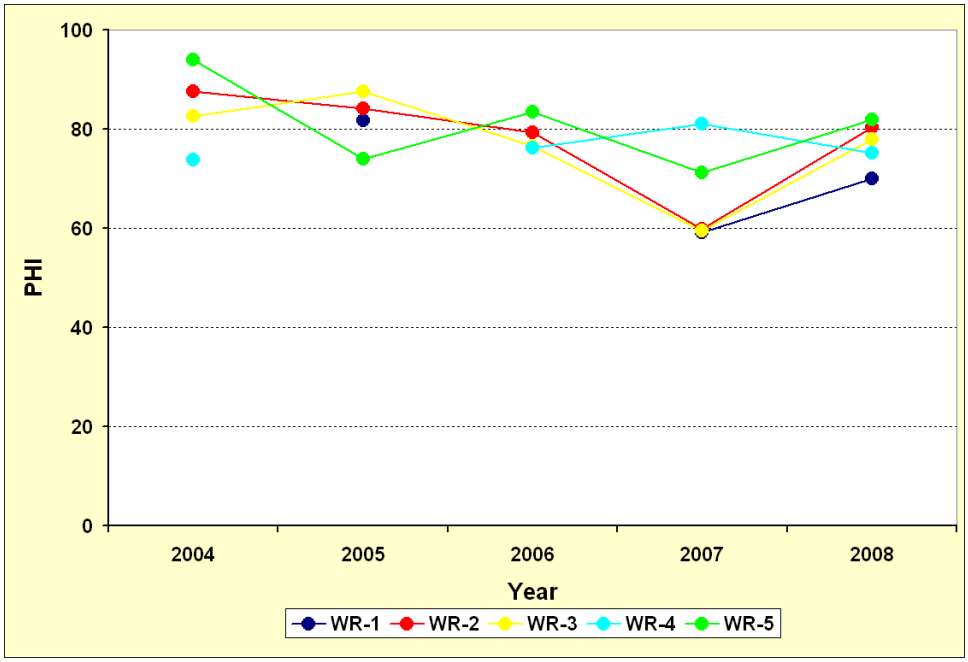


Figure 8-37: Windlass Run Physical Habitat Scores

Table 8-16: Windlass Run Functional Feeding Group Means

Interval	FFG	WR-1	WR-2	WR-3	WR-4	WR-5
2002 to 2005	%collectors	53.8	55.9	45.8	81.2	47.0
	%filterers	6.3	25.2	43.2	12.9	36.8
	%predators	2.1	3.2	2.2	1.2	1.3
	%scrapers	30.0	2.9	0.9	1.8	0.0
	%shredders	1.2	1.4	2.0	0.0	9.1
2005 to 2008	%collectors	37.1	42.6	36.5	32.7	30.5
	%filterers	47.3	33.5	22.6	30.6	53.2
	%predators	3.4	14.9	19.4	5.0	9.2
	%scrapers	4.4	3.6	5.9	17.3	2.1
	%shredders	3.9	4.1	12.5	12.6	4.4

The recent subtle changes in geomorphology suggest that development is influencing Windlass Run, especially in Reaches 2, 3, and 4. The most notable difference is in substrate composition, which has coarsened in the affected reaches. The biological data are less clear, as biological condition has improved since the beginning of development. The effects of a long history of agricultural land use will need to be identified before the effects of recent development are fully understood. The relative stability of the stream channels facilitated identification of the

beginning of development-related change in Reaches 2, 3, and 4. Further monitoring will help determine the effectiveness of storm-water management techniques applied in Windlass Run.

9.0 Permit Requirements

F. Watershed Assessment and Planning

Baltimore County shall continue to update and revise watershed assessments that have been developed for its 10 urban watersheds (Baltimore Harbor, Bird River, Back River, Gwynns Falls, Jones Falls, Little Gunpowder, Loch Raven, Lower Gunpowder River, Middle River, and the Patapsco River). The overall goal is to ensure that each County watershed is thoroughly evaluated and has an action plan to maximize water quality improvements. Additionally, the County shall encourage the public to participate in the development and implementation of watershed restoration activities. At a minimum, the County shall:

1. Continue to perform and update detailed assessments in all of its urban watersheds. These watershed assessments shall include:
    a. Determining current water quality conditions;
    b. Identifying and ranking water quality problems;
    c. Identifying all structural and non-structural water quality improvements opportunities;
    d. Reporting the results of a visual watershed inspection;
    e. Specifying how the restoration efforts will be monitored; and
    f. Providing an estimated cost and a detailed implementation schedule for those improvement opportunities identified above.

H. Assessment of Controls

Assessment of controls is critical for determining the effectiveness of the NPDES stormwater management program and progress toward improving water quality. Therefore, Baltimore County shall use chemical, biological, and physical monitoring to document work toward meeting the watershed restoration goals identified above.

9.1 Introduction

In order to meet the permit requirements detailed in section F (1. a-e) and section H, Baltimore County has initiated chemical, biological, and geomorphological monitoring programs in addition to the specific monitoring required by the permit and detailed in Section 8. The chemical monitoring program (9.2) consists of two elements, stream baseflow monitoring and tidal water monitoring. A third element consisting of storm event monitoring at USGS gage sites has been sporadic and will not be included in this report. The stream geomorphological monitoring program (9.3) includes monitoring of stream restoration projects and conducting stream assessments in support of the Small Watershed Action Plan preparation. The biological monitoring program (9.4) has four elements including probabilistic monitoring, CIP monitoring, reference site monitoring, and submerged aquatic vegetation monitoring. Baltimore County recently began monitoring brook trout populations in streams of the Prettyboy Reservoir watershed to support the Prettyboy Reservoir Watershed Restoration Action Strategy (9.5). The

SCA survey (9.6) provides descriptive and positional data for potential environmental problems along a watershed's non-tidal stream network.

9.2 Chemical Monitoring Program

In order to determine the chemical condition of Baltimore County waters two chemical monitoring programs have been implemented. The chemical monitoring program is intended to provide information on ambient chemical conditions and, over time, to assess trends in both chemical concentrations and chemical loads. The information will be used to better target restoration activities, to provide data for the calibration of pollutant load models, and to provide local data to assess the results of the Chesapeake Bay Program modeling efforts and TMDL modeling. The data will be used to assess water quality improvements that are the result of restoration efforts. It will also be used to determine progress in meeting the pollutant load reductions required by the Chesapeake Bay restoration efforts and as determined by the development of Total Maximum Daily Loads (TMDLs). These programs will partially fulfill the restoration effectiveness monitoring required under NPDES Permit section F.1 and H above.

The two current, chemically oriented programs, the Baseflow Monitoring Program and the Tidal Waters Monitoring Program are described in Sections 9.2.1 and 9.2.2, respectively.

9.2.1 Baseflow Monitoring

A baseflow monitoring program was initiated in 1999. The initial effort was targeted at watersheds that were undergoing or about to undergo the preparation of a Water Quality Management plan. The targeted watersheds included the Lower Gunpowder, the Little Gunpowder, the Middle River and the Baltimore Harbor watersheds. The limited data was used in the calibration of the SWMM pollutant load models that were included in the Water Quality Management plans. In the fall of 2000, the baseflow monitoring was shifted to the Back River, Jones Falls and Gwynns Falls watersheds. The shift was intended to address the lack of chemical monitoring information available for these watersheds. These watersheds were monitored until the spring of 2001. The data collected was presented in the NPDES – 2001 Annual Report. Staffing levels curtailed the continuance of the baseflow monitoring program until the spring of 2003.

The baseflow monitoring program, which resumed in 2003 was also redesigned. Baseflows are monitored in the Patapsco/Back River Basin in odd-numbered years, while the Gunpowder Basin/Deer Creek are monitored in the even-numbered years. In 2007, because of staff time constraints, we created Tier 1 and Tier 2 sites. The Tier 1 sites are our regular sampling sites. Tier 2 are sites that were removed from sampling, but will be picked back up if we have a Small Watershed Action Plan (SWAP) or other project in that area. There are 31 Tier 1 and 9 Tier 2 sites in the Patapsco Back River Basin. Four of the Tier 2 sites were sampled because of our SWAP in the Upper Back River and Lower Jones Falls. There are 53 Tier 1 and 22 Tier 2 sites in the Gunpowder Basin/Deer Creek. The points were chosen to maximize the number of subwatersheds monitored. The monitoring points within the Patapsco/Back River Basin are displayed in Figure 9-1, while the Gunpowder Basin/Deer Creek monitoring points are displayed in Figure 9-2. Appendix 9-1, at the end of this section, displays the watersheds and subwatersheds associated with each monitoring point.

The target number of baseflow samples is eight samples per year at each site. The actual number sampled will vary depending on weather conditions, staffing and other duties. The standard set

of monitored pollutants includes (TSS, TS, TKN, Nitrate/Nitrite, Total Phosphorus, Ortho-phosphorus, Cadmium, Copper, Lead, Zinc, BOD, COD, Chlorides, Sodium, Hardness, Magnesium and Calcium) as well as temperature and pH determined in *situ*. Discharge measurements are taken during each sample collection. A minimum of three days of dry weather is required prior to monitoring any baseflow site.

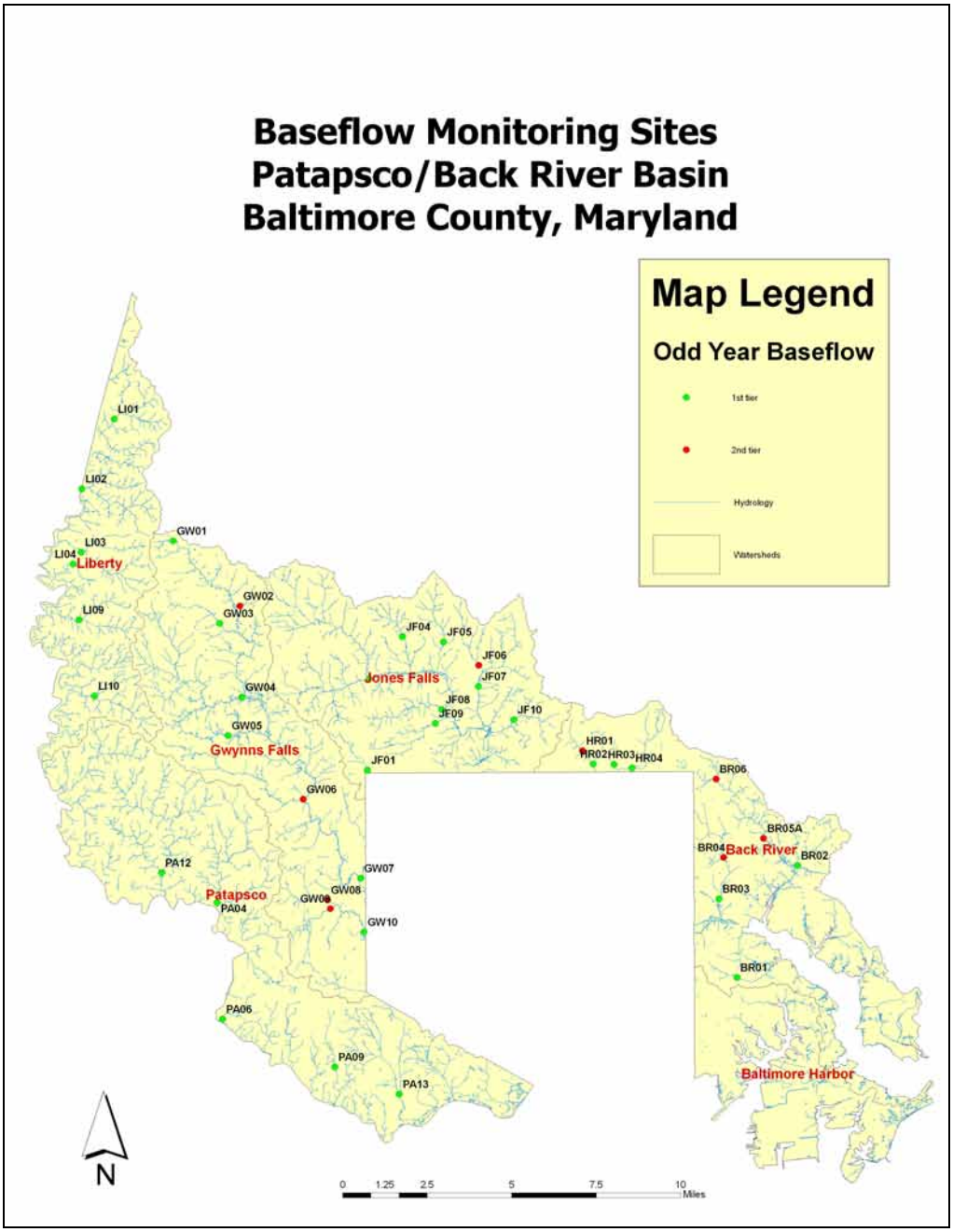


Figure 9-1: Patapsco/Back River Basin – Baseflow Monitoring Sites

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

Figure 9-2: Gunpowder Basin/Deer Creek – Baseflow Monitoring Sites

A total of 183 baseflow samples were collected in the Gunpowder/Deer Creek Basin in 2008. The number of samples per site varied from two to five, with the majority of being done three times. In addition to the baseflow samples, 35 field blanks and 35 duplicate samples were collected; these are excluded from calculations and are only for quality control purposes. The mean, number of samples and the standard deviation for each site are presented at the end of this section in Appendix 9-2 for each parameter analyzed.

A frequency analysis was conducted on the metals data to determine exceedance of water quality criteria. All statistical analyses were conducted using Statistica (Ver. 6.1). Figure 9-3 displays

the frequency distribution for both total copper and dissolved copper. Maryland Department of the Environment water quality criteria was used. The water quality criteria are based on dissolved metals and the toxicity is influenced by hardness. The total copper samples exceeded the chronic criteria for aquatic life for 24.0% and exceeded the acute criteria for 9.8% of the samples. On June 10, 2008 LR-18, LR-19, LR-20 all had unusually high total copper. While out that day, LR-20 was observed to be cloudy and foul smelling with lots of gnats flying around. When we went back the following day to investigate further, the problem was gone. For dissolved copper, 2.7% of the samples exceeded the chronic standard and 1.1% exceeded the acute criteria. The sample results for total and dissolved zinc and cadmium indicated they did not exceed the water quality standards for chronic or acute conditions. Total lead exceeded the chronic standard (.0025 mg/L) once for total metals at a concentration of .003 mg/L.

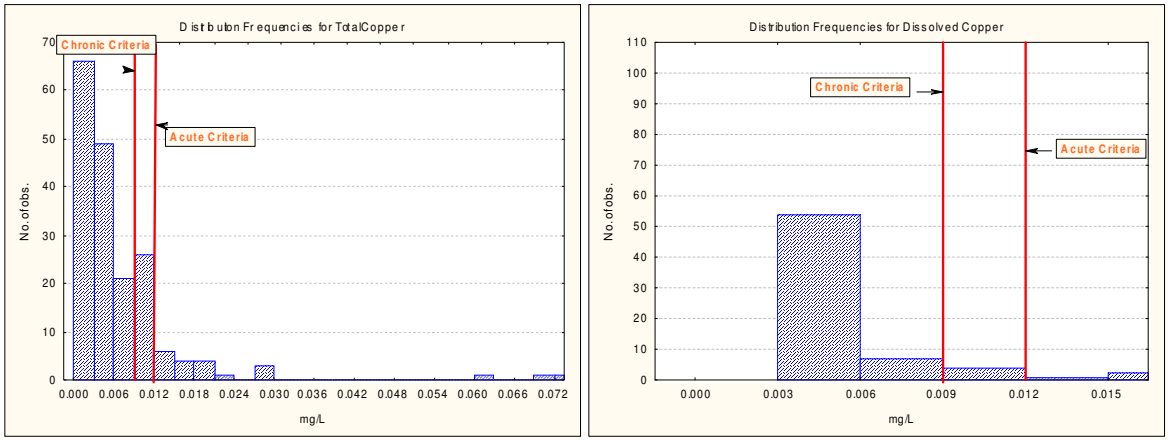


Figure 9-3: Frequency distributions by concentration for Total Copper and Dissolved Copper for the 2008 Gunpowder/Deer Creek samples.

The baseflow data collected in 2008 were analyzed for differences in concentration for each pollutant between the six watersheds sampled. ANOVA and Duncan's Multiple Range tests were used to examine relationships among the watersheds. The results are displayed in Table 9-1. The results of the Duncan's Multiple Range Test are displayed with the watersheds having the highest concentrations to the left and progressing in order to the lowest concentrations on the right. The watersheds joined by the same line are not significantly different. Total and dissolved cadmium had no variance and therefore was not included.

Table 9-1: Baseflow Pollutant ANOVA and Duncan's Multiple Range Test Results

Pollutant Parameter	df Effect	Df Error	F	P
pH	5	177	24.57	<.001
TSS	5	177	0.67	NS
TS	5	177	8.93	<.001
TKN	5	176	3.75	<.05
Nitrate/Nitrite	5	171	10.30	<.001
TP	5	176	1.21	NS
Total Copper	5	177	2.30	<.05
Dissolved Copper	5	177	2.74	<.05
Lead	5	177	1.43	NS
Dissolved Lead	5	177	1.01	NS
Zinc	5	177	2.68	<.05
Dissolved Zinc	5	177	2.85	<.05

BOD	5	177	0.48	NS
COD	5	176	2.68	<.05
Chloride	5	171	11.06	<.001
Hardness	5	177	17.00	<.001
Sodium	5	173	21.73	<.001
TN	5	170	9.15	<.001
Magnesium	5	173	6.79	<.001
Calcium	5	173	18.37	<.001

Duncan's Multiple Range Test

pH	GU LR LG DC BI PR
TS	BI GU LR LG DC PR
Total Kjedahl Nitrogen (TKN)	BI PR LG LR DC GU
Nitrate/Nitrite	DC PR GU LR LG BI
Total Copper	LR DC BI GU LG PR
Dissolved Copper	LR GU LG BI DC PR
Total Zinc	BI LG LR GU DC PR
Dissolved Zinc	BI LR LG GU DC PR
Chemical Oxygen Demand (COD)	BI LR PR LG DC GU
Chloride	BI GU DC LR LG PR
Hardness	GU BI LR DC LG PR
Sodium	BI LR GU DC LG PR
Total Nitrogen (TN)	DC PR GU LR LG BI
Magnesium	BI GU LR DC LG PR
Calcium	GU BI LR LG DC PR

The concentrations of fifteen parameters were found to differ significantly between watersheds. The Bird River watershed had the highest concentrations for eight of the parameters thirteen parameters, including Total Solids, TKN, Total and Dissolved Zinc, COD, Chloride, Sodium and Magnesium. Magnesium and Calcium are now included in our water testing. Sodium can displace the Magnesium and Calcium, binding with the soil, and is used as another indicator of road salt pollution. The Lower Gunpowder Falls was highest for pH, Hardness, and Calcium. The Loch Raven watershed was highest in Total and Dissolved Copper, while Deer Creek was highest in Nitrate/Nitrite and Total Nitrogen. In contrast, the Prettyboy Reservoir exhibited low concentrations for ten of the pollutants: pH, TS, Total and Dissolved Copper, Total and Dissolved Zinc, Chloride, Hardness, Sodium, Magnesium and Calcium. Figure 9-4 displays the results of the Duncan's Multiple Range Test for COD, TN, Dissolved Copper, and Chlorides. Figure 9-5 displays the results for COD, TN, Dissolved Copper, and Chlorides, as these are of major concern.

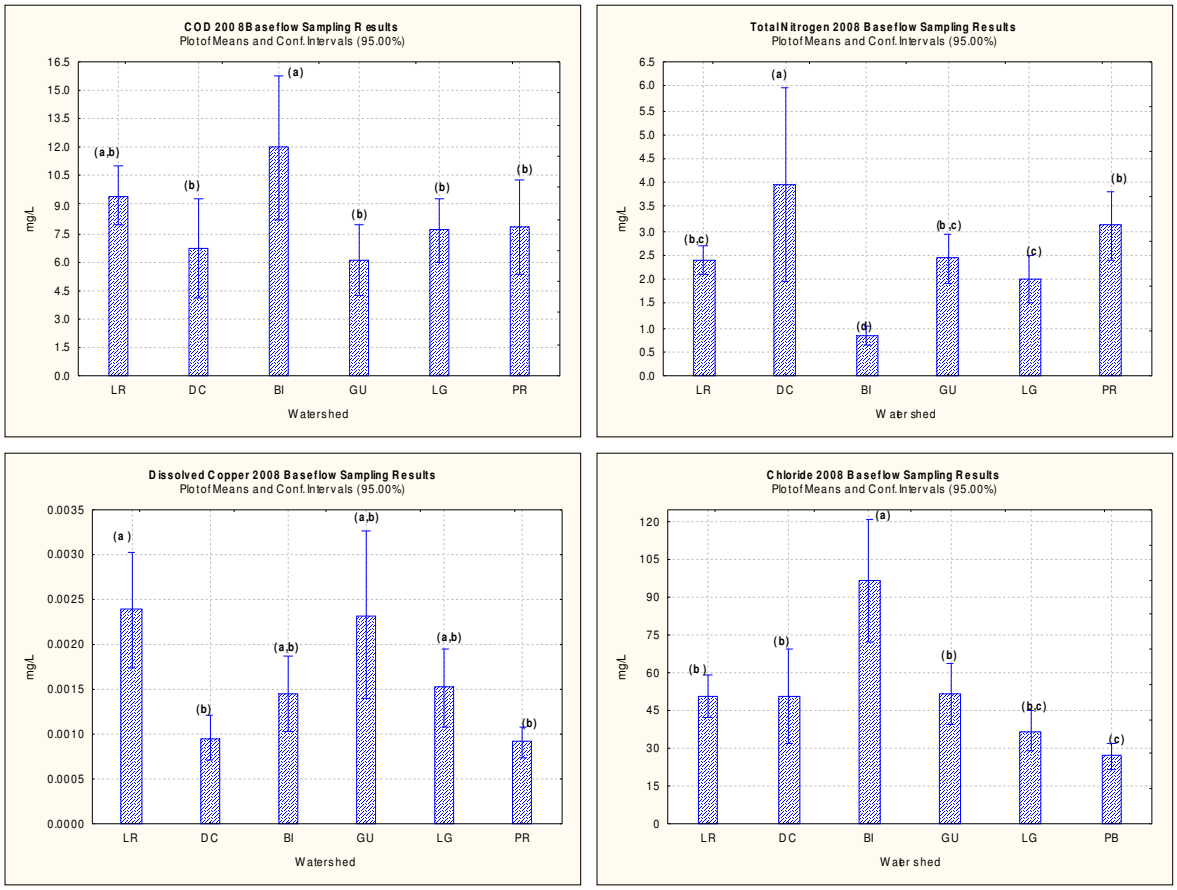


Figure 9-4: Duncan's Multiple Range Test results for COD, TN, Dissolved Copper, and Chlorides.

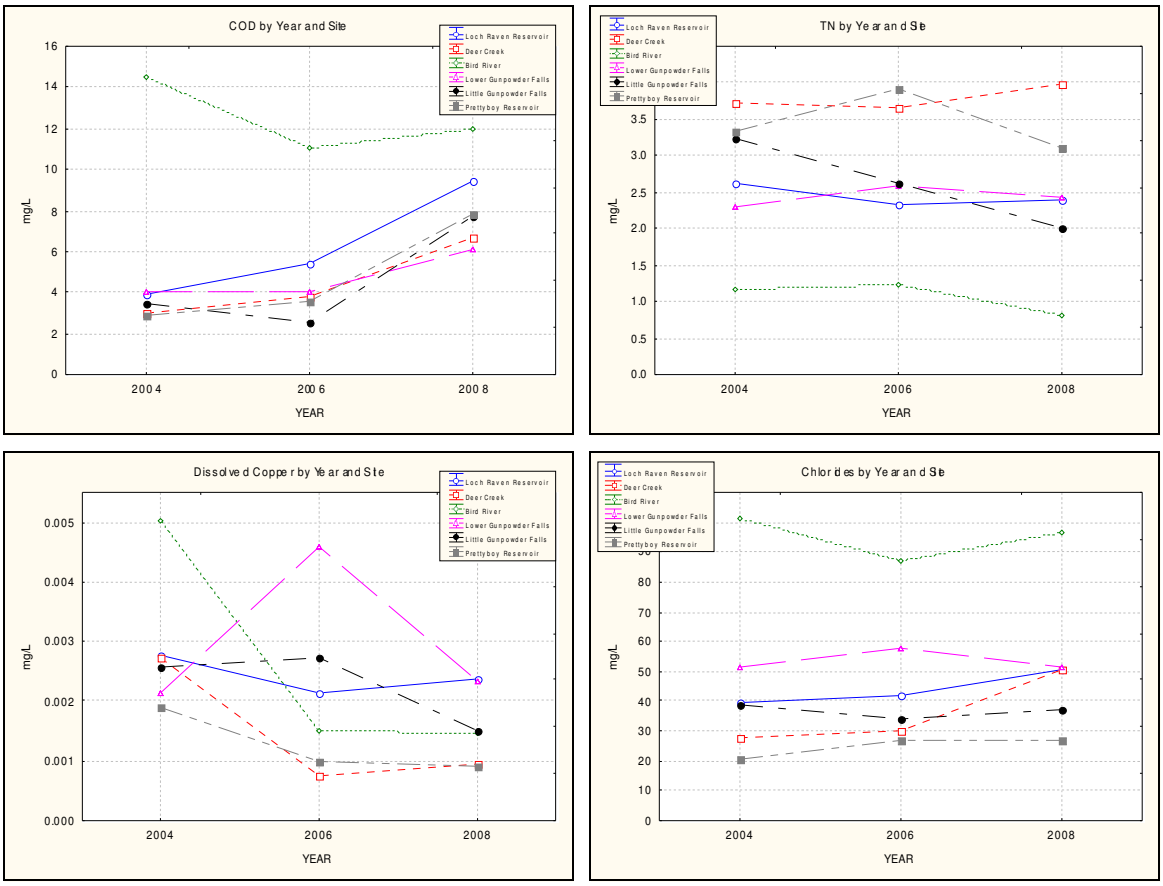


Figure 9-5: Baseflow COD, TN, Dissolved Copper, and Chlorides for sampling years 2004, 2006, and 2008.

Several interesting trends can be seen from the graphs in Figure 9-5.

For COD:

- After only slight changes from 2004 to 2006, Loch Raven, Deer Creek, Lower Gunpowder, Little Gunpowder and Prettyboy increased in 2008.
- Bird River consistently has concentrations higher than the other watersheds.

For TN:

- Prettyboy, Little Gunpowder, Lower Gunpowder and Back River decreased from 2006 to 2008.
- Deer Creek and Loch Raven increased from 2006 to 2008.
- Little Gunpowder is the only watershed that has showed a steady trend, declining since 2004.

For Dissolved Copper:

- Unlike the dramatic increases and decreases from 2004 to 2006, Loch Raven, Bird River, Prettyboy and Deer Creek only had slight changes between 2006 and 2008.
- The Lower Gunpowder had the largest change from 2006 to 2008, falling from 0.0046 mg/L to 0.0023 mg/L.

- The Little Gunpowder had the next largest change from 2006 to 2008 falling from 0.0027 mg/L to 0.0015 mg/L

For Chlorides:

- Bird River, Loch Raven, Deer Creek, and Little Gunpowder all increased from 2006 to 2008.
- Lower Gunpowder and Prettyboy were the only watersheds to show decreases.
- Bird River consistently has higher concentrations than the other watersheds.

Two map displays showing the Total Nitrogen and Total Phosphorus mean concentrations are shown in Figures 9-6 and 9-7 on the following two pages. As can be seen from Figure 9-6, the highest concentrations of Total Nitrogen predominate in the agricultural portions of the County. These increased Total Nitrogen concentrations may be the result of agricultural activities, septic system inputs, or a combination of both. The upper Gwynns Falls, a predominately urban area shows high values of Total Nitrogen, as well as one sub-watershed in the Back River.

The distribution of Total Phosphorus concentrations conversely shows the highest concentrations in the predominately in the urban areas, with several notable exceptions, including upper Lower Gunpowder Falls, and the rural portions of the Liberty Reservoir and Loch Raven watersheds. The majority of Total Phosphorus is delivered during storm events, associated with sediment. Thus the concentrations measured in baseflow sampling are much lower than during storm event sampling. The elevated concentrations in the urban areas are likely the result of increases in orthophosphate, which occurs in a dissolved form. The source is currently not known, but may be associated with sewage and various industrial processes. The elevated and very high concentrations in rural areas may be associated with animal operations where livestock have access to the stream.

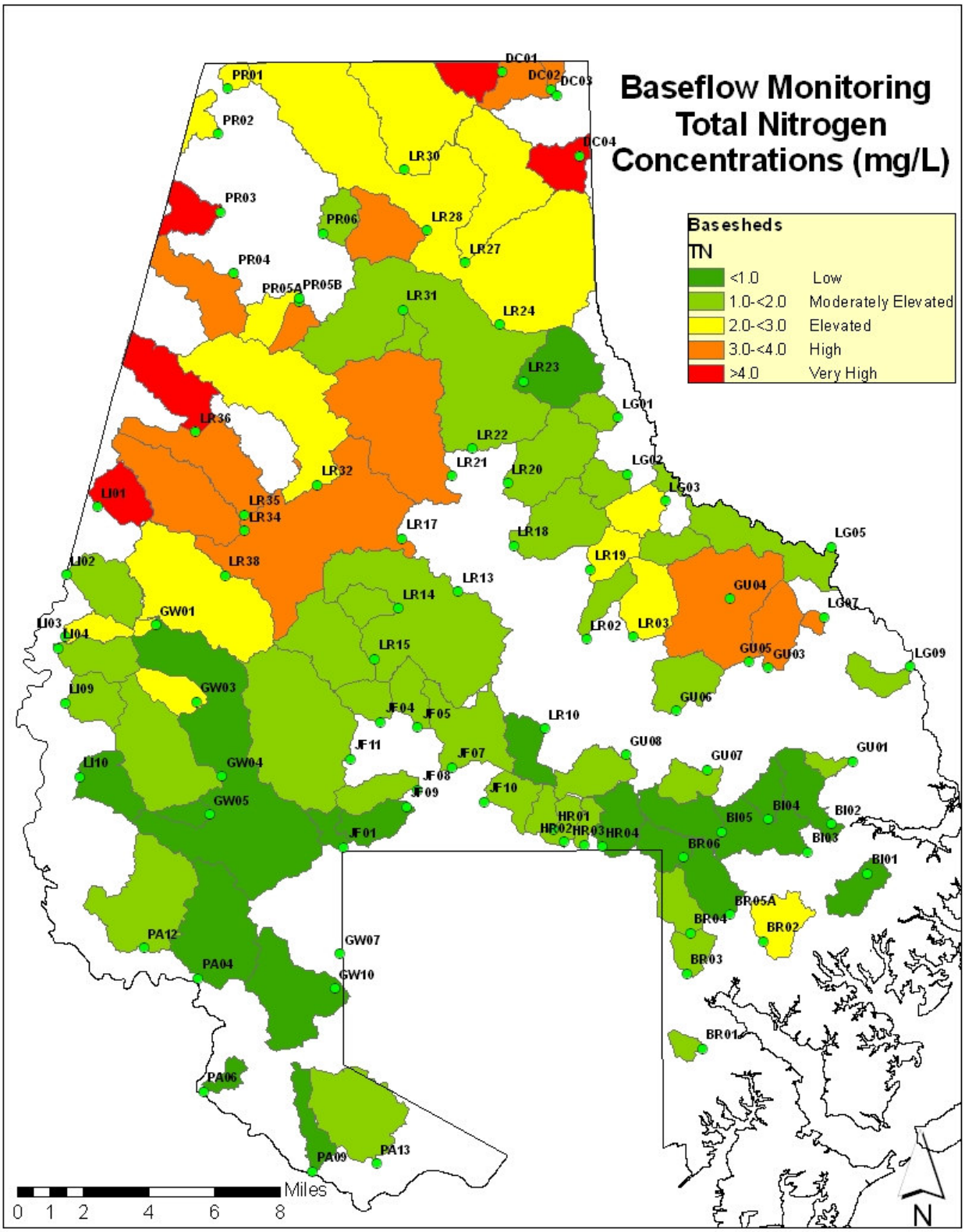


Figure 9-6: Baseflow Total Nitrogen Mean Concentrations for Monitoring Years 2007 (Patapsco/Back River Basin) and 2008 (Gunpowder Basin).

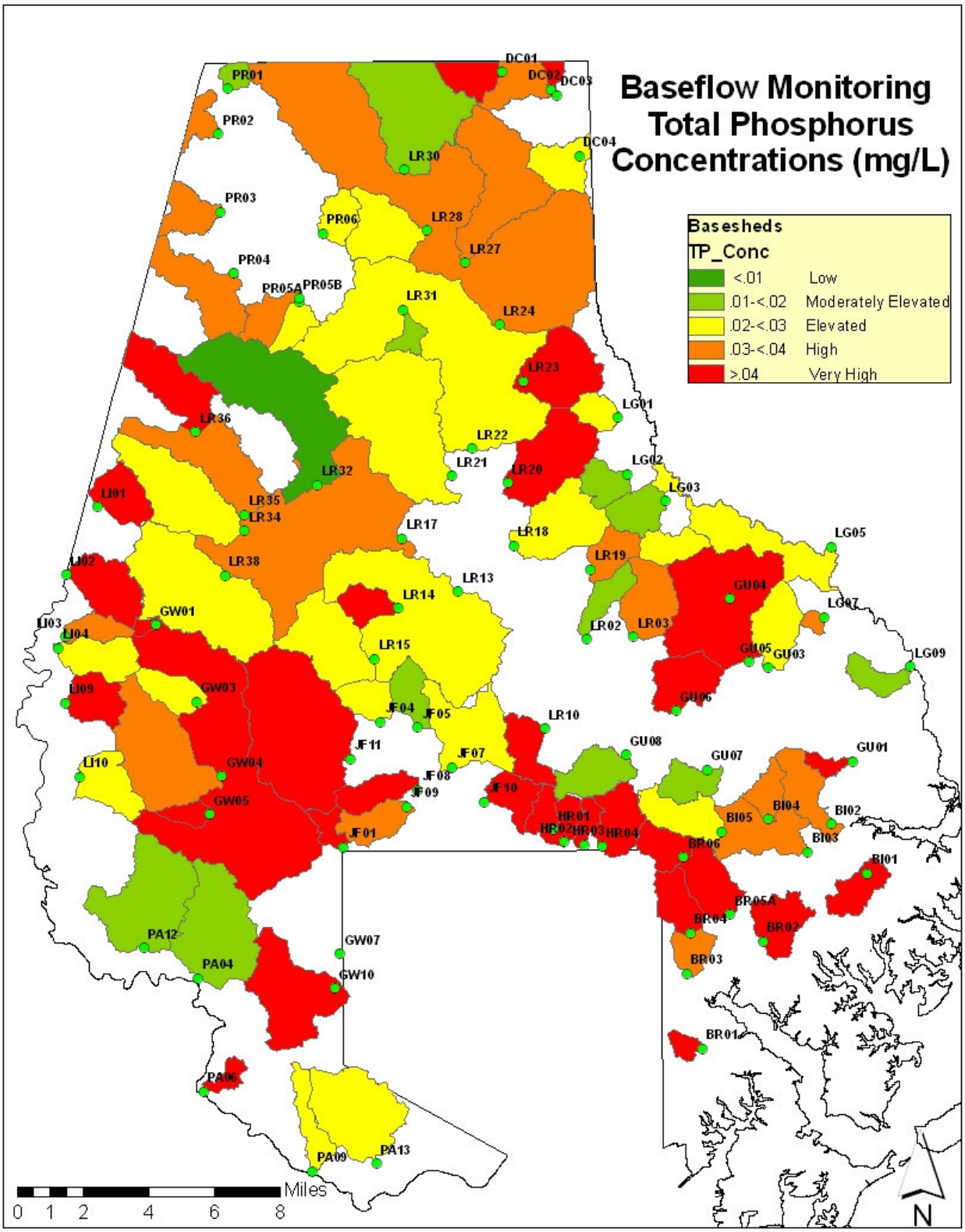


Figure 9-7: Baseflow Total Phosphorus Mean Concentrations for Monitoring Years 2007 (Patapsco/Back River Basin) and 2008 (Gunpowder Basin).

9.2.2 Tidal Waters Monitoring Program

Baltimore County has had a tidal recreational water-monitoring program since 1970. Early bacteriological sampling was conducted on a monthly basis between, Labor Day and Memorial Day, for fecal coliform. Since 2000, and the advent of the US EPA Beach Act, tidal water sampling has been conducted bi-weekly by boat for the indicator organism Enterococci. The sampling season has been extended to cover the period of April through November (weather permitting). Multiple bacteriological samples are taken in 10 zones representing areas of heavy recreational use with 4 single grab samples taken in less utilized areas. In addition, beach sampling also utilizing Enterococci is conducted at 3 permitted beach locations, on a basis alternate to recreational water sampling.

Individual sample results are recorded as well as the Geometric Mean of multiple sample zones. A value of 35 MPN (geomean) Enterococci is required to be utilized as a threshold for public safety and water contact only in association with a known or suspected sewage overflow. 35 MPN is otherwise used for comparison purposes to make general characterizations of open water. The results of the bacteriological sampling can be viewed on the internet at: http://www.baltimorecountymd.gov/Agencies/environment/watersampling/results.html.

Special sampling is also conducted to support environmental/public health evaluations after severe storm events or sanitary sewage overflows.

Starting in 2002, chemical sampling of surface waters was initiated at locations designed to represent major county tidal basins. This sampling takes place during the recreational water-sampling run and has recently been expanded to ten locations. The codes for those locations as noted on the "Beach, Beach Area, And Recreational Water Sampling Locations" map (Figure 9-8) and the tidal water basins they represent are found on Table 9-2.

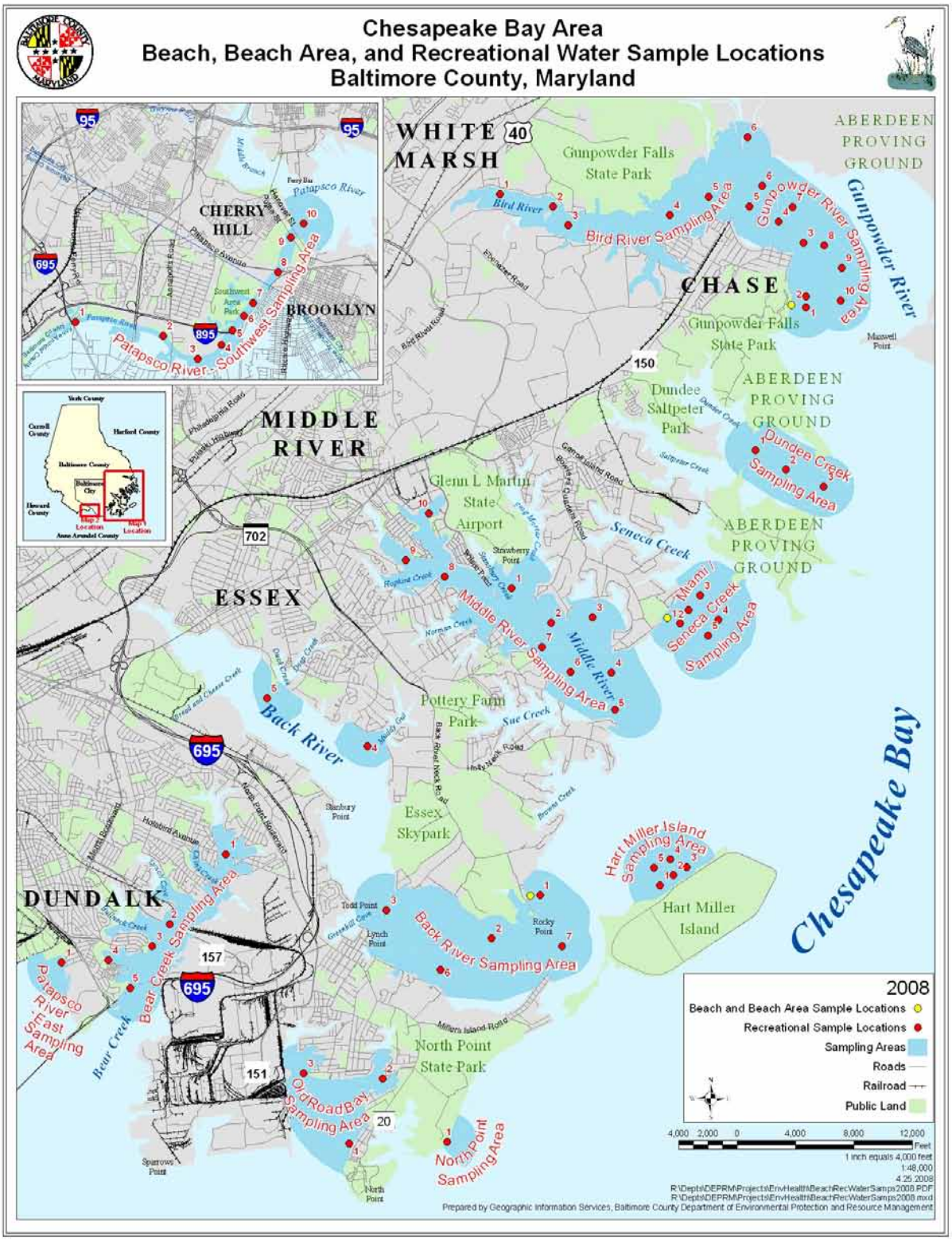


Figure 9-8: Tidal Waters Monitoring Site Locations.

Table 9-2: Site Codes and the Associated Tidal Water body

Code	Water Body
BC	Bear Creek
PR	Patapsco River - Outer
GR	Gunpowder River
MS	Miami Beach/Seneca Creek
MR	Middle River
BR	Back River
HM	Hart Miller Island
BD	Bird River
PS-F	Patapsco River – Fresh Water
PS-E	Patapsco River – Estuarine
DD	Dundee Creek
ORB	Old Road Bay

All twelve stations were monitored between eleven and thirty-one times during the time period of April 2008 through November 2008. The same standard set of pollutant parameters detailed in Section 9.1.1, were monitored in the tidal waters. The data are summarized by site in Appendix 9-3, which presents the means, number of samples and the standard deviation for each pollutant parameter presented.

An analysis of variance (ANOVA) was used for each pollutant to determine if there were significant differences between the twelve sites. The results of the ANOVA are displayed in Table 9-3. If a significant difference was found a post hoc Duncan's Multiple Range Test was used to determine which sites were significantly different. The results of the Duncan's Multiple Range Test are presented at the end of Table 9-3. When interpreting the results of the Duncan's Multiple Range Test, the sites are arranged from highest concentration of the parameter to the lowest concentration. The sites joined by the same line are not significantly different. All statistical analyses were conducted using Statistica (Ver. 6.1).

Table 9-3: ANOVA and Duncan's Multiple Range Test Results

Pollutant Parameter	df Effect	Df Error	F	P
TSS	11	200	2.80	<.01
TS	11	200	14.46	<.001
TKN	11	203	25.51	<.001
Nitrate/Nitrite	11	173	2.95	<.05
TN	11	173	14.69	<.001
TP	11	203	13.66	<.001
Total Copper	11	203	0.94	NS
Dissolved Copper	11	203	0.90	NS
Total Lead	11	203	.33	NS
Dissolved Lead	11	203	0.81	NS
Total Zinc	11	203	0.77	NS
Dissolved Zinc	11	203	0.76	NS
BOD	11	203	27.20	<.001
COD	11	203	5.08	<.001
Chloride	11	176	7.56	<.001
Fluoride	11	179	0.53	NS
Sulfate	11	176	8.90	<.001

Duncan's Multiple Range Test

Total Suspended Solids (TSS)	PR BC ORB MS PSE DD MR BR GR HM BD PSF
Total Solids (TS)	PR BC ORB PSE MS MR HM DD GR BR BD PSF
Total Kjedahl Nitrogen (TKN)	BR BC BD PR ORB PSE HM DD PSF MR GR MS
Nitrate/Nitrite	PSF BC BR ORB PSE HM MR BD PR MS DD GR
Total Nitrogen	BR BC PSF BD ORB PSE PR HM MR DD MS GR
Total Phosphorus (TP)	BR BD BC GR PR PSE ORB PSF MR DD MS HM
Biological Oxygen Demand (BOD)	BC BR BD PR ORB PSE MR HM DD GR MS PSF
Chemical Oxygen Demand (COD)	BC PR ORB BR PSE MS HM MR BD DD GR PSF
Chloride	PR BC ORB MS PSE DD MR HM GR BR BD PSF
Sulfate	PR BC ORB MS PSE DD HM MR GR BR BD PSF

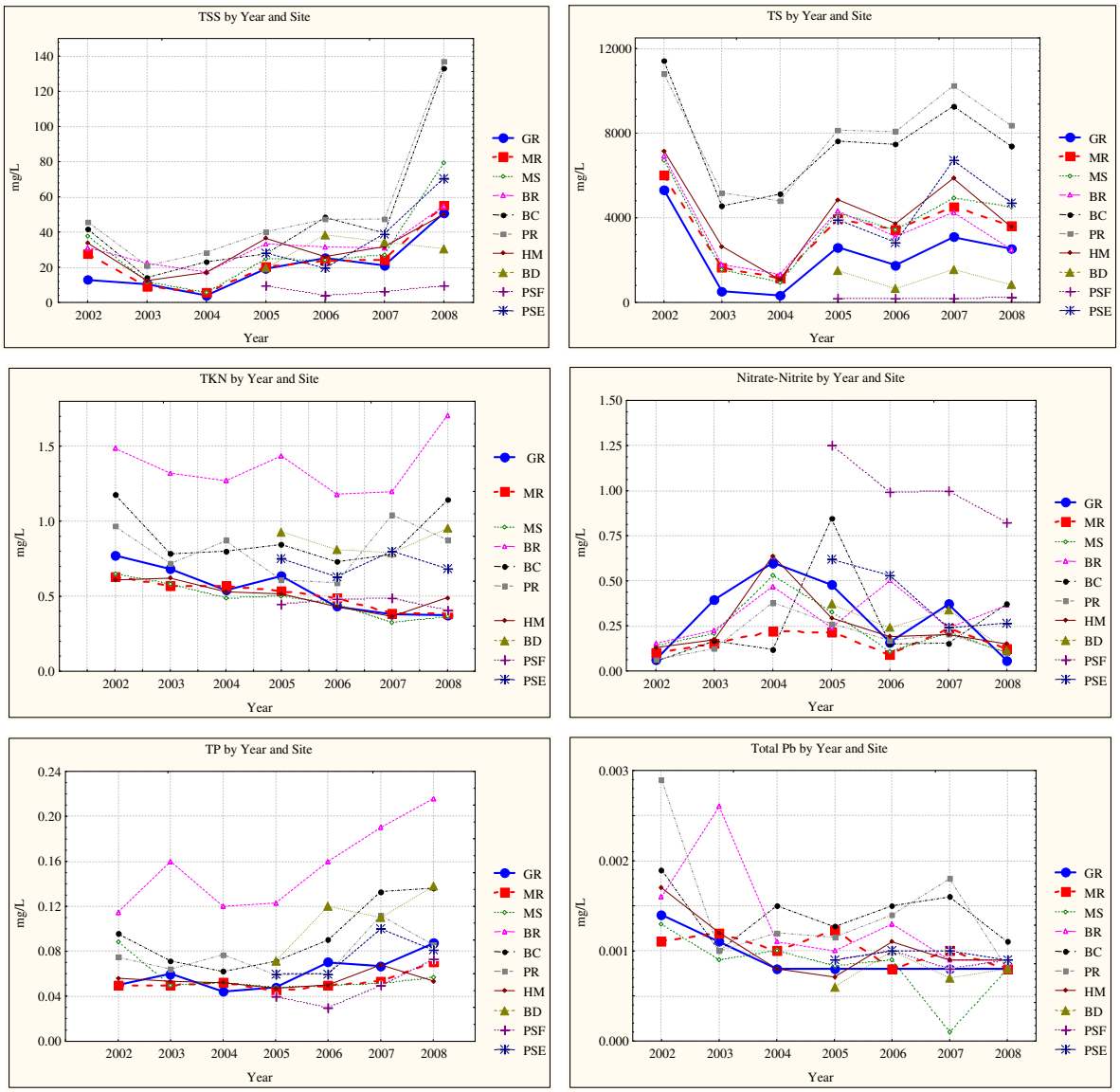
Sampling results for 2008 indicated that ten of the parameters (TSS, TS, TKN, Nitrate/Nitrite, TN, TP, BOD, COD, Chloride, and Sulfate had mean concentrations that differed among sites.

There were few changes in the relative ranking of the sites from highest to lowest between years for the ten parameters that were found to have a significant difference among sites. Both the TS and chloride parameters were highest in concentrations for the Patapsco River (PR), Bear Creek (BC), and Old Road Bay (ORB). This would indicate that these sites had the highest mean salinity. The Back River (BR) had significantly higher TKN concentrations than the other nine sites. This is probably due to the presence of the Waste Water Treatment Plant (WWTP) in this area. BD (Bird River) and BC (Bear Creek) also have relatively high TKN concentrations. This may also be related to the relatively poorer connection with open bay waters and the presence of algal populations, which would increase the organic nitrogen concentration. BR (Back River)

had the highest concentration and HM had the lowest concentration for Total Phosphorus mean concentrations. Last year the lowest concentration for TP was PSF, which this year is in the middle of the rankings. The presence of the Back River WWTP could account for the elevated concentrations of Total Phosphorus.

Bear Creek (BC) had the highest mean concentration for biological oxygen demand and chemical oxygen demand. This could indicate that the BC had a greater algal population than the other sites. A graphical comparison between years for site and select pollutants was conducted. Bird River (BD), PS-F (Patapsco River – Fresh), and PS-E (Patapsco River – Estuarine) have only four years of data. Old Road Bay (ORB) and (DD) are not included because they were added this year. The results are presented in Figure 9-9.

Figure 9-9: Pollutant Between Year Variation by Site



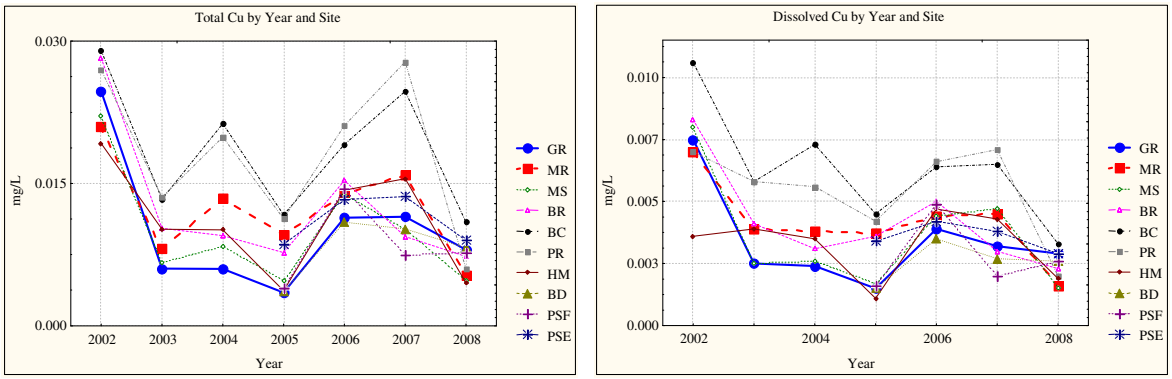


Figure 9-9: Pollutant Between Year Variation by Site (continued).

Several interesting trends can be seen from the graphs in Figure 9-9.

For Total Suspended Solids (TSS):

- All the sites are following the same trend except PSF (Patapsco River- Fresh), which has much lower levels than the other sites.
- A noted decrease in concentrations for all sites can be noted between 2002 and 2003.
- Since 2004, there has generally been an increasing trend, with the highest increases taking place between 2007 and 2008.

For Total Solids (TS) and Total Copper:

- The TS reduction between 2002 and 2003 is undoubtedly related to the reduced salinity that resulted from the increased runoff.
- There was an increase in TS and a decrease in Total Copper for all sites in 2005.
- From 2006 to 2007 there was again a moderate increase for all sites except PSF.
- For 2007, both TS and Total Copper increased, except for Total Copper levels in BR (Back River) and MS (Miami Beach/Seneca Creek).
- In 2008 all sites experienced declines in both TS and Total Copper relative to the 2007 results.

For Dissolved Copper and Total Lead:

- They both continued to decrease in 2004 and 2005 for all sites followed by an increase in 2006.
- For 2007, Dissolved Copper decreased slightly in about half the sites including BD, GR, PSF, and BR while the remaining sites held steady.
- Total Lead held steady in 2006 and 2007.
- PR had the largest decrease for both Dissolved Copper and Total Lead.
- Dissolved copper never exceeded the acute (0.0061 mg/L) Maryland Department of the Environment estuarine water quality standards for 2008.

For Nitrate/Nitrite:

- Concentrations increased in 2004 (with the exception of Bear Creek) relative to the 2003 and 2002 concentrations
- They decreased in 2005 (except for the HM site).
- Concentrations saw a large decrease in 2006, with the exception of Back River (BR), which increased by 48%.
- GR had the greatest decrease from 2007 to 2008, falling from 0.37 mg/L to 0.06 mg/L.
- PSF, a fresh water site, generally has higher concentrations than the other sites.

For Total Kjeldahl Nitrogen (TKN):

- Concentrations continue to decrease or stay about the same, except for PR (Patapsco River) and PSE (Patapsco River – Estuarine), which increased significantly in 2007.
- BR had the highest increase from 2007 to 2008 going from 1.20 mg/L to 1.71 mg/L. BR consistently has higher concentrations than the other stations.

For Total Phosphorus:

- Concentrations varied little among sites until 2006.
- Total Phosphorus in Back River (BR) has consistently risen since 2006. The concentrations are always higher for BR than the other sites, probably due to the presence of the Back River WWTP.

9.3 Stream Geomorphological Monitoring

Baltimore County DEPRM performs post-project monitoring of its completed stream restoration projects in accordance with applicable federal and state waterway construction permit requirements. The field monitoring and reports are either done completely in-house or by consulting firms competent in this work. These monitoring activities also provide compliance with the NPDES permit requirement to monitor effectiveness of restoration projects.

9.3.1 Stream Restoration Project Monitoring

The U.S. Army Corps of Engineers authorization for stream restoration activity is generally required pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899. Additionally, projects are normally eligible for authorization by the Maryland State Programmatic General Permit (MDSPGP) as published in the Special Public Notice 96-19 issued in June, 1996. For these projects, the conditions of the (MDSPGP) authorization normally require the development of a monitoring plan that will be used to identify and evaluate changes in the completed stream restoration project and to take remedial measures as necessary in coordination with the regulatory agencies. For each project, specific elements of the monitoring plan are identified as determined by the regulatory agencies. See Exhibit 5-1 of the 2003 NPDES Report for an example of an authorization document/permit and monitoring criteria. Periodic field monitoring followed by a written report of findings and any proposed remedial measures are submitted to the Army Corps of Engineers, Maryland Section Northern and to the Maryland Department of the Environment (MDE) Non-Tidal Wetland and Waterways Division as called for in the monitoring plans. Monitoring is also utilized to determine if the capital project implementation meets the goals of the project. Further, the DEPRM believes that

the post construction monitoring program provides valuable feed-back information that enables it to improve the effectiveness of its future project design and construction approaches.

The post construction monitoring plans require periodic collection of field data – usually annually for 2 to 5 years. Additional monitoring may be required after large storms. In most cases, monumented and surveyed channel cross-sections located at strategic points along the project are required. Occasionally, longitudinal profiles are required or elected to be done by DEPRM. Field data are collected using Standard Operating Procedures for pebble counts, cross sectional surveys, and longitudinal surveys. Data from the cross-sections and longitudinal surveys are entered into a computer program and plotted. For multi-year surveys these plots are overlayed (current over prior year(s)) to detect any changes in morphology that may have occurred between these periods. Bed material characterization via the Wolman pebble count procedure, inspection of the condition of any riparian plantings, visual inspection of the degree of channel erosion or deposition etc., and photographing the channel and banks at key locations are other components that may be included in the monitoring plan and report.

Table 9-4 summarizes the streams and stream restoration projects monitored and/or reported to the regulatory agencies in 2008. Copies of the completed reports submitted and listed in Table 9-4 are on file at the Maryland Department of the Environment (MDE) Non-Tidal Wetland and Waterways Division and at the DEPRM CIP Section where they are available for inspection.

Table 9-4: Summary of Capital Improvements Projects Monitoring Reports Submitted for 2008

Project	Submitted	Responsible Personnel
Hampton Branch Stream Restoration	2008	In-House WMM
Minebank Run II Stream Restoration	2008	GPI/BioHabitats
North Fork Stream Restoration	2008	KCI

9.3.2 Stream Stability Assessments

DEPRM is utilizing consulting assistance through a multi-year on-call contract to perform planning level stream stability assessments on various streams in Baltimore County. These assessments entail field teams who "cruise", by walking, assigned stream reaches collecting morphological, riparian, habitat quality, and other data useful in making evaluative assessments of stream condition and evidence of change. Other information will be collected related to infrastructure conflicts, pollution sources, fish blockages, etc. The stream assessments will be in support of the Small Watershed Action Plan (SWAP) process, TMDL's, and for comparison of baseline conditions and stream management/restoration needs, and for consideration of potential stream restoration projects. Four stream stability assessments have been completed to date: *Hunt Valley Stream Stability Assessment, Prettyboy Reservoir Stream Stability Assessment (Compass Run and Frog Hollow Subwatersheds), Lower Jones Falls Stream Stability Assessment, and Upper Back River Stream Stability Assessment*. An electronic copy of the first two reports was submitted with the NPDES 2006 Annual Report. Electronic copies of the Lower Jones Falls and Upper Back River reports are included with this report. These assessments have identified potential restoration projects by category, including:

- Stream restoration/stabilization,
- Buffer enhancement,
- Bank plantings,
- Utility conflict resolution,
- Habitat enhancement,
- Trash cleanup,

- Yard waste cleanup, and
- Invasive species removal.

9.3.3 Geomorphological Monitoring Summary

In summarizing the results of the in-house monitoring completed through 2008, it can be stated that the stream restoration projects have been successful in achieving the goals of self-maintaining channel stability, reduction of bed and bank erosion, protection of private and public infrastructure, and habitat improvement. Improvements in aesthetics and public safety aspects have been additional benefits. Most of the problems observed have been localized and minor in scale such as shifting of rock elements in grade control structures, bank scouring at the downstream end of bank protection structures, depositional bar build-up in the vicinity of grade control structures, and channel erosion at intra project segments that were not restored or modified during the overall project. The information gained from the monitoring has enabled DEPRM to improve its stream restoration approaches such as increasing the size of the rock elements in grade control structures subject to high tractive forces, and more closely relating the height of bank protection structures to bank full elevation. The challenges of effective stream improvement in an urban setting are formidable. Through the knowledge and experience gained with its design, construction, and monitoring efforts, DEPRM continues to build upon a successful stream restoration program.

9.4 Biological Monitoring

In addition to the biological monitoring required at Scotts Level Branch under Baltimore County's NPDES permit, the County has four additional biological monitoring programs. These programs use the biological community to assess the ecological health of the streams within the County (Probabilistic Monitoring Program, Section 9.4.1), assess the effectiveness of stream restoration projects (CIP Monitoring Program, Section 9.4.2), provide data on the best streams in Baltimore County to serve as bench marks for other stream assessments (Reference Site Monitoring Program, Section 9.4.3), and assess Submerged Aquatic Vegetation (Submerged Aquatic Vegetation (SAV) Monitoring Program, Section 9.4.4). The first three programs use assessments based on the benthic macroinvertebrate community and, in some cases, the fish assemblage. It is widely accepted that the biological community of streams is sensitive to anthropogenic perturbations. By monitoring the biological community, the County can assess the amount of change due to anthropogenic activities and the benefit of stream restoration to stream organisms. The SAV Monitoring Program provides an assessment of the coverage of SAV and progress made in meeting the new water quality standards for water clarity and SAV coverage in Baltimore County tidal waters.

9.4.1 Probabilistic Monitoring

The County adopted Maryland Biological Stream Survey (MBSS) methodologies in 2003, which has allowed for direct comparisons with State generated data. This has expanded upon the available data for assessing County waters. Probabilistic monitoring (randomly selected monitoring sites) has allowed statistically valid statements regarding the state of the waters.

The County has contracted a consultant to perform the probabilistic monitoring. Each year a different basin is sampled, with the Patapsco/Back River Basin (Liberty Reservoir, Patapsco River, Gwynns Falls, Jones Falls, and Back River) monitored in odd years and the Gunpowder River Basin and Deer Creek watersheds (Deer Creek, Prettyboy Reservoir, Loch Raven

Reservoir, Lower Gunpowder, Little Gunpowder, and Bird River) monitored in the even years. Three watersheds are not assessed using the Biological Probabilistic Monitoring Program (Baltimore Harbor, Middle River, and Gunpowder River) due to the limited miles of free flowing streams in the watersheds.

One hundred sites are selected at random for each year's sampling effort. The contractor samples these 100 sites during the spring index period, March 1 to April 30, for macroinvertebrates using the MBSS protocols. These samples are sub-sampled to 100 organisms and identified to Genus or the lowest possible taxonomic level. A Benthic Index of Biotic Integrity (BIBI) is calculated. The BIBI describes the biological condition of the streams in the County. In 2006, a subset of previously sampled random sites was selected to serve as sentinel sites. The sites were located towards the base of major subwatersheds. Eighteen sentinel sites were selected in the Patapsco/Back River basin, and 13 sentinel sites were selected in the Gunpowder/Deer Creek basin. The sentinel sites will be used to monitor biological condition over a range of watershed and stream conditions.

The current BIBI uses six metrics. These six metrics, what they measure and the expected response to stressors are displayed in Table 9-5.

Table 9-5: BIBI Metrics

BIBI Metric	Metric Measure	Expected Response
Number of Taxa	Species Richness	Decrease
Number of EPT	Species Richness	Decrease
Number of Ephemeroptera	Species Richness	Decrease
Percent Intolerant to Urban	Tolerance/Intolerance	Decrease
Percent Chironomidae	Taxonomic Composition	Increase
Percent Clingers	Habit	Decrease

The results for each site from the 2008 probabilistic monitoring are displayed in Appendix 9-4 at the end of this section. The sites are grouped by subwatershed and 12-digit watershed, along with their respective BIBI and condition rating. The sites are assigned condition ratings based on the BIBI scores, with 1.00 – 1.99 being "Very Poor," 2.00 – 2.99 being "Poor," 3.00 – 3.99 being "Fair," and 4.00 – 5.00 being "Good." Figure 9-10 displays the site condition by color code for each of the 192 sites sampled in 2005 and 2006. Figure 9-11 displays the same information for sites sampled in 2007 and 2008.

Table 9-6 shows the results by watershed, as the percentage of sites within each BIBI range, for the entire six-year probabilistic data set. The Patapsco/Back River Basin data show an improvement in biological condition. Sites within the Good and Fair categories increased from 15% in 2003 to 44% in 2007. Liberty Reservoir had all 20 sampled sites in the Fair and Good categories in 2007. As in 2005, Jones Falls had the next highest percentage of sites in the Fair and Good categories (46%).

The 2004 and 2006 sampling results for the Gunpowder Basin/Deer Creek watersheds indicated a decrease in water quality. In 2004, 79% of sites were in the Fair and Good categories, while in 2008 only 62% of sites rated Fair and Good. The biological condition of streams in the Gunpowder River/Deer Creek watersheds continues to be better than in Patapsco/Back River. Gunpowder River/Deer Creek streams had higher percentages of sites rated Fair and Good, and Patapsco/Back River had higher percentages of streams rated Very Poor and Poor. This is likely a reflection of higher population density and greater development pressure in Patapsco/Back River. However, over the entire county for the 6-year sampling period, the percentages of

streams rated Fair and Good (47%) is roughly equal to percentage rated Very Poor and Poor (53%).

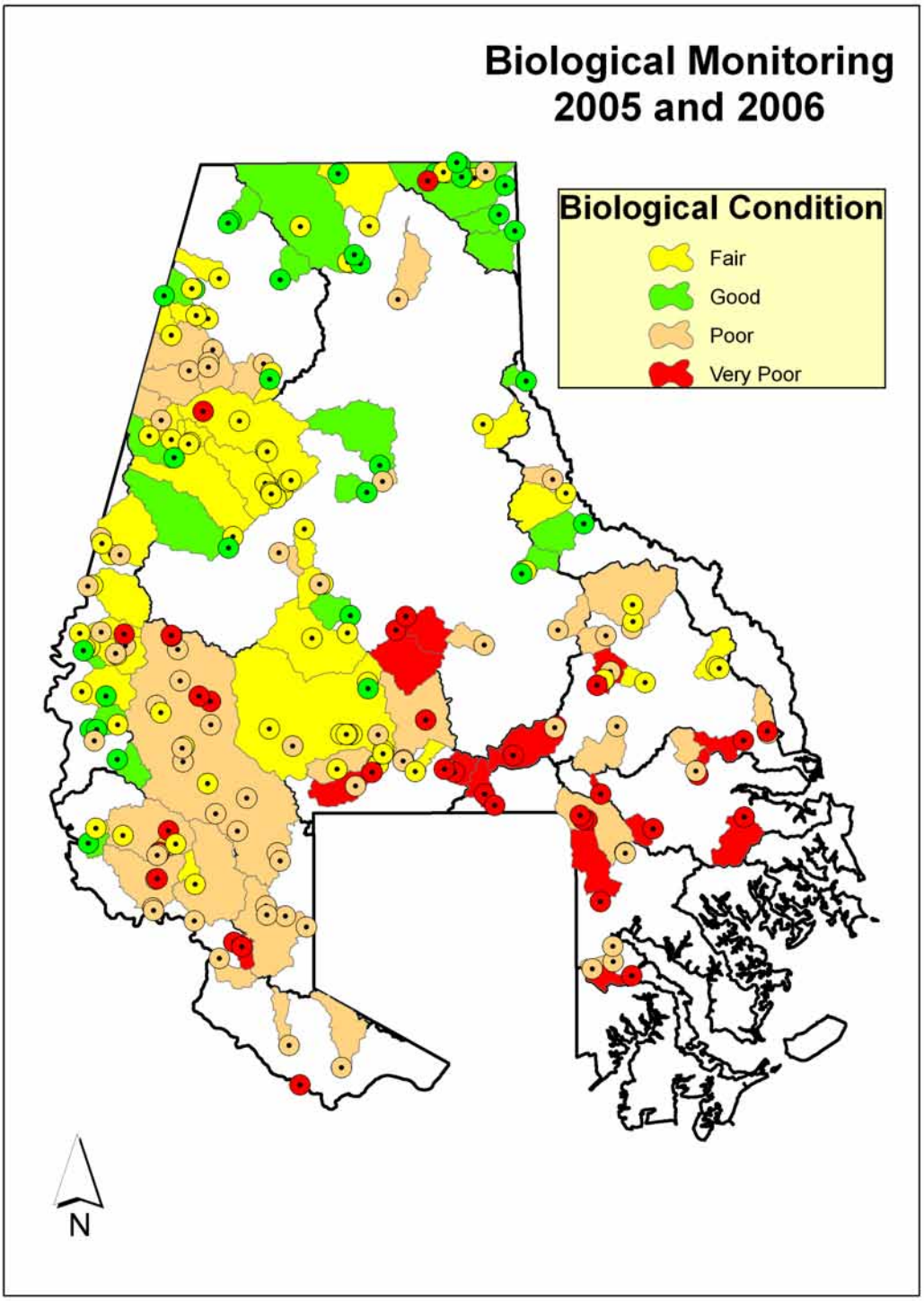


Figure 9-10: Probabilistic Biological Monitoring results for 2005 and 2006.

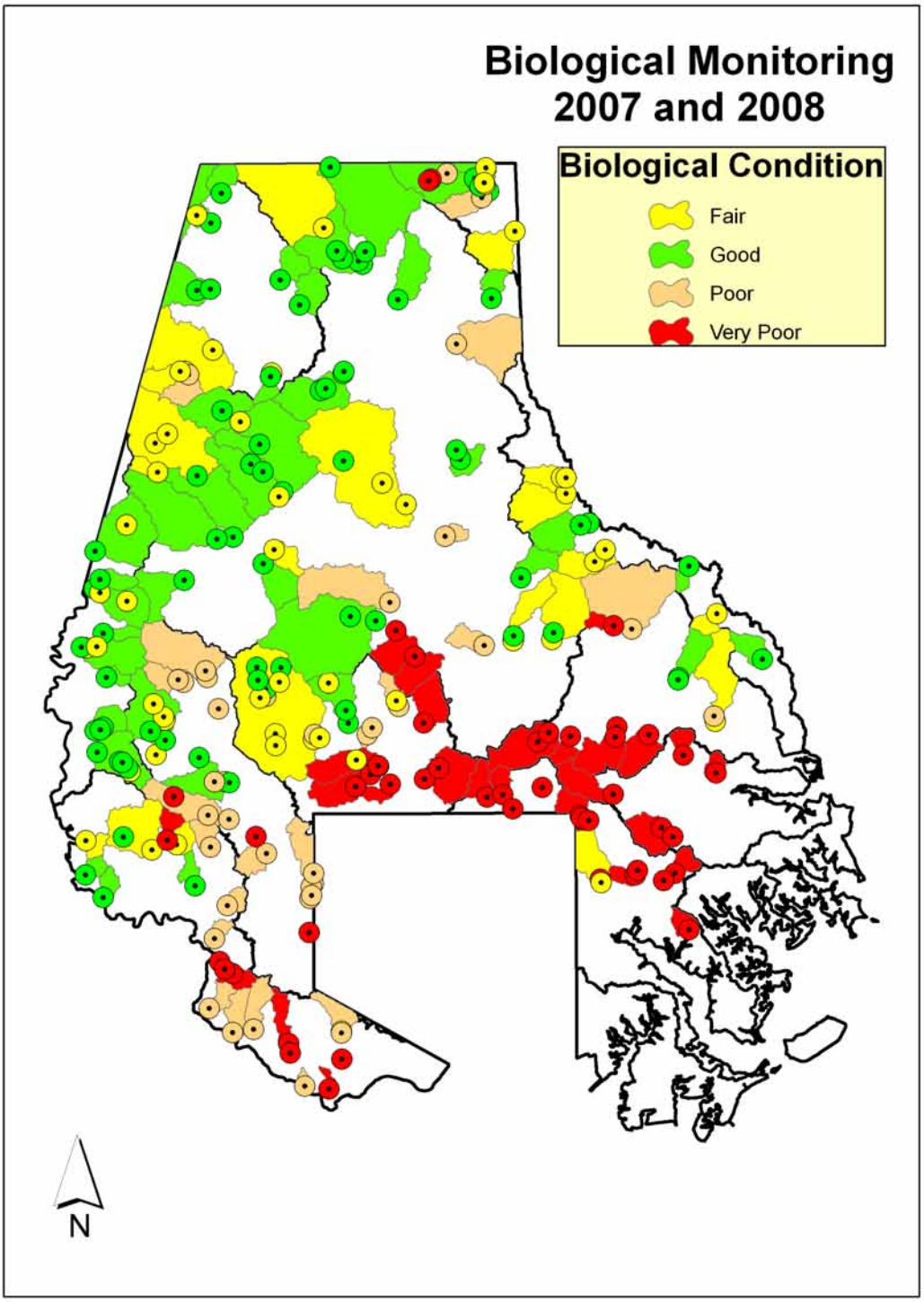


Figure 9-11: Probabilistic Biological Monitoring results for 2007 and 2008.

Table 9-6: BIBI Score Distribution by Watershed (% by Category)

Watershed	N	1.00-1.99 Very Poor	2.00-2.99 Poor	3.00-3.99 Fair	4.00-5.00 Good
Patapsco/Back River Basin – Sampled in 2003					
Liberty Reservoir	10	10	50	30	10
Patapsco River	13	54	46	0	0
Gwynns Falls	30	43	53	3	0
Jones Falls	32	38	31	25	6
Back River	15	87	13	0	0
Total	**100**	**46**	**39**	**12**	**3**
Gunpowder River Basin/Deer Creek – Sampled in 2004					
Deer Creek	3	0	33	67	0
Prettyboy Reservoir	7	0	14	43	43
Loch Raven Res.	67	6	9	43	42
Lower Gunpowder	7	29	43	29	0
Little Gunpowder	6	0	0	50	50
Bird River	2	50	50	0	0
Total	**92**	**8**	**13**	**42**	**37**
Patapsco/Back River Basin – Sampled in 2005					
Liberty Reservoir	22	5	32	41	23
Patapsco River	21	29	43	24	4
Gwynns Falls	22	18	68	14	0
Jones Falls	23	17	30	48	4
Back River	12	58	42	0	0
Total	**100**	**22**	**43**	**28**	**7**
Gunpowder River Basin/Deer Creek – Sampled in 2006					
Deer Creek	13	8	8	31	53
Prettyboy Reservoir	17	0	30	35	35
Loch Raven Res.	44	7	16	57	20
Lower Gunpowder	17	30	35	35	0
Little Gunpowder	4	0	25	25	50
Bird River	5	80	20	0	0
Total	**100**	**13**	**21**	**42**	**24**
Patapsco/Back River Basin – Sampled in 2007					
Liberty Reservoir	20	0	0	30	70
Patapsco River	24	33	33	17	17
Gwynns Falls	26	12	54	19	15
Jones Falls	28	29	25	25	21
Back River	19	84	11	5	0
Total	**117**	**30**	**26**	**20**	**24**
Gunpowder River Basin/Deer Creek – Sampled in 2008					
Deer Creek	12	17	17	33	33
Prettyboy Reservoir	13	0	8	38	54
Loch Raven Res.	47	4	9	23	64
Lower Gunpowder	12	58	17	8	17
Little Gunpowder	11	0	0	64	36
Bird River	5	100	0	0	0
Total	**100**	**30**	**8**	**28**	**34**
County Total	**509**	**24**	**29**	**28**	**19**

Figures 9-12 and 9-13 show the means and one standard deviation of the mean BIBI scores for each watershed between 2003 and 2008. The mean scores for Liberty, Patapsco, and Gwynns increased over the period. Watersheds in the Gunpowder River and Deer Creek basins were stable.

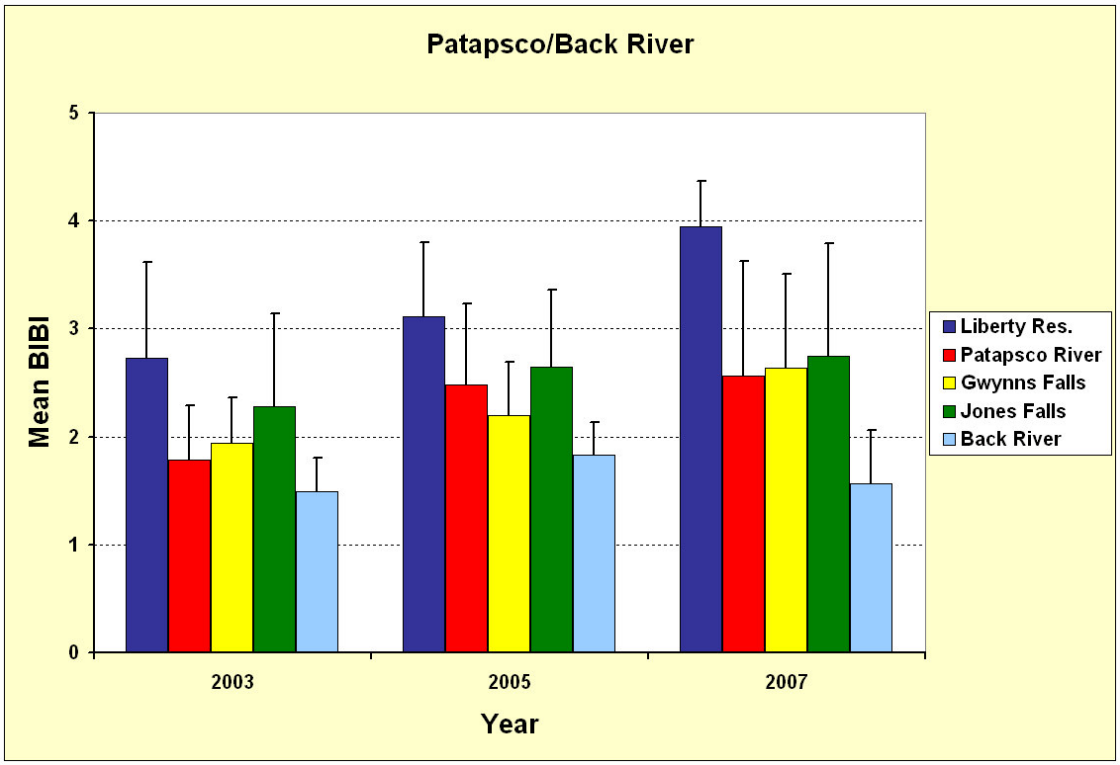


Figure 9-12: Means and one standard deviation of BIBI scores for Patapsco/Back River watersheds between 2003 and 2007.

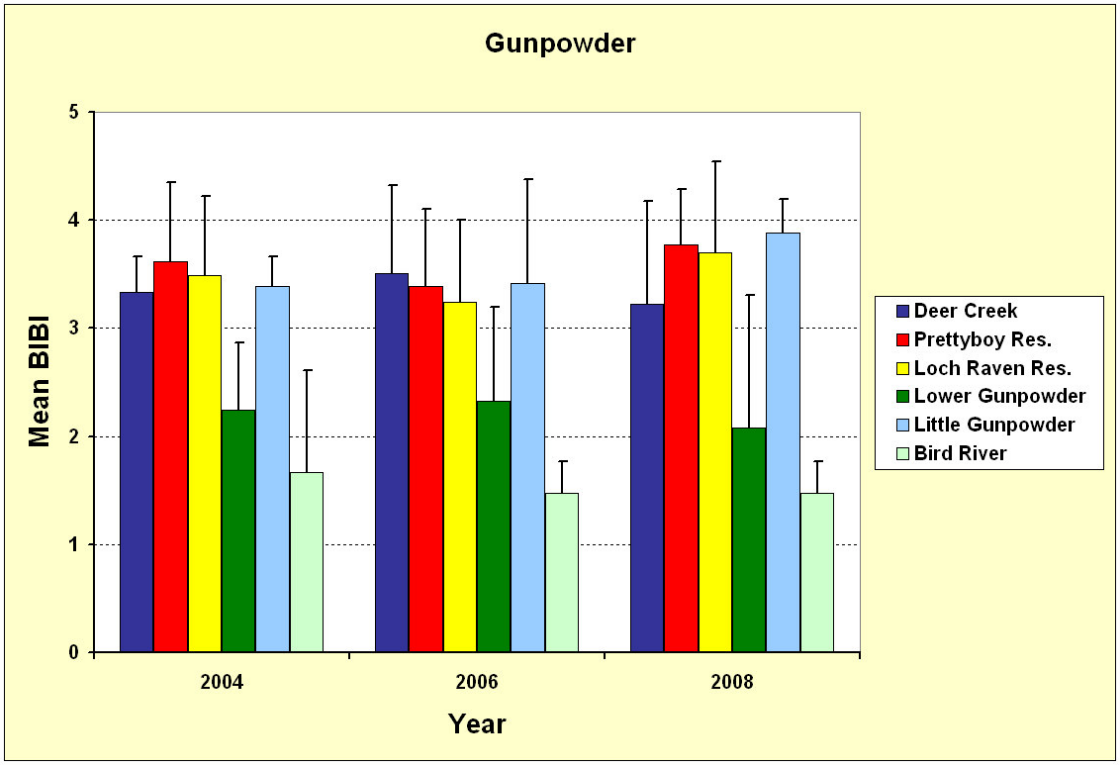


Figure 9-13: Means and one standard deviation of BIBI scores of Gunpowder Falls/Deer Creek watersheds between 2004 and 2008.

The methodology developed by Maryland Department of the Environment and Maryland Department of Natural Resources to determine biological impairment of fresh water streams was used to determine the watershed condition for all five sampling years. The methodology is detailed in Part C.2.1 at the following web site:

http://www.mde.state.md.us/assets/document/2008_IR_Parts_A_thru_E(1).pdf

The method assesses watersheds at the Maryland 8-digit scale, and uses 90% confidence limits around the proportion of degraded stream miles to determine whether the proportion of degraded stream miles is significantly different than reference conditions. Watersheds are listed as "Attaining," "Impaired," or "Inconclusive." The former methodology calculated mean BIBI and 90% confidence intervals in watersheds with a minimum of 10 sampling locations. Less than 10 sampling locations in a watershed were considered to have insufficient data to make a determination. The results of the revised biological listing method are presented in Table 9-7, and the results of the former (average IBI) biological listing method are presented in Table 9-8.

Table 9-7: Watershed Biological Condition Using Percent Stream Mile Method

Watershed	Sites Degraded	N	% Stream Miles With Possible Degradation	CL_{Lower} (%)	CL_{Upper} (%)	Category
2003 Sampling Year						
Liberty	6	10	60	35	81	Impaired
Patapsco River	13	13	100	84	100	Impaired
Gwynns Falls	29	30	97	88	99	Impaired
Jones Falls	22	32	69	56	80	Impaired
Back River	15	15	100	86	100	Impaired
2004 Sampling Year						
Deer Creek	1	3	33	3	80	Inconclusive
Prettyboy	1	7	14	1	45	Attaining
Loch Raven	10	67	15	9	22	Attaining
Lower Gunpowder	5	7	71	40	92	Impaired
Little Gunpowder	0	6	0	0	32	Attaining
Bird River	2	2	100	32	100	Impaired
2005 Sampling Year						
Liberty	8	22	36	22	52	Impaired
Patapsco River	15	21	71	55	84	Impaired
Gwynns Falls	19	22	86	72	95	Impaired
Jones Falls	11	23	48	33	63	Impaired
Back River	12	12	100	83	100	Impaired
2006 Sampling Year						
Deer Creek	2	13	15	4	36	Attaining
Prettyboy	5	17	29	15	48	Impaired
Loch Raven	10	44	23	15	33	Impaired
Lower Gunpowder	11	17	65	46	80	Impaired
Little Gunpowder	1	4	25	3	68	Inconclusive
Bird River	5	5	100	63	100	Impaired
2007 Sampling Year						
Liberty	0	20	0	0	11	Attaining
Patapsco River	16	24	67	52	80	Impaired
Gwynns Falls	17	26	65	51	78	Impaired

Jones Falls	15	28	54	40	67	Impaired
Back River	18	19	95	81	99	Impaired
2008 Sampling Year						
Deer Creek	4	12	33	15	56	Impaired
Prettyboy	1	13	8	1	27	Attaining
Loch Raven	6	47	13	7	21	Attaining
Lower Gunpowder	9	12	75	52	90	Impaired
Little Gunpowder	0	11	0	0	19	Attaining
Bird River	5	5	100	63	100	Impaired

Table 9-8: Watershed Biological Condition Using Average IBI Method

Watershed	BIBI Mean	N	CL_{Lower}	CL_{Upper}	Condition
2003 Sampling Year					
Liberty	2.73	10	2.37	3.09	Inconclusive
Patapsco River	1.79	13	1.61	1.97	Impaired
Gwynns Falls	1.94	30	1.84	2.04	Impaired
Jones Falls	2.28	32	2.09	2.47	Impaired
Back River	1.49	15	1.39	1.59	Impaired
2004 Sampling Year					
Deer Creek	3.33	3	3.09	3.57	Insufficient Data
Prettyboy	3.62	7	3.27	3.97	Insufficient Data
Loch Raven	3.49	67	3.38	3.60	Meets Criteria
Lower Gunpowder	2.24	7	1.94	2.54	Insufficient Data
Little Gunpowder	3.89	6	3.25	3.53	Insufficient Data
Bird River	1.67	2	0.82	2.52	Insufficient Data
2005 Sampling Year					
Liberty	3.11	22	2.92	3.30	Inconclusive
Patapsco River	2.48	21	2.27	2.69	Impaired
Gwynns Falls	2.20	22	2.07	2.33	Impaired
Jones Falls	2.65	23	2.46	2.84	Impaired
Back River	1.83	12	1.72	1.94	Impaired
2006 Sampling Year					
Deer Creek	3.51	13	3.22	3.80	Meets Criteria
Prettyboy	3.39	17	3.17	3.61	Meets Criteria
Loch Raven	3.24	44	3.09	3.39	Meets Criteria
Lower Gunpowder	2.33	17	2.06	2.60	Impaired
Little Gunpowder	3.42	4	2.81	4.03	Insufficient Data
Bird River	1.47	5	1.30	1.64	Insufficient Data
2007 Sampling Year					
Liberty	3.95	20	3.83	4.07	Meets Criteria
Patapsco River	2.56	24	2.28	2.84	Impaired
Gwynns Falls	2.64	26	2.42	2.86	Impaired
Jones Falls	2.75	28	2.50	3.00	Inconclusive
Back River	1.58	19	1.43	1.71	Impaired
2008 Sampling Year					
Deer Creek	3.22	12	2.87	3.57	Inconclusive
Prettyboy	3.77	13	3.59	3.95	Meets Criteria
Loch Raven	3.70	47	3.54	3.86	Meets Criteria
Lower Gunpowder	2.08	12	1.63	2.53	Impaired
Little Gunpowder	3.88	11	3.76	4.00	Meets Criteria
Bird River	1.47	5	1.30	1.64	Insufficient Data

Based on the percent stream mile criteria, Patapsco River, Gwynns Falls, Jones Falls, Back River, Lower Gunpowder, and Bird River are impaired, as they have consistently failed to meet biological criteria. The Liberty Reservoir watershed attained biological water quality standards in 2007, but was considered impaired in 2003 and 2005. The Prettyboy Reservoir, Loch Raven Reservoir, and Little Gunpowder Falls watersheds attained water quality standards in two of the three years in which data are available. The Deer Creek watershed attained water quality standards in only one year (2006).

There are 18 sentinel sites in the Patapsco/Back River drainage and 13 sentinel sites in the Gunpowder River/Deer Creek drainage. Sentinel sites were sampled 2003, 2004, 2006, 2007, and 2008. Figure 9-14 shows the mean BIBI scores for the sentinel sites between 2003 and 2008. As with the probabilistic monitoring, the biological condition of sentinel sites in the

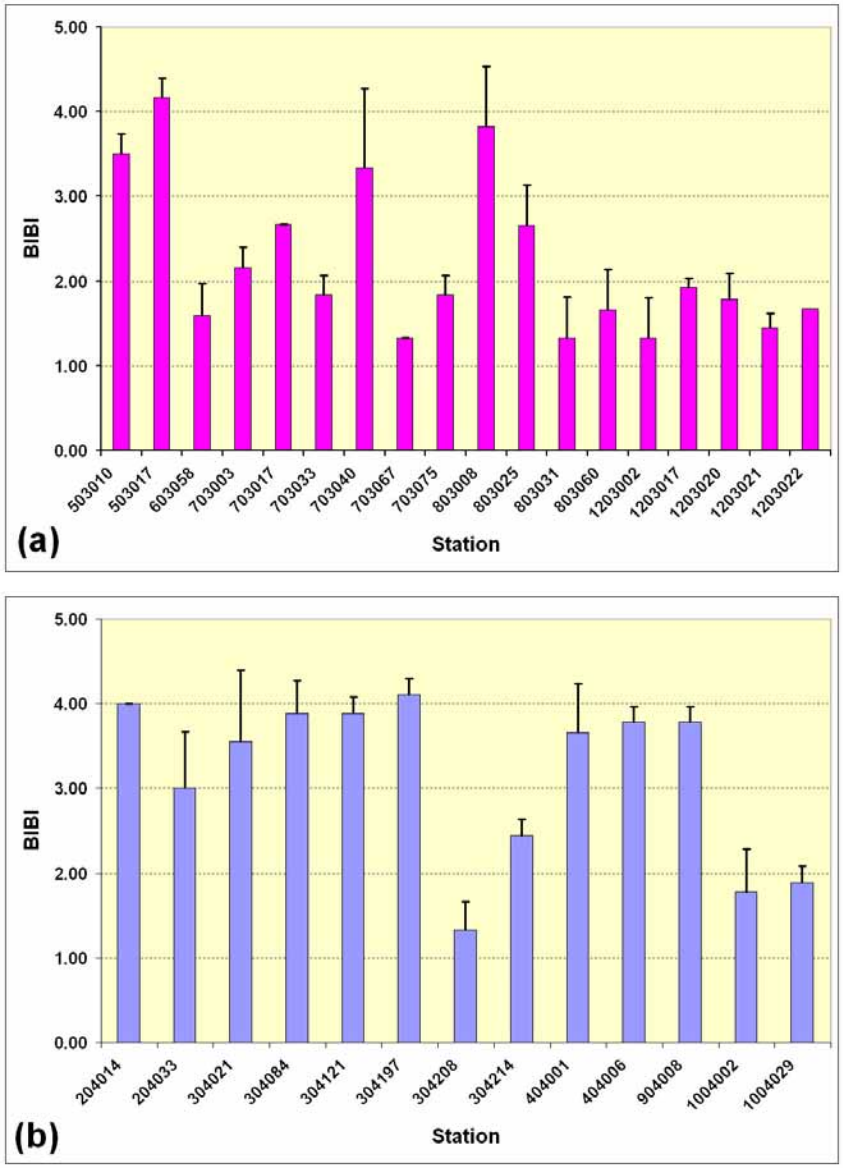


Figure 9-14: Mean BIBI scores for (a) Patapsco/Back River and (b) Gunpowder/Deer Creek Sentinel Sites between 2003 and 2008. Error bars indicate one standard deviation of the mean. N=2 for Patapsco/Back River, N=3 for Gunpowder/Deer Creek.

Gunpowder River/Deer Creek drainage was generally better than the biological condition of sentinel sites in the Patapsco/Back River drainage. As more data is collected from the sentinel sites, a trend analysis will be performed.

9.4.2 Capital Improvement Projects Monitoring

Baltimore County monitors benthic macroinvertebrate and fish assemblages in conjunction with several capital improvement stream restoration projects. Stream segments are monitored pre- and post-construction to document any change in the biological community. As with the Probablistic Monitoring Program, MBSS methods are followed, including stream physical habitat assessments. Habitat assessments are based on visual ratings of instream and riparian zone characteristics that are important to stream biological communities. A physical habitat index (PHI) is calculated based on the visual ratings. The Minebank Run and Woodvalley projects are currently being monitored under the Capital Improvement Projects Monitoring Program. Their ADC map locations are displayed in Table 9-9.

Table 9-9: Stream Restoration Biological Monitoring Site Locations

Station	Stream and Location	ADC Map, Grid
Minebank Run II Stream Restoration		
MNBK-1	Minebank Run upstream of Gunpowder River	28 C2
MNBK-2	Minebank Run upstream of USGS gage	28 B3
MNBK-3	Minebank Run downstream of bridge @ park	28 A4
MNBK-4	Minebank Run upstream of bridge @ park	28 A4
MNBK-5	Minebank Run behind Loch Raven High School	27 K5
MNBK-6	Minebank Run upstream of Cowpens Road	27 J5
MNBK-7	Minebank Run upstream of Glen Eagles Court	27 H6
MNBK-8	Minebank Run upstream of MNBK-7	27 H6
MNBK-9	Minebank Run downstream of Cromwell ES	27 G6
JB-1	Jennifer Branch upstream of Gunpowder River	28 J2
JB-2	Jennifer Branch near archery range	28 J3
Woodvalley Stream Restoration		
WDVL-1	Unnamed Trib to Jones Falls at Michelle Way	25 F7
WDVL-2	Unnamed Trib to Jones Falls at Gardenview Way	25 G6
WDVL-3	Unnamed Trib to Jones Falls at Evan Way	25 F6

The Minebank Run stream restoration project has been monitored annually since April, 2004, at eleven sampling stations (Figure 9-15). The stream restoration was completed in 2002 (Phase I) on the reach where MNBK-6, MNBK-7, MNBK-8, and MNBK-9 are located. The stream restoration was completed in 2005 (Phase II) where MNBK-2, MNBK-3, MNBK-4, and MNBK-5 are located. Stations MNBK-1, JB-1, and JB-2 are controls. As of 2008, DEPRM has collected five years of post-restoration data at the Phase I stations, and two years of pre-restoration and four years of post-restoration data at the Phase II stations. While all eleven stations are sampled for macroinvertebrates, fish are sampled at a sub-set of the stations: MNBK-1, MNBK-2, MNBK-4, MNBK-7, and JB-1.

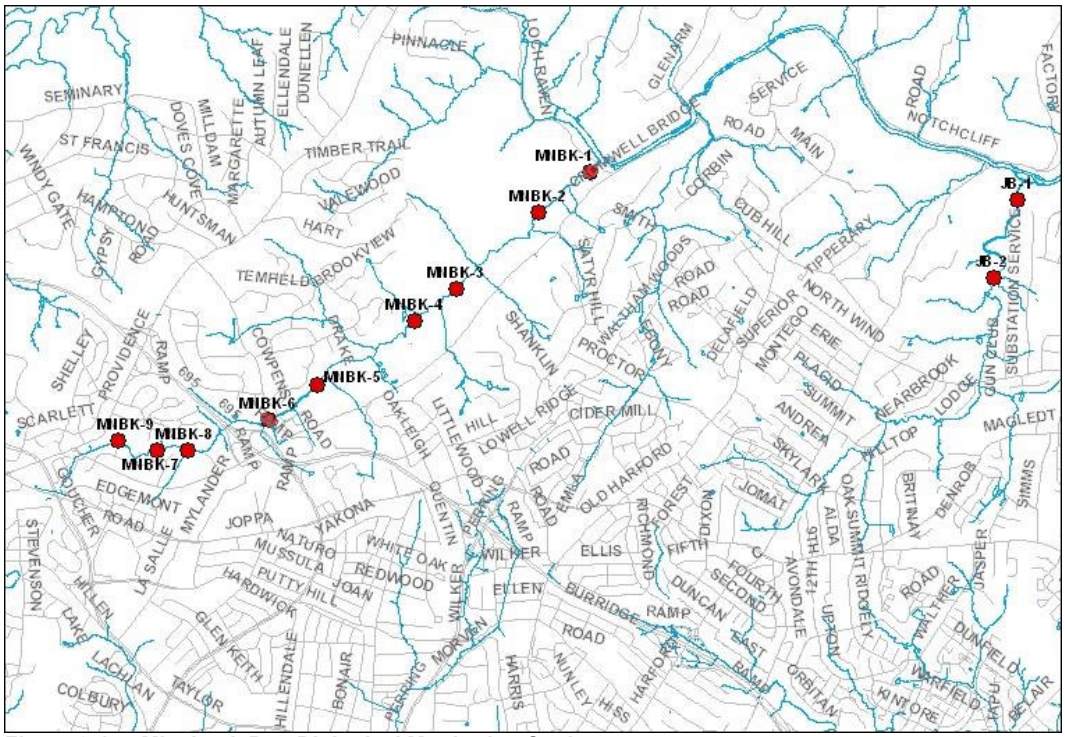


Figure 9-15: Minebank Run Biological Monitoring Stations.

As in 2007, BIBI scores across all treatments were Very Poor at both control and restored stations (all scores 1.00). The FIBI scores were 2.67 (JB-1) and 4.00 (MNBK-1) at the control stations. All other stations had FIBI scores of 2.33 (MNBK-2, MNBK-4, and MNBK-7). To examine the cumulative effect of the restoration on IBI scores, we plotted BIBI and FIBI scores at MNBK-1, the downstream control, over time (Figure 9-16). It is not possible to definitively determine the effect of the Phase I restoration on the downstream control, as pre-restoration data are not available. However, it appears that both benthos and fish were showing signs of improvement until the completion of Phase II. Post-Phase II sampling showed stable fish and initially declining then stabilizing benthic populations. These data suggest inherent differences in the organisms' ability to adapt to changing stream condition. The depressed benthic populations are likely related to the continued flashy hydrology of Minebank Run. Fish are more mobile and thus better able to use flow refugia during high flow events. Benthic macroinvertebrates are dependent on stable, diverse substrate. The benthic community of MNBK-1 is dominated by pollution tolerant, generalist taxa with short life cycles (Table 9-10). Only 12% of the organisms collected were specialized feeders (predators and filterers), and even these were highly tolerant of pollution. Over 99% of the organisms present had moderate to high pollution tolerances (tolerance value > 5). The one relatively intolerant individual (Ephemeroptera: *Ameletus*) employs a generalist feeding strategy (collector). Post-restoration geomorphic monitoring shows that the restoration was successful in stabilizing the stream banks and reducing sediment fluxes within Minebank Run. It is possible that improvements in biological function at the microbiological level have occurred, but that it is too soon after restoration to see conclusive changes in the benthic and fish communities.

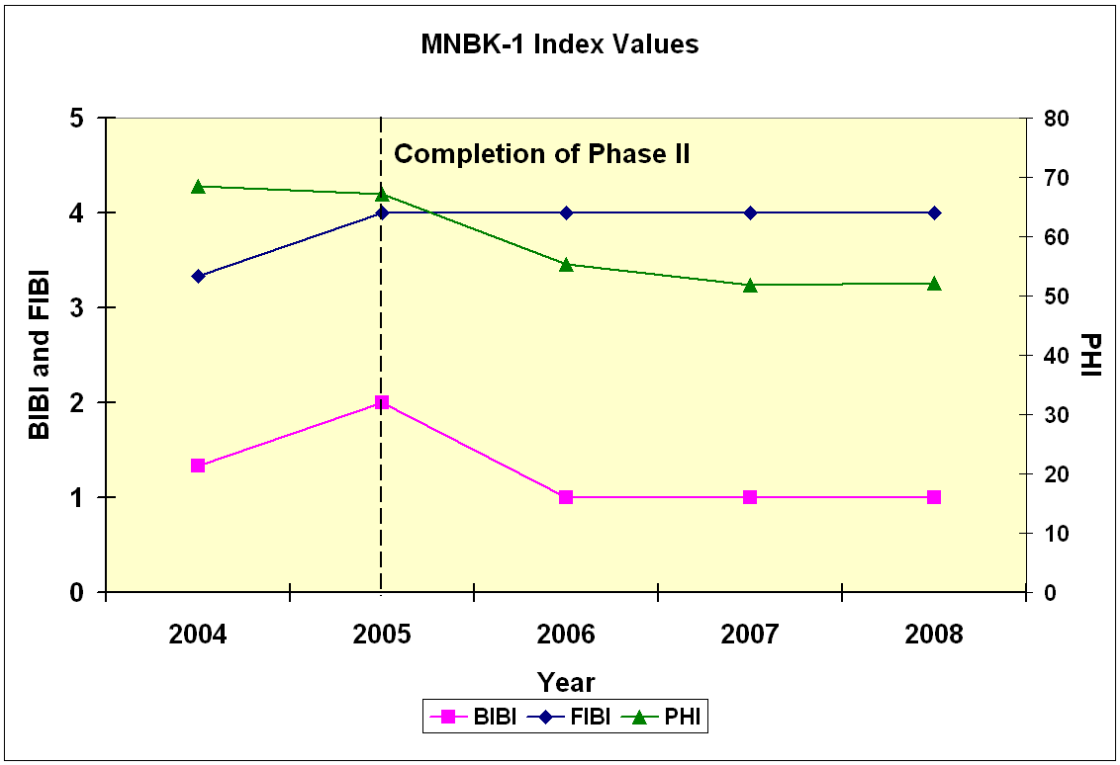


Figure 9-16: Biological index values at MNBK-1 from beginning of monitoring to present.

Table 9-10: Taxonomic composition of MNBK-1, 2008. FFG=Functional Feeding Group

Taxon	No. of organisms	Tolerance Value	FFG
Ameletus	1	3	Collector
Clinocera	11	7	Predator
Diamesa	5	8	Collector
Muscidae	1	7	Predator
Oligochaeta	5	10	Collector
Orthocladiinae	2	8	Collector
Orthocladius	69	9	Collector
Simulium	1	6	Filterer
Sympotthastia	11	8	Collector
Thienemanniella	1	5	Collector

The Woodvalley stream restoration project was completed in 2005. Pre-restoration data were collected in 2004 at two stations: (1) WDVL-1, unnamed tributary to Jones Falls at Michelle Way (within the restored reach), and (2) WDVL-2, unnamed tributary to Jones Falls at Gardenview Way. WDVL-2 served as a control for the restored reach. Post-restoration data were collected beginning in 2005. A third station, WDVL-3, unnamed tributary to Jones Falls at Evan Way and Park Heights Avenue, was added as a control in 2005 because no fish were collected at WDVL-2 in 2004. See Figure 9-17 for station locations. Presently, biological sampling is done at WDVL-1 and WDVL-3. As with the Minebank Run restoration project, all data from 2004-2007 were presented in the 2008 annual report. Therefore, only data from 2008 will be discussed here.

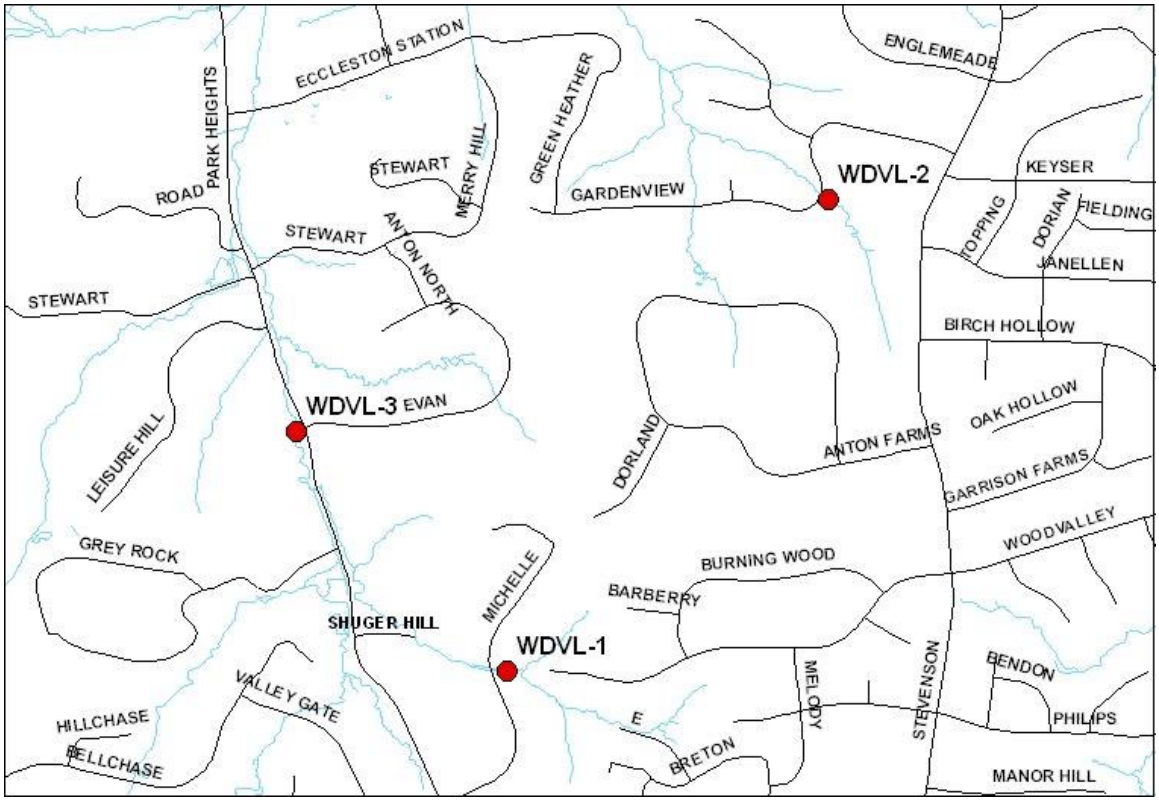
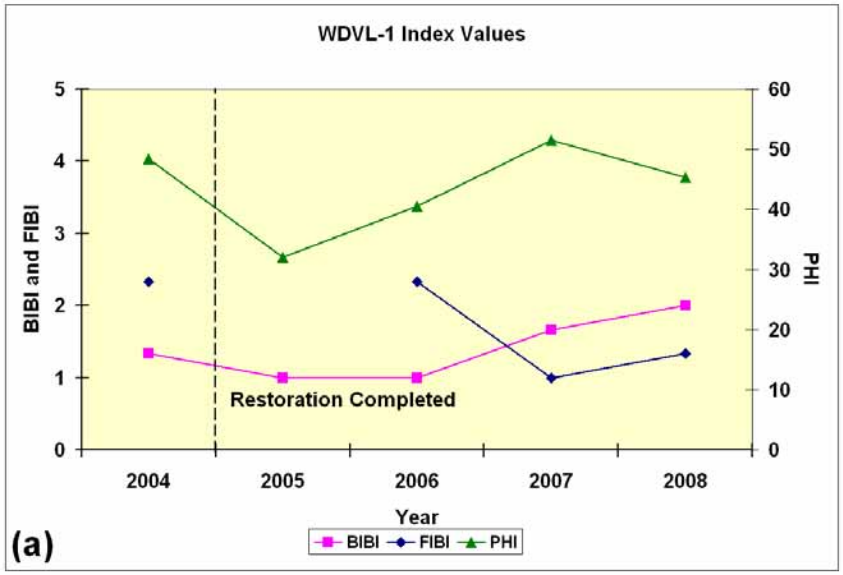


Figure 9-17: Woodvalley Biological Monitoring Station Locations.

The BIBI and FIBI scores at WDVL-1 rated Poor and Very Poor, respectively (Figure 9-18). Both index scores at WDVL-3 were Poor. The PHI at WDVL-1 was Severely Degraded while the PHI at WDVL-3 was Degraded. Both biological indices suggested slight improvement from 2007 at both control and restored sites. Physical habitat has generally shown slight improvement at both control and restored sites since completion of restoration.



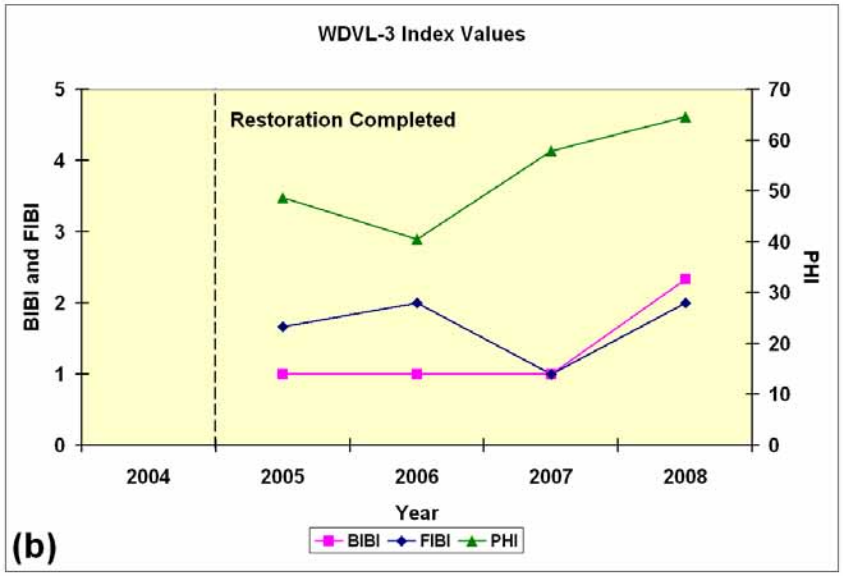


Figure 9-18: Benthic and Fish IBI and Physical Habitat Index Values for (a) WDVL-1 (restored) and (b) WDVL-3 (control).

Based on biological index values, the restored station is performing similarly to the control, although there are differences in the taxonomic composition of benthos and fish. Table 9-11 shows benthic and fish taxa and numbers of individuals collected in 2008. The Percent Similarity Index is 38% for benthos and 80% for fish. Two wild brown trout were collected from within the control reach. The continued presence of brown trout (documented in previous NPDES reports) suggests the potential of the restored reach to provide habitat for wild salmonids.

Table 9-11: Benthic and fish taxa collected at WDVL-1 and WDVL-3, 2008

Benthos				Fish			
WDVL-1		WDVL-3		WDVL-1		WDVL-3	
Taxon	No.	Taxon	No.	Taxon	No.	Taxon	No.
Antocha	2	Antocha	2	Blacknose dace	129	Blacknose dace	106
Cheumatopsyche	8	Baetis	1	Creek chub	22	Brown trout	2
Chironomidae	1	Caecidotea	1			Creek chub	36
Cricotopus	7	Chaetocladius	1			Longnose dace	17
Diamesa	1	Cheumatopsyche	7				
Dicrotendipes	3	Chimarra	1				
Hydropsyche	28	Chironomidae	1				
Microtendipes	2	Corynoneura	5				
Oligochaeta	5	Diplectrona	4				
Orthocladius	28	Glossosoma	1				
Parametriocnemus	1	Glossosomatidae	2				
Physidae	2	Hydropsyche	14				
Sympotthastia	1	Oligochaeta	1				
Tanypodinae	1	Orthocladiinae	1				
Tanytarsini	3	Orthocladius	2				
Tanytarsus	15	Paracricotopus	1				
Thienemannimyia	10	Parametriocnemus	8				

Tipula	2	Physidae	1				
Tvetenia	1	Polypedilum	2				
		Simulium	1				
		Sympotthastia	5				
		Tanytarsus	1				
		Thienemanniella	1				
		Tipula	3				
		Trichoptera	1				
		Tvetenia	8				
Total	121		76		151		161

9.4.3 Reference Site Monitoring

Baltimore County has been monitoring eight (8) reference sites since spring of 2001. GIS was used to identify watersheds within the County that contained greater than 50% forested land use and less than 20% urban land use. An initial suite of twenty-one (21) sites was reduced to eight (8) sites for future monitoring based on land use, chemical, and stream physical habitat benchmarks. The ADC map site locations, along with the stream name are displayed in Table 9-12.

Table 9-12: Reference Site Locations

Station	Stream Name and Location	ADC Map, Grid
REF-001	Baisman Run upstream of Ivy Hill Road	18 C5
REF-004	Poplar Run upstream of Gunpowder Road	1 H11
REF-009B	Springhouse Run downstream of Gunpowder Rd	1 H8
REF-012	Panther Branch upstream of Gunpowder Falls	7 H8
REF-013	Mingo Branch upstream of Gunpowder Falls	7 C7
REF-015	Charles Run upstream of Gerting Road	8 F11
REF-017	Sunnyking Run near Sunnyking Drive	24 A3
REF-019	Fourth Mine Branch upstream of Stablers Church Road	3 H12

The eight sites are sampled annually for benthic macroinvertebrates in the spring index period using MBSS sampling protocols. The samples are sorted and identified in the laboratory to genus or the lowest practical taxonomic level. The metrics in Table 9-6 are used to calculate BIBIs. Fish sampling is done only periodically to reduce stress to the naturally reproducing trout populations inhabiting these streams. REF-009B was confirmed in 2008 as a replacement site for original reference site REF-009, which is no longer sampled due to loss of landowner permission. The new site is located downstream of REF-009 on Prettyboy Reservoir Watershed property.

All reference sites have had BIBI values in the Good range in at least some years since sampling began (Figure 9-19). Sites exhibited their greatest variability in 2003. Over the entire 6-year record, median BIBI values have been Fair to Good, although four of the eight sites have had BIBI values in the Poor range (Figure 9-20).

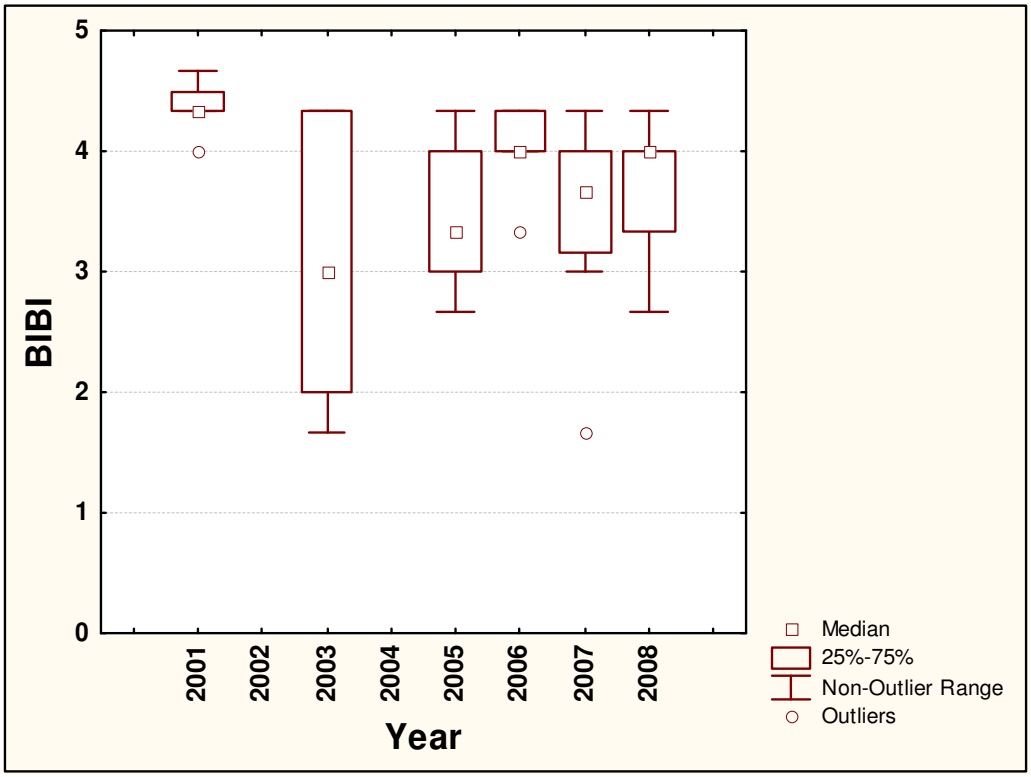


Figure 9-19: Box and Whisker Plot of Reference Site BIBI Values by Year

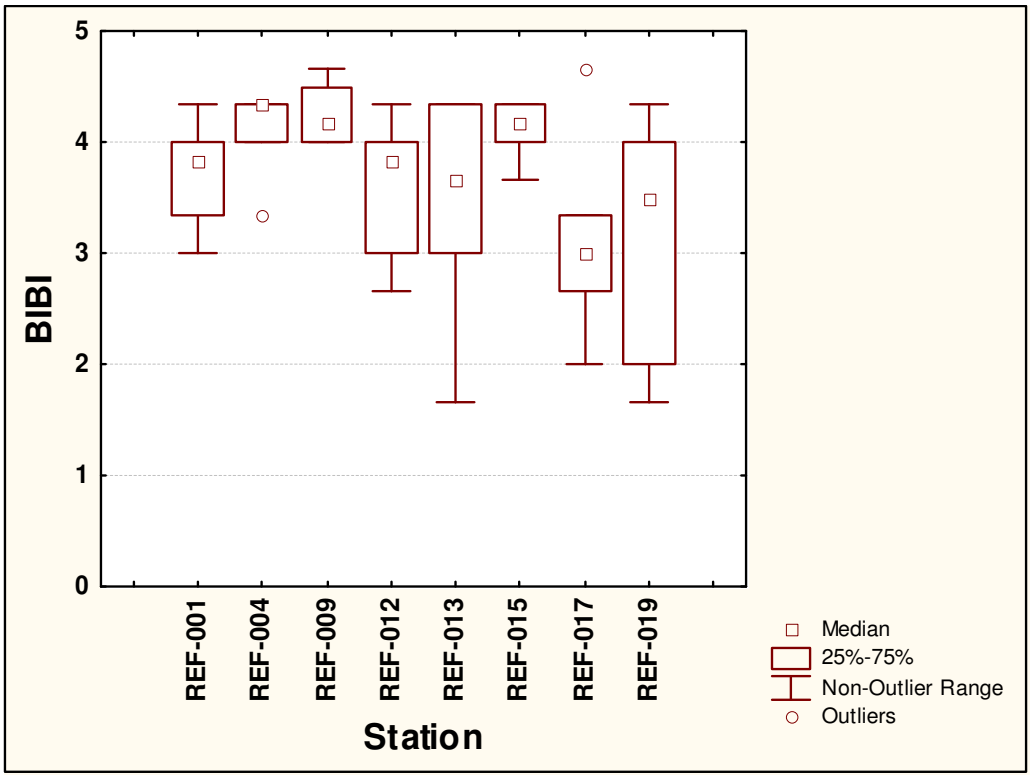


Figure 9-20: Box and Whisker Plot of Reference Site BIBI Values by Site

Of the four sites exhibiting periodically poor benthic biology, Panther Branch (REF-012) and Mingo Branch (REF-013) have impervious surface in their headwaters, which conveys pollutant-laden stormwater to the stream. Sunnyking Run (REF-017) is unique among all the other sites in that it flows through serpentine barrens at Soldiers Delight Natural Environmental Area. Finally, Fourth Mine Branch (REF-019) has the largest amount of agricultural land use among the reference sites.

Stream physical habitat was assessed following Maryland Save Our Streams protocols in 2001-2003 and MBSS protocols since 2005. In the previous NPDES report, an attempt was made to standardize the different protocols to report habitat conditions since 2001. In this report, the MBSS Physical Habitat Index will be reported for data recorded since 2005. Minimally degraded sites have PHI scores of 81-100, partially degraded sites have PHI scores of 66-80, degraded sites have PHI scores of 51-65, and severely degraded sites have PHI scores of 0-50. Figure 9-21 shows mean PHI scores for reference sites since 2005. On average, all sites have partially degraded habitat, except for REF-012, Panther Branch, which is minimally degraded. REF-013 (Mingo Branch), REF-017 (Sunnyking Run), and REF-019 (Fourth Mine Branch) had lower and more variable PHI scores than the other reference sites. The differences in physical habitat condition at these sites are likely related to the upstream land use, as mentioned in the discussion of benthic community condition at these sites.

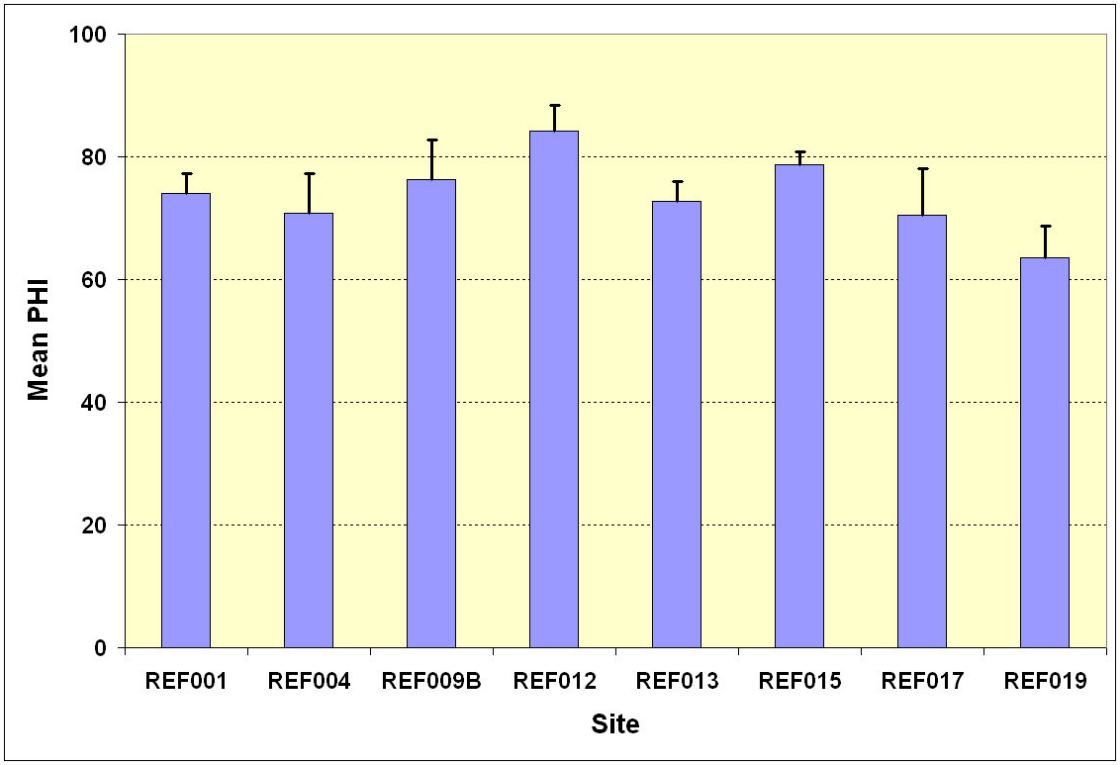


Figure 9-21: Mean and One Standard Deviation of PHI Scores for Reference Stations Since 2005.

To examine how the reference sites might be used to gage the performance of other Baltimore County assessment sites, BIBI and PHI scores of reference sites and WDVL-1 (the restored site for the Wood Valley stream restoration project) are shown in Figure 9-22. Biological and physical habitat conditions are clearly better at the reference sites, but Figure 9-22 also shows that BIBI scores were slightly higher in 2008 then they were in 2007 at both the reference sites

and Wood Valley. Physical habitat conditions have been relatively constant at the reference sites, while physical habitat gradually improved between 2005 and 2007, with a slight decrease in condition between 2007 and 2008 at Wood Valley. These observations suggest that benthos were responding to patterns of climate or precipitation, rather than to changes in physical habitat condition. Thus, it appears that the reference sites are performing their intended function, that is, providing a benchmark with which to compare stream biological condition in other, anthropogenically-affected streams. Benthic macroinvertebrate communities of the reference sites seem to be responding to physical and climactic influences in predictable ways, and should prove useful in assessing human-induced changes to other Baltimore County streams.

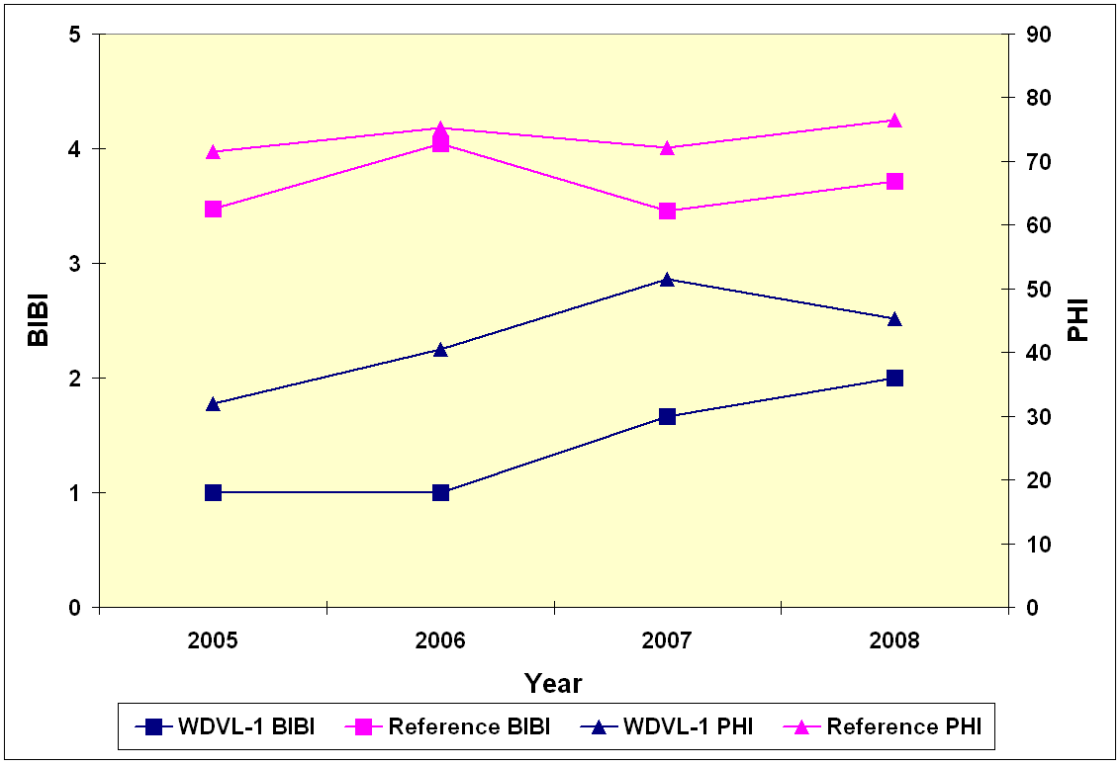


Figure 9-22: BIBI and PHI values for WDVL-1 and Reference Sites

9.4.4 Submerged Aquatic Vegetation Monitoring Program

Baltimore County has conducted Submerged Aquatic Vegetation monitoring since 1989 on certain waterways. With the advent of water quality standards for submerged aquatic vegetation, reporting on the monitoring results commenced in the 2006 NPDES Annual Report. During the last Water Quality Standards Triennial Review Maryland Department of the Environment adopted standards for tidal water submerged aquatic vegetation and water clarity, among other standards also adopted. The standards are based on water quality segments that are derived from the Chesapeake Bay Program model. There are a total of seven segments in Baltimore County tidal waters. Three of the segments (MIDOH, GUNOH1, and BACOH) are entirely within Baltimore County tidal waters. Four other segments have tidal waters that extend to other jurisdictions. Two of these segments (CB2OH and CB3MH) are Chesapeake Bay mainstem segments and extend to the eastern shore of Maryland. The Chesapeake Bay Program draft document *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries 2006 Addendum* provides guidance on

assessing the attainment of the SAV acreage criteria. The document states "the shallow-water bay grass designated use is considered in attainment if there are sufficient acres of SAV observed within the segment or there are enough acres of shallow-water habitat meeting the applicable water clarity criteria to support restoration of the desired acres of SAV for that segment." The recommended procedure is to use the **single best year SAV acreage** based on the most recent three-year period of available data. The criteria may also be met by attaining water clarity acres for the most recent three-year period of available data. The water clarity depth varies by tidal segment (see Table 9-13). Water clarity data is currently not collected in Baltimore County, so only the SAV acreage will be used.

The draft 2009 Triennial Review of Water Quality Standards, currently open for public comment, proposes several changes that affect the SAV criteria. First, the tidal segment BACOH, which covers tidal Back River, has had a change in the target SAV acreage goal from 0 to 340 acres. Secondly, credit for meeting water clarity standards in areas with no SAV have changed from an acre by acre basis to 2.5 acres per acre basis. In other words, using Back River as an example, if no SAV were present in Back River, water clarity standards would have to be met for 850 acres (340 acres SAV goal X 2.5).

Baltimore County monitors SAV distributions in the spring and summer of each year in accordance with the US Fish and Wildlife methodologies. There are currently 29 waterways in the County that are monitored. In order to assess the total acres of yearly coverage for the creeks surveyed, the data for the spring and summer were analyzed for overlap in SAV distribution between the two seasons. The total SAV coverage for each year is calculated by the following formula:

$$\textbf{Total SAV}_{\textbf{acres}} = (\textbf{Spring SAV}_{\textbf{acres}} - \textbf{Overlap}_{\textbf{acres}}) + (\textbf{Summer}_{\textbf{acres}}\ \textbf{SAV} - \textbf{Overlap}_{\textbf{acres}}) + \textbf{Overlap}_{\textbf{acres}}$$

To estimate the progress in meeting the SAV goal for each tidal segment the Total SAV_{acres} are divided by the SAV goal for that segment. Only two of the seven segments are totally within Baltimore County jurisdiction and therefore can be assessed for SAV criteria attainment. However, these two segments are not intirely surveyed for SAV coverage and so, like the other five segments this analysis will only provide a conservative estimate of SAV criteria attainment.

Table 9-13 presents the SAV water quality standard for each segment and the results of the last three years of SAV monitoring. The yellow highlighted water quality segments lie entirely within Baltimore County. The red highlighted cells are the highest percent attainment for each water quality segment based on the last three years of data.

Table 9-13: SAV Standards and Baltimore County SAV Monitoring Results (2006-2008)

Water Quality Segment	SAV Goal (Acres)	Water Clarity Depth (m)	2006		2007		2008	
			Acres	% of Goal	Acres	% of Goal	Acres	% of Goal
MIDOH	879	2.0	234	26.7	240.7	27.3	518.0	58.9
GUNOH1	1,860	0.5	**	**	**	**	**	**
GUNOH2	572	2.0	84	14.7	194.4	33.9	187.7	32.8
BACOH	340	0.5	5	1.5	6.3	1.9	0	0
PATMH	389	1.0	5	1.3	9.0	2.3	6.1	1.6
CB2OH	705	0.5	152	21.6	133.8	19.0	197.9	28.1
CB3MH	1,370	0.5	55	4.0	44.3	3.2	77.4	5.6
Total SAV Acres			**535.0**		**628.5**		**987.1**	

** No monitoring conducted by Baltimore County in this segment.

The Middle River segment (MIDOH) has consistently the highest acreage of SAV coverage each year. In 2004 Middle River attained 54.9% of the SAV criteria. 2008 saw a resurgence of SAV in Middle River with a total of 518 acres representing ~59% of the goal. Back River has the least amount of SAV coverage over the three-year period and is far from meeting the new draft criteria of 340 acres of SAV coverage. Overall, the SAV coverage has increased in each of the last three years of monitoring, with almost 1,000 acres of coverage in 2008. Since not all of the county tidal waters are monitored through this program, the numbers represent a conservative estimate of progress in meeting the SAV goals. The Gunpowder segment (GUNOH1) is not monitored by Baltimore County.

Figure 9-23 displays the trends in SAV coverage over 20 years of monitoring. The figure displays the percent of the area survey that was covered by SAV. As can be seen from the figure there is a generally increasing trend in the percent of the area surveyed that is covered by SAV from a low in 1989 of 0.37% to a high of 27.4% in 2008. While there is a certain degree of variability, possibly related to climatic events (record wet year in 2003 with reduced % coverage) the overall trend is improved coverage.

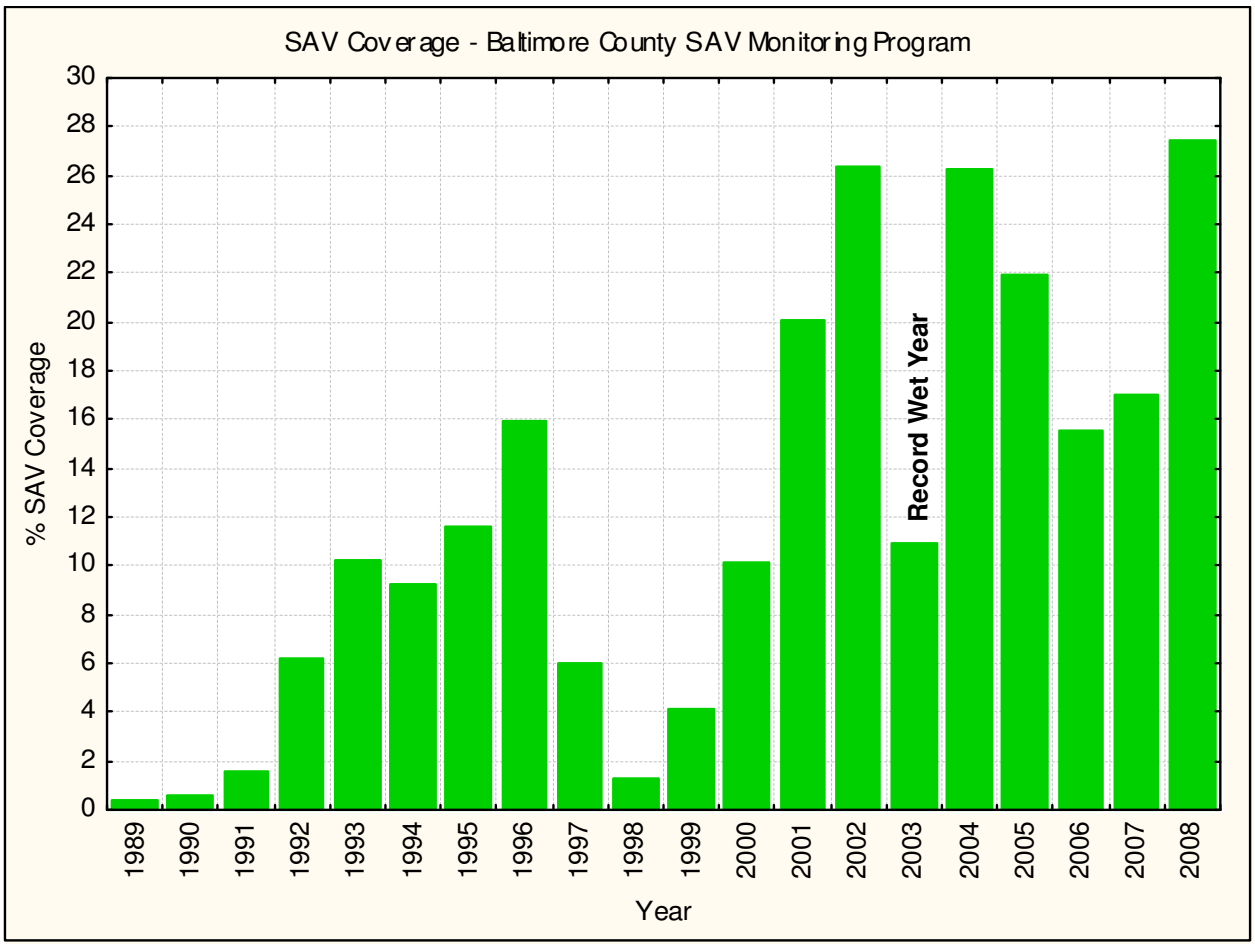


Figure 9-23: Baltimore County SAV Monitoring Program – Trends in % Coverage

9.5 Status of Brook Trout in the Prettyboy Reservoir Watershed

9.5.1 Introduction

The plight of wild brook trout (*Salvelinus fontinalis*) in Maryland streams has been documented in increasing detail in recent years. Brook trout have disappeared from streams and entire watersheds as a result of various land uses that have disrupted stream functions vital to their survival. Elevated water temperature is the most frequent result of anthropogenic activities that influence the distribution of brook trout. Brook trout require suitable water temperature regimes for optimal feeding, growth, and reproduction. The Code of Maryland Regulations established a water temperature threshold of 20 °C for naturally reproducing trout streams, while the United States Environmental Protection Agency established a maximum weekly average temperature threshold of 24 °C for brook trout (US EPA, 1986).

The Maryland Department of Natural Resources (MD DNR) has listed brook trout as a Species of Greatest Conservation Need in its Wildlife Diversity Conservation Plan. Recently, the Prettyboy Reservoir Watershed Restoration Action Strategy (WRAS) was completed. The WRAS was a cooperative effort among citizen-based organizations and state and local government agencies. The goal of the WRAS was to develop a plan of action that promotes the overall (aquatic and terrestrial) ecological health of the Prettyboy Watershed. The plan includes restoration, education, and monitoring actions. This report presents first-year results in support of one of the monitoring actions of the WRAS: to monitor brook trout population trends in streams draining Prettyboy Reservoir. The work was a joint venture among MD DNR Fisheries Service, Baltimore City Reservoir Natural Resources Section (BC RNR), Carroll County Bureau of Resource Management (CC BRM), and Baltimore County Department of Environmental Protection and Resource Management (BC DEPRM).

The overall goal of this study is to assess the current extent of wild brook trout in the Prettyboy Reservoir watershed. The brook trout population data, as well as water temperature and physical habitat data, will also be used to establish fixed sampling stations where the variability/long-term stability of brook trout populations may be evaluated. Physical habitat and riparian zone conditions will be examined to isolate streams where habitat improvement measures may bolster brook trout populations. Therefore, the objectives of the study were to (1) determine brook trout distribution and abundance, (2) measure air and water temperature regimes, (3) assess physical habitat quality, and (4) document brook trout spawning activity.

9.5.2 Methods

Historical brook trout sampling data from MD DNR and BC DEPRM were reviewed to identify streams which had not been previously sampled for brook trout, or which had not been sampled for brook trout for longer than 3-5 years. Brook trout distribution and density data were also used to select streams for thermal monitoring. We attempted to include streams that had high, medium, and low densities of brook trout. We originally selected 19 stations for thermal monitoring and brook trout sampling (Table 9-14), with the understanding that the number of stations might increase or decrease, depending upon staff and time availability and landowner permission for private property. Ultimately, 24 stations were monitored for air temperature, water temperature, or brook trout. Figure 9-24 shows the location of the monitoring stations.

Water temperature was measured at 19 stations using Onset HOBO® Pendant continuously recording thermometers. Thermometers were deployed between April 11 and April 29, 2008 by

attaching them with cable ties to stable instream structures (tree roots, for example). Thermometers were set deep enough below the stream surface so that they would not be exposed to the air during low summer stream flow. At each station, the serial number of each thermometer, latitude, longitude, and time of deployment were recorded. A Maryland Biological Stream Survey (MBSS) Spring Index Period physical habitat assessment was completed at each station. On May 7, 2008, Onset HOBO® Water Temp Pro continuously recording thermometers were deployed at ten stations to measure air temperature. Air temperature was not measured at all stations due to limited availability of temperature sensors. Thermometers were recovered between November 12 and 20, 2008.

Several stream reaches were examined for the presence of brook trout redds and spawning pairs of brook trout on days when thermometers were recovered. These observations were an initial attempt to develop a reasonable technique to standardize redd counts and gage the amount of spawning activity. Only gravel in the classic "pit and mound" formation was counted.

Electrofishing was conducted between June 19 and September 19, 2008. At minimum, a 75-m reach was sampled at each station, using the two-pass removal method with Smith-Root® LR12 backpack electrofishing units. All fish species were identified, counted, and weighed. Brook trout young-of-year and brook trout adults were counted and weighed separately. Non-trout fish species were weighed in aggregate. In the case of wider streams (average width >5m), or in reaches where sufficient adult brook trout habitat was not present in 75-m, longer reaches were sampled. "Sufficient adult brook trout habitat" was defined as at least one pool within the reach with depth > 0.5 m and containing overhead cover (i.e., stable boulders, logs, or undercuts). The length beyond 75-m sampled was based on the best professional judgment of the sampling crew. At these longer stations, only brook trout were collected beyond the first 75-m. The MBSS Fish Index of Biotic Integrity (FIBI) was calculated for each station. An MBSS Summer Index Period physical habitat assessment was completed at each station. Physical habitat data were converted to physical habitat index (PHI) scores.

Data analyses were exploratory and consisted of comparisons of water temperature, trout abundance and biomass, FIBI, and PHI among stations, although two relationships were statistically tested. Linear regression was used to test for relationships between percent watershed forest cover and maximum daily water temperature, and percent watershed forest cover and PHI. This was done primarily because of the limited data set. More rigorous statistical testing will be done after a second field season of data from a wider geographic area has been collected.

9.5.3 Results and Discussion

Brook trout were found at 12 of the 19 stations surveyed (Table 9-15). No individuals of any fish species were collected at station BC-09. The highest density of adult brook trout was found at BC-05 (476 trout/ha). The presence and abundance of brook trout was not reflected in FIBI values (Tables 9-15 and 9-16). The stations with the highest FIBI values (BC-06 and BC-13) had moderate (BC-06) or absent (BC-13) brook trout populations. Non-brook trout fish species were present at all stations except BC-09 (Table 9-18). The number of species ranged from one (BC-08) to 15 (BC-12).

Of the 19 water temperature sensors deployed, two (BC-06 and BC-10) were not found. Therefore, water temperature data is presented for 17 stations (Table 9-17). Station BC-11 had the highest maximum daily temperature (28.5 °C); 45.9% of all station readings at BC-11 were

greater than 20 °C. Four stations had temperature readings greater than 24 °C (Table 9-17). Interestingly, the only station with no fish present (BC-09) also had no water temperatures exceeding 20 °C. Northern Baltimore County experienced an extreme drought between 2001 and 2002. It is likely that this stream went dry and was never re-populated by fish. A significant relationship was found between percent forest cover and maximum daily water temperature ($p < 0.05$). As percent forest cover increased, maximum daily water temperature decreased. Of stations sampled for both brook trout and water temperature, the stations where brook trout were present had lower mean and maximum daily temperatures and lower proportions of readings greater than 20 °C than stations where brook trout were absent.

Figure 9-25 shows graphs of maximum daily air and water temperatures, for stations where both air and water temperatures were measured. Water temperatures generally remained stable relative to air temperature. One exception was station BC-11, where air temperature appeared to have a greater influence over water temperature than at other stations. BC-11 had the most agriculture and least forest cover of all stations surveyed. It is also possible that there is less groundwater influence in this stream than in the others surveyed.

As noted in Table 9-15, no brook trout were collected from station CC-03 during the survey. Angler reports to the Maryland DNR Fisheries service suggest a small, seasonal population of brook trout in this reach of Gunpowder Falls (M. Staley, personal communication). Qualitative sampling was done in the best available habitat, downstream of the station reach, in an attempt to document the presence of this population. Two adult brook trout were found in one deep pool. Water temperatures in this reach of Gunpowder Falls were already routinely greater than 20 °C prior to the survey date (June 19). It is likely that brook trout use this and similar pools as thermal refuge, as water temperatures at the bottom of the pool were probably several degrees colder than water temperatures throughout the reach. This would be due to the depth, the presence of a stream bottom spring or seep, or a lateral spring or seep from the stream bank. It is also likely that other brook trout had migrated to small, cold-water tributaries to escape the already warm temperatures. Seasonal, temperature-induced migration of salmonids is a well-documented phenomenon.

Physical habitat data were converted to physical habitat index (PHI) scores and rated using criteria from Southerland et al (2005). Minimally degraded stations had PHI scores of 81-100, partially degraded stations had PHI scores of 66-80, degraded stations had PHI scores of 51-65, and severely degraded stations had PHI scores of 0-50. Physical habitat was minimally degraded at 4 stations, partially degraded at 7 stations, degraded at 6 stations, and severely degraded at one station (Table 9-16). In general, remoteness was the lowest rated habitat parameter at each station, reflecting an extensive network of roads, even in this less developed portion of Baltimore County. Fifteen of 17 stations had sub-optimal or lower remoteness scores. Half of the stations had shading of 90% or greater. Epifaunal substrate and instream fish habitat averaged in the high sup-optimal category. Values for the number of pieces of instream wood and instream root wads were generally low (mean=2.0). Bank stability averaged optimal, while riffle quality was sub-optimal. Nine stations had embeddedness ratings of 50% or greater, which suggests that sedimentation is a significant factor in overall habitat quality. There was no relationship between PHI and the percentage of forest cover. The PHI and individual habitat parameters generally did not differ between stations where brook trout were present and stations where brook trout were absent, with two exceptions. Stations where brook trout were absent had twice as much instream wood as stations where brook trout were present. Stations where brook trout

were present had greater watershed forest cover (46%) than stations where brook trout were absent (39%, Table 9-19).

Brook trout redd counts revealed that spawning activity was limited to short stream reaches and consisted of only a small number of redds (Table 9-20). The procedures used during the first year of the study will be used to construct a more rigorous, standardized method to characterize brook trout spawning effort. These observations highlight the extremely fragile nature of wild brook trout populations in the Prettyboy watershed.

Our initial data show that brook trout are widely distributed in streams of the Prettyboy watershed, with variable population sizes. The stability of water temperature relative to air temperature suggests that groundwater may play a major role in providing suitable temperatures for brook trout, but more data are needed to discriminate between influence of groundwater and riparian tree canopy. Although riparian and instream physical habitat are significantly altered, brook trout are able to exploit the available habitat. High population densities in several of the sampled streams shows that despite hundreds of years of landscape alteration in the piedmont of Central Maryland, wild brook trout are still able to thrive, given the proper physical and chemical conditions.

9.5.4 References

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US EPA. 1986. Quality criteria for water: 1986. EPA 440/5-86-001. U. S. Environmental Protection Agency, Office of Water Regulations and Standards. Washington, D. C.

Table 9-14: Prettyboy Reservoir brook trout and thermal monitoring stations.

Station	Stream	Location	Electrofishing	Water Temperature	Air Temperature
BC-01	Gunpowder Falls	Downstream of Gunpowder Rd	X	X	
BC-02	Walker Run	Gunpowder Rd		X	
BC-03	Silver Run	Hoffmanville Rd		X	
BC-04	UNT	Clipper Mill Rd	X	X	X
BC-04B	UNT	Hoffmanville Rd	X		
BC-05	UNT	Clipper Mill Rd	X	X	X
BC-06	UNT	Kidds Schoolhouse Rd	X	X	X
BC-06B	UNT	Bulls-Sawmill Rd	X		
BC-06W	UNT	West of BC-06	X		

BC-07	Frog Hollow	Spook Hill Rd	X	X	X
BC-08	UNT	Armacost Rd	X	X	
BC-09	UNT	Prettyboy Dam Rd	X	X	X
BC-10	UNT Prettyboy Branch	Traceys Store Rd	X	X	X
BC-11	Prettyboy Branch	Traceys Store Rd	X	X	X
BC-12	Compass Run	Gunpowder Rd	X	X	X
BC-13	Grave Run	Gunpowder Rd	X	X	X
BC-14	Poplar Run	Gunpowder Rd		X	X
BC-16	UNT	Cotter Rd	X		
BC-17	UNT	Cotter Rd	X		
CC-01	UNT			X	
CC-02	UNT			X	
CC-03	Gunpowder Falls	Upstream of Gunpowder Rd	X	X	
CC-04	Grave Run	Millers Station Rd	X	X	
CC-05	UNT			X	

Table 9-15: Prettyboy Reservoir brook trout population data.

Station	Adult trout Kg/ha	Adult trout/ha	Young-of-year/ha
BC-01	1	5	0
BC-04	4	125	1313
BC-04B	8	167	1083
BC-05	29	476	476
BC-06	6	120	160
BC-06B	2	54	514
BC-06W	0	0	929
BC-07	0	0	93
BC-08	0	0	0
BC-09	0	0	0
BC-10	0	0	0
BC-11	0	0	0
BC-12	0	0	0
BC-13	0	0	0
BC-16	6	120	40
BC-17	13	167	333
CC-03*	0	0	0
CC-04	0	0	67

*Two adult brook trout were captured downstream from the station during qualitative sampling. No lengths or weights were recorded.

Table 9-16: Fish Index of Biotic Integrity (FIBI) and Physical Habitat Index (PHI) Scores

Station	FIBI	Condition	PHI	Condition
BC-01	2.67	Poor	85.38	Minimally Degraded
BC-04	2.67	Poor	65.94	Degraded
BC-04B	1.67	Very Poor	69.29	Partially Degraded
BC-05	1.33	Very Poor	84.05	Minimally Degraded
BC-06	4.33	Good	65.03	Degraded
BC-06B	3.33	Fair	81.24	Minimally Degraded
BC-06W	3.33	Fair	71.78	Partially Degraded
BC-07	2.67	Poor	66.85	Partially Degraded
BC-08	1.00	Very Poor	71.87	Partially Degraded
BC-09	NA	NA	65.52	Degraded
BC-10	3.33	Fair	73.75	Partially Degraded
BC-11	3.67	Fair	56.58	Degraded
BC-12	3.67	Fair	70.86	Partially Degraded
BC-13	4.00	Good	75.79	Partially Degraded
BC-16	1.67	Very Poor	49.21	Severely Degraded
BC-17	1.33	Very Poor	51.07	Degraded
CC-03	3.33	Fair	90.73	Minimally Degraded
CC-04	3.67	Fair	52.48	Degraded

Table 9-17: Water Temperature Summary

Station	Mean temperature, °C	Maximum daily temperature, °C	% readings exceeding 20 °C	% readings exceeding 24 °C
BC-01*	17.8	25.3	33.5	1.0
BC-02*	16.2	21.7	5.0	NA
BC-03*	16.3	21.6	4.5	NA
BC-04	15.6	21.8	2.2	0.0
BC-05	15.0	22.6	1.1	0.0
BC-06	NA	NA	NA	NA
BC-07	15.9	21.6	4.3	0.0
BC-08	14.8	20.2	0.2	0.0
BC-09	15.0	19.8	0.0	0.0
BC-10	NA	NA	NA	NA
BC-11	18.9	28.5	45.9	9.0
BC-12	15.8	22.4	6.0	0.0
BC-13	16.4	23.7	14.8	0.0
BC-14	15.5	21.9	2.2	0.0
CC-01	16.4	22.7	6.6	0.0
CC-02	18.4	25.7	39.2	2.2
CC-03	17.8	25.2	32.8	0.7
CC-04	15.3	20.6	0.6	0.0
CC-05	17.1	23.4	17.8	0.0

* Water temperatures were measured hourly at these stations.

Table 9-18: Fish Community Composition

	Station																	
	BC-01	BC-04	BC-04B	BC-05	BC-06	BC-06B	BC-06W	BC-07	BC-08	BC-10	BC-11	BC-12	BC-13	BC-15	BC-16	BC-17	CC-03	CC-04
Blacknose dace		62	157	52	17	49	6	13	31	26	15	52	18	128	390	132	29	88
Blue Ridge Sculpin					104	115	53					131	56	147				135
Bluegill	1									5	2	2	4				7	
Bluntnose minnow					12		1	2					1					
Brook trout		23	15	20	7		12	3							4	6		1
Brown bullhead										1	5	14	3					
Central stoneroller	4				1					3	29	6					30	
Common shiner																	13	
Creek chub		4	16		4	10	2			27	20	14		3	33		2	45
Cutlips minnow																	3	
Fantail darter												4						
Golden shiner					1													
Green sunfish												1	1		2			
Largemouth bass	1	3			11	7	1	3		3	8	3	16					
Longnose dace	14							2		72	78	9	4	17			34	
Northern hogsucker	15												4				28	
Potomac sculpin	26	1															120	
Pumpkinseed																		
Redbreast sunfish					1		2	1				3					4	
River chub													1				2	
Rosyside dace						2						13		12			1	
Smallmouth bass	4																8	
Spottail shiner					4						5							
Tesselated darter					4		3	43		13	13	14	11					
White sucker	5	16		1	5					6	4	9	6				47	
Yellow bullhead					4		2	28				54	1					

Table 9-19: Land Use by Percentage

	Land Use				
	Agriculture	Forest	Residential	Commercial	Other
BC-04	47.7	46.1	6.2	0.0	0.0
BC-04B	60.8	30.5	8.7	0.0	0.0
BC-05	49.5	33.1	17.3	0.0	0.0
BC-06	29.5	55.8	14.0	0.7	0.0
BC-06B	28.2	54.0	17.0	0.8	0.0
BC-06W	29.5	59.5	11.0	0.0	0.0
BC-07	33.2	42.6	23.2	0.4	0.6
BC-08	44.1	55.2	0.7	0.0	0.0
BC-09	0.0	67.4	32.6	0.0	0.0
BC-10	61.1	31.3	7.6	0.0	0.0
BC-11	71.7	13.0	11.8	0.0	3.5
BC-12	46.6	26.4	27.0	0.0	0.0
BC-13	39.1	45.8	15.1	0.0	<0.1
BC-14	30.8	30.8	20.4	0.0	17.9
BC-16	58.7	32.5	7.3	0.8	0.7
BC-17	46.7	50.3	3.0	0.0	0.0

Table 9-20: Brook Trout Redd Counts

Stream	Date	Length of Reach (m)	Number of redds
Clipper Mill Road Tributary	11/14/08	900	0
Silver Run	11/05/08	450	4
Walker Run	11/05/08	400	2
	11/14/08	300	3

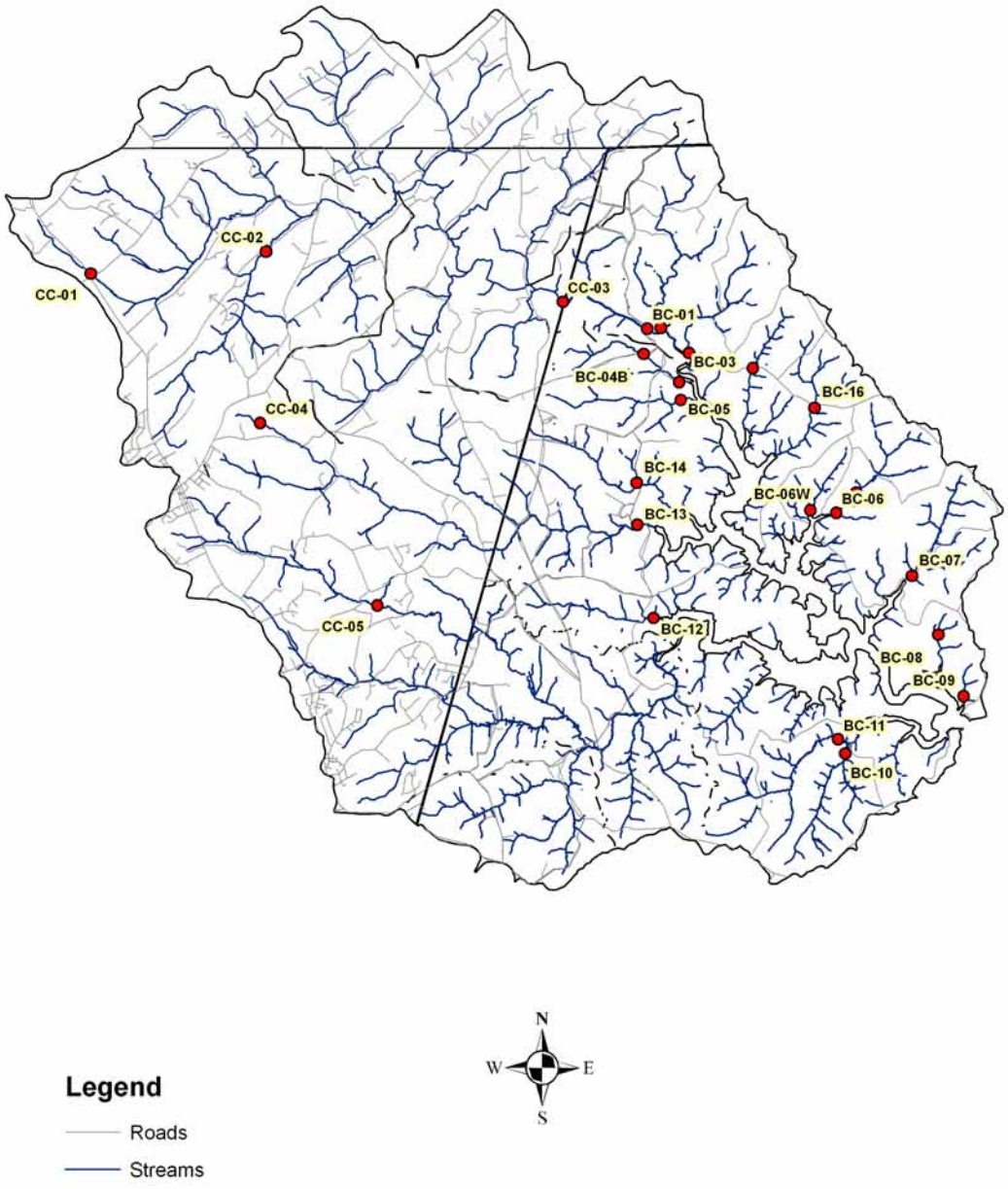
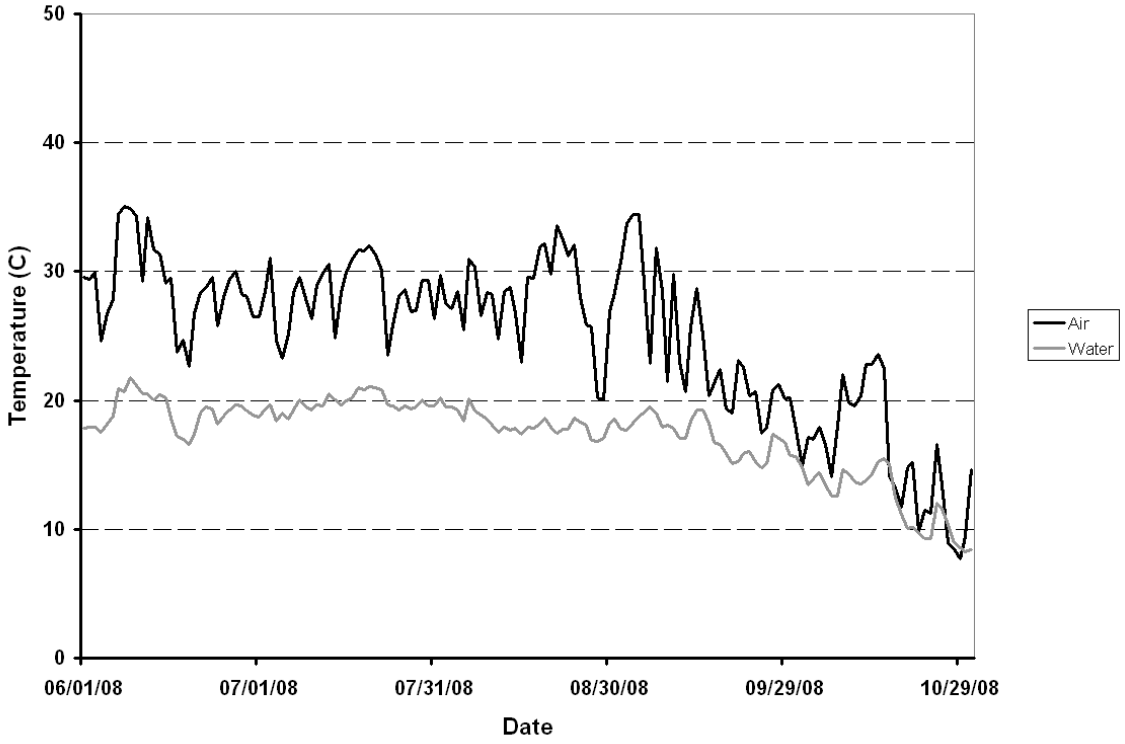


Figure 9-24: Locations of Prettyboy Reservoir Watershed Monitoring Sites.



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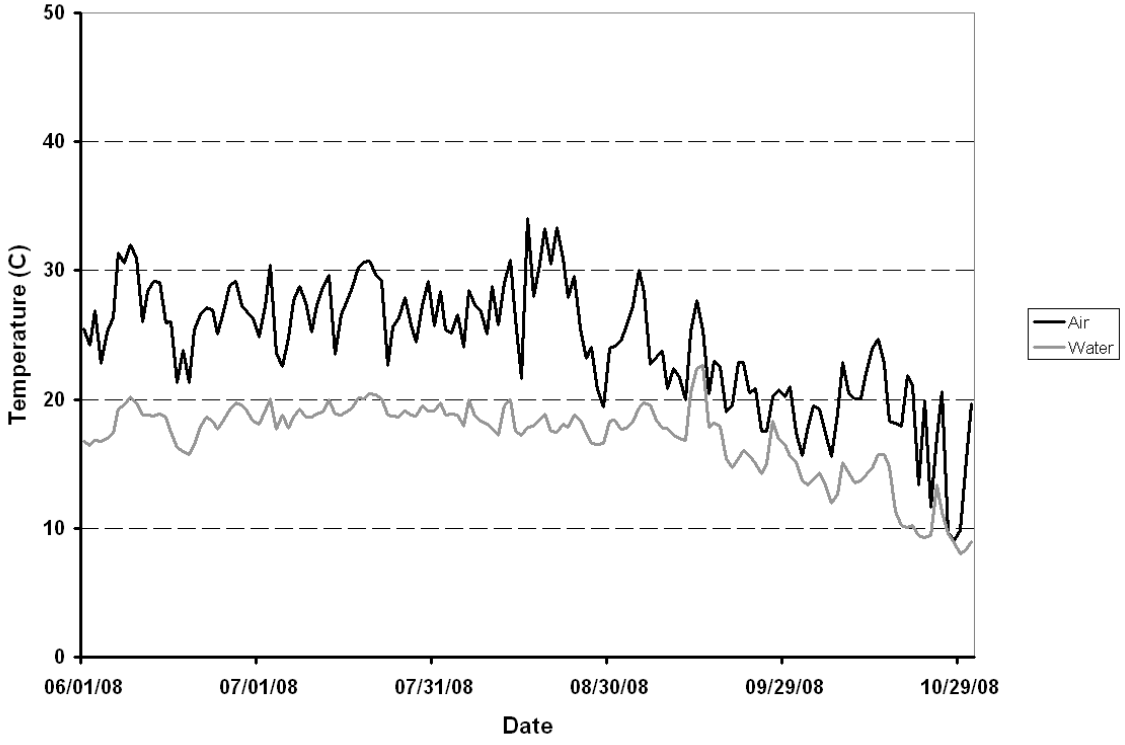
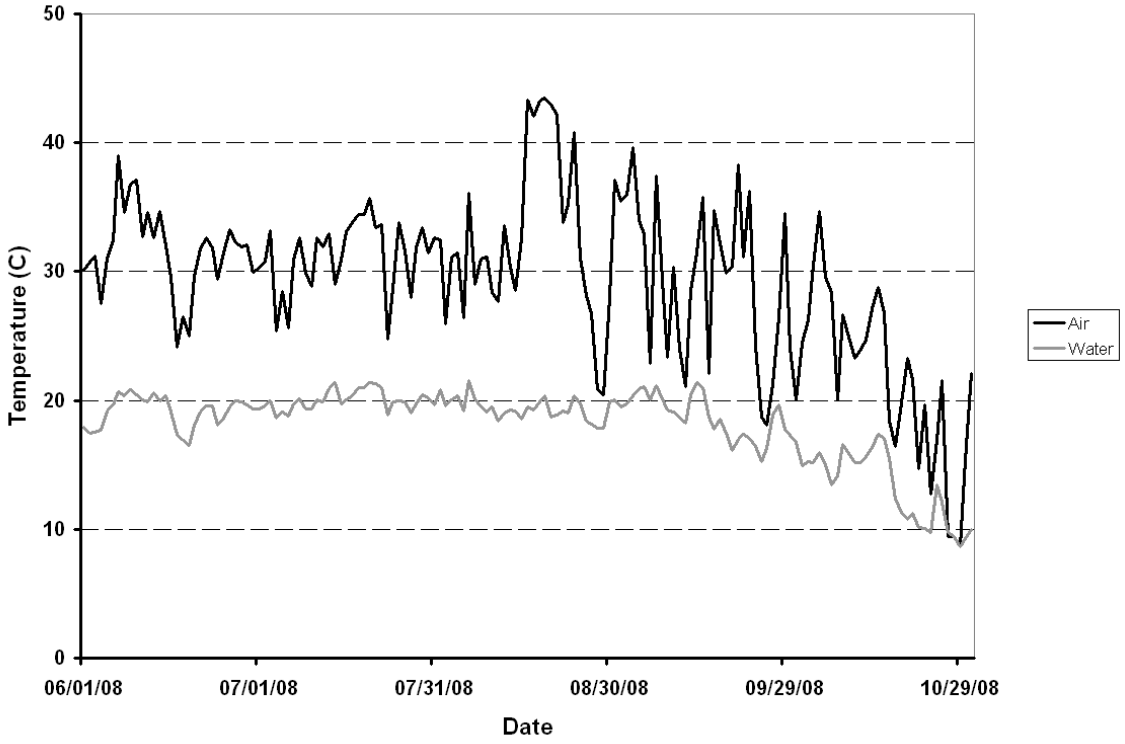


BC-05

Figure 9-25: Maximum Air and Water Temperatures at Prettyboy Stations.



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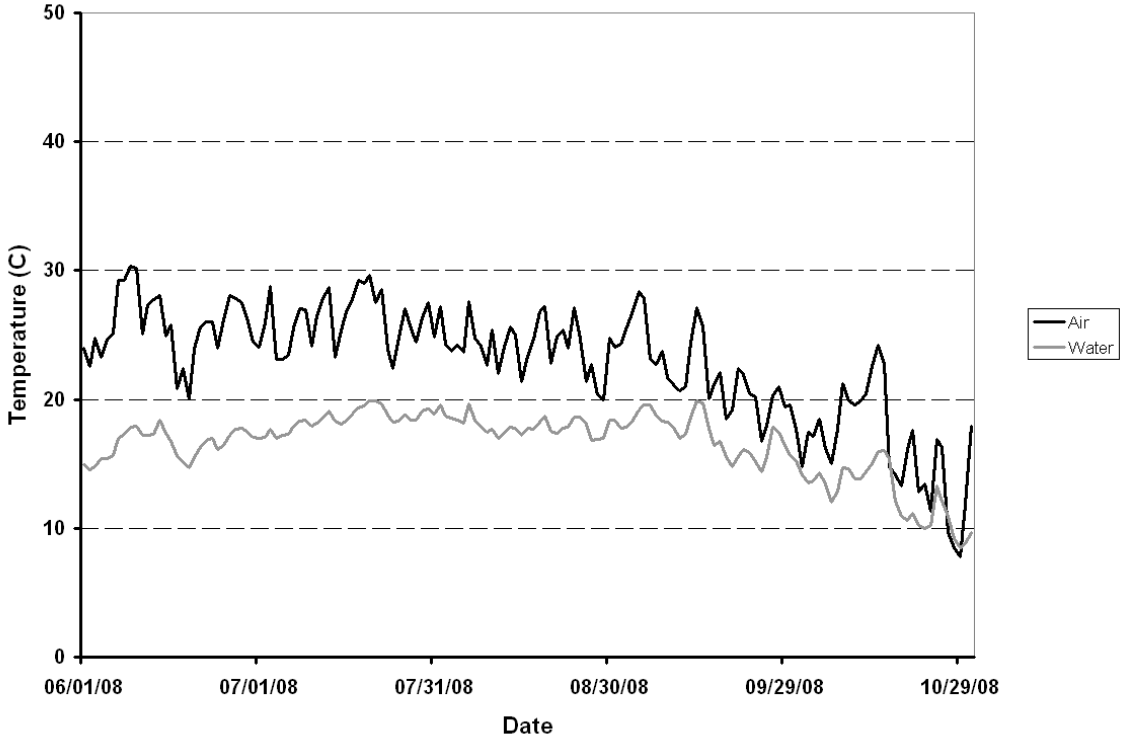

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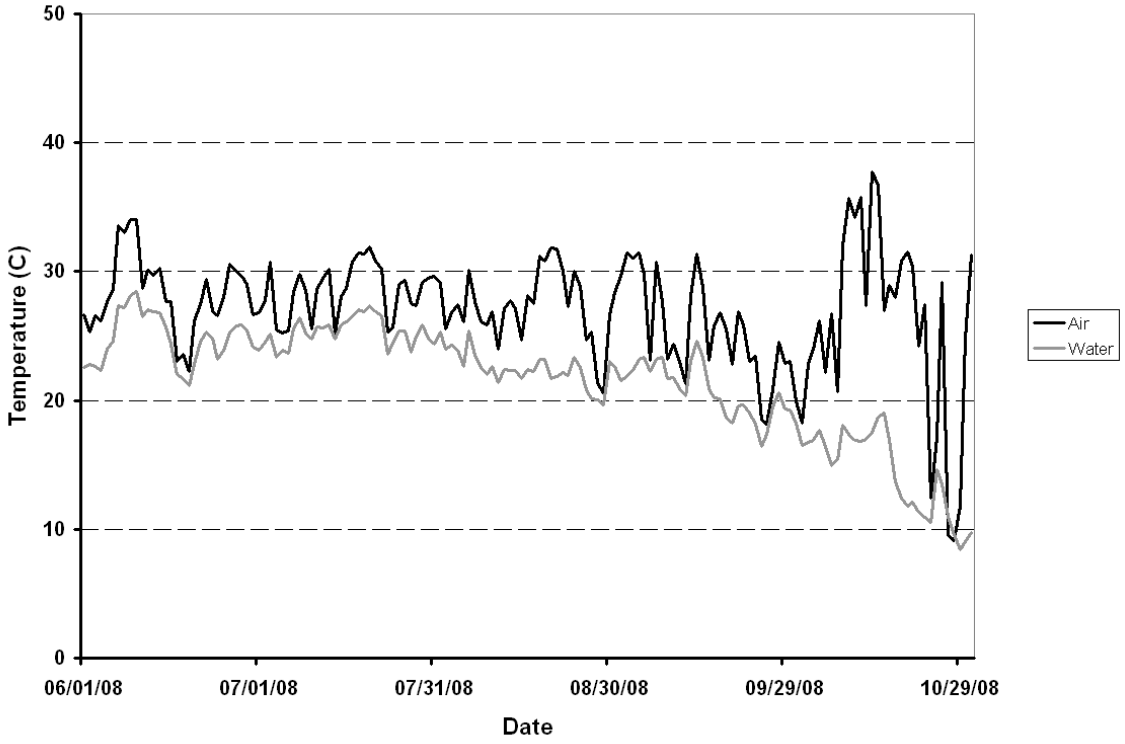
Figure 9-25 (cont.).



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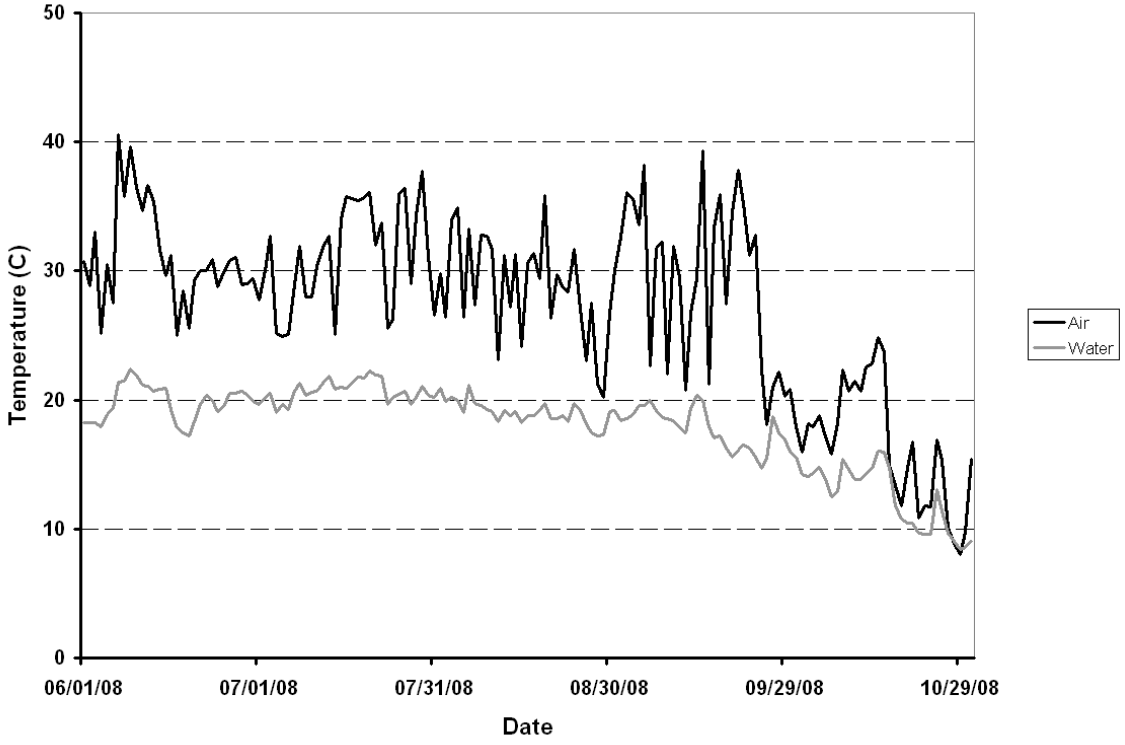

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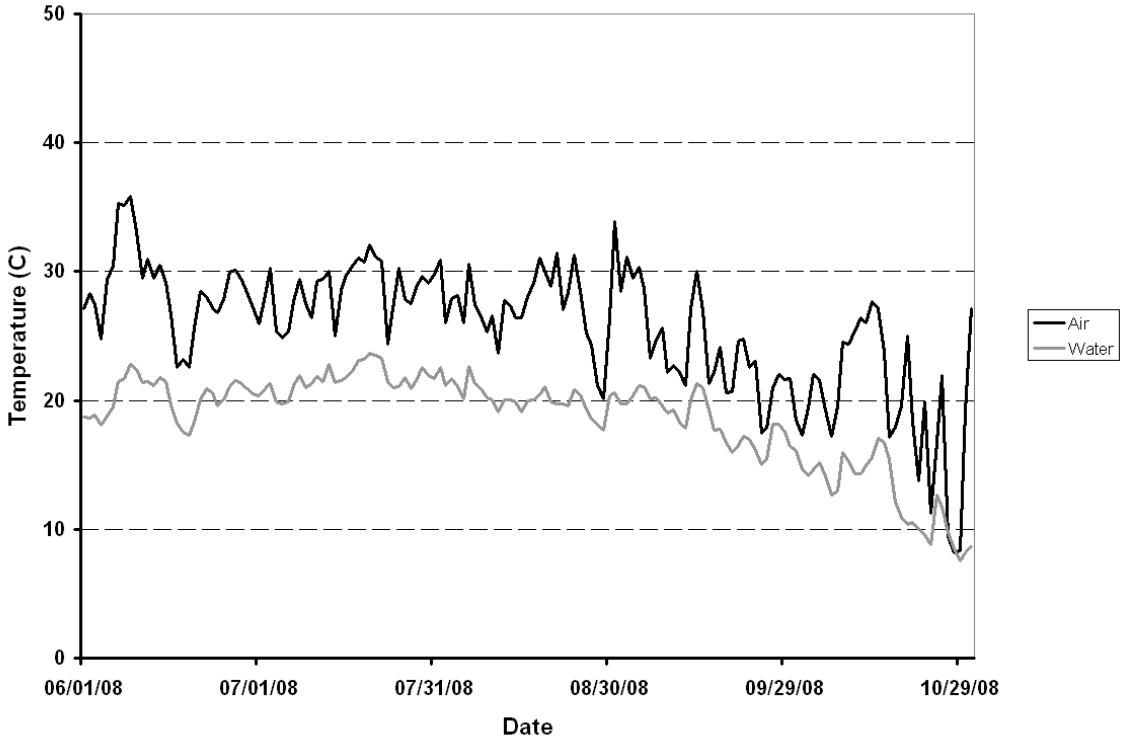

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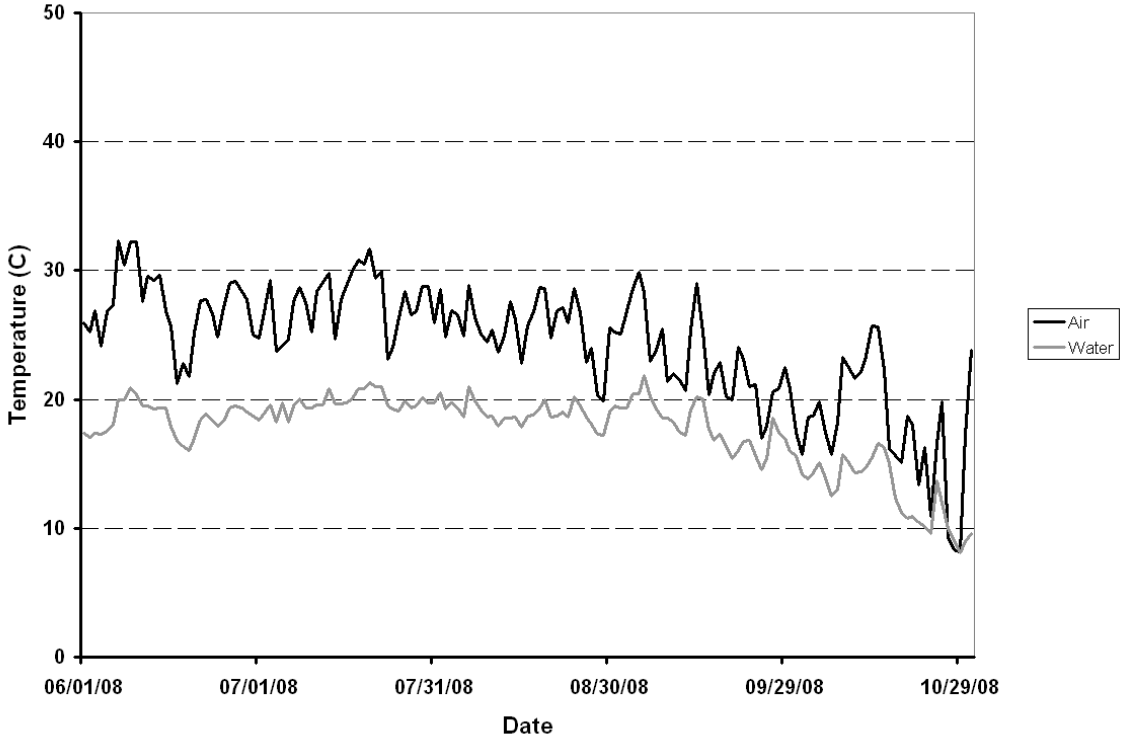

BC-14

Figure 9-25 (cont.).

9.6 Stream Corridor Assessment

9.6.1 Introduction

In 1998, the Maryland Clean Water Action Plan identified the Prettyboy Reservoir watershed as one of the State's water bodies that did not meet water quality requirements. In response to this finding, the Maryland Department of Environment (MDE) and Baltimore County formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Prettyboy Reservoir watershed. This Stream Corridor Assessment (SCA) survey is a result of recommendations that came out of the WRAS. It was recommended that the remaining sub-watersheds be surveyed that had not been completed prior to the completion of the WRAS. In Baltimore County this includes Direct Drainage 1, 2, 3, and 4, Gunpowder Falls, Muddy Creek and Indian Creek. These will be completed over a five-year schedule. Direct Drainage 3 and 4 were the first of this group to be surveyed and were completed in Winter 2009 (Figure 9-26).

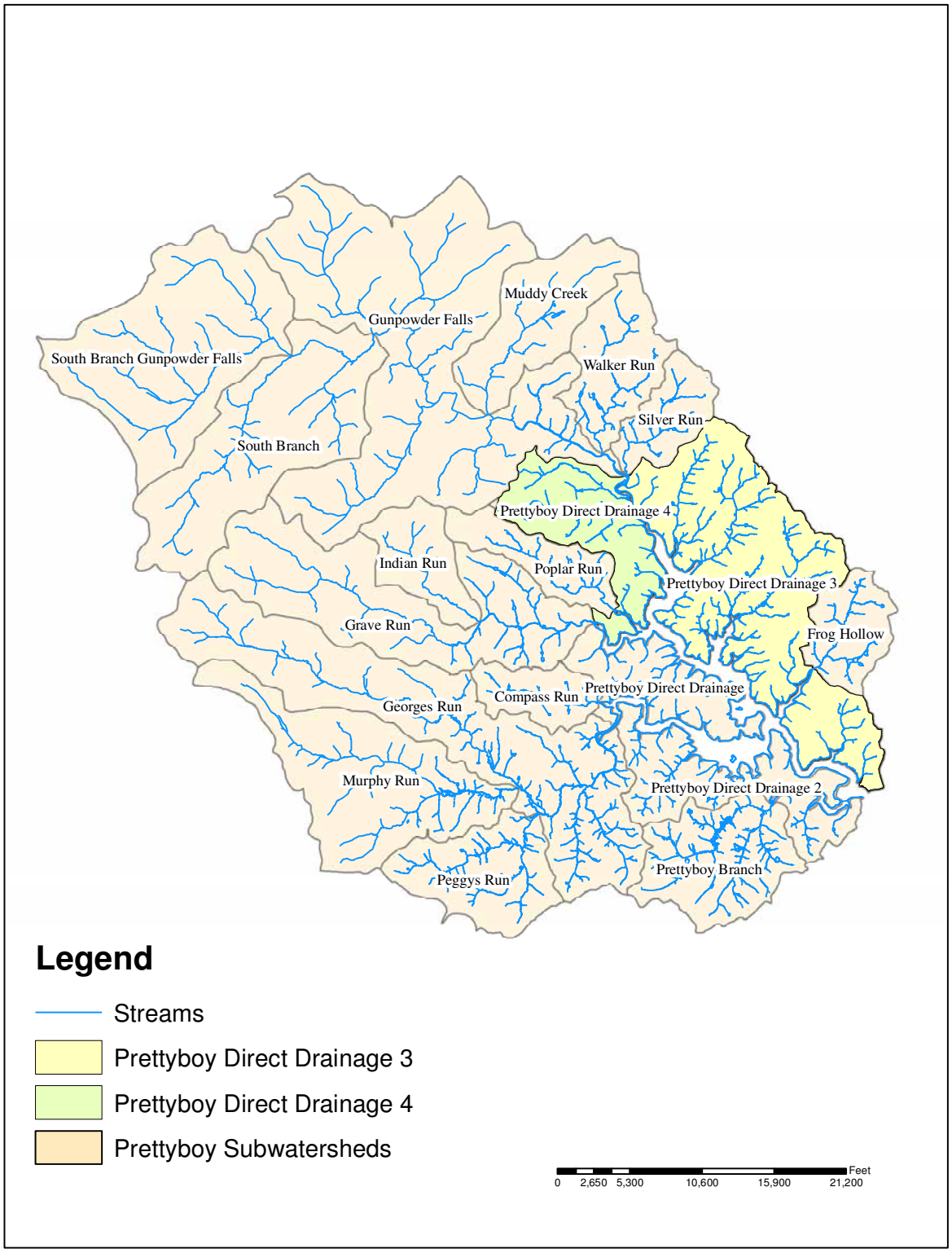

Figure 9-26 Map of Prettyboy Subwatersheds

The SCA survey provides descriptive and positional data for potential environmental problems along a watershed's non-tidal stream network. Developed by DNR's Watershed Services, the survey is a watershed management tool to identify environmental problems and helps prioritize restoration opportunities on a watershed basis. As part of the survey, specially trained personnel walk a watershed's streams and record data for several potential environmental problems that can be easily observed within the stream corridor. Each potential problem site is ranked on a scale of one to five for its severity, correctability, and access for restoration work.

9.6.2 Summary of Results

The Stream Corridor Assessment crew surveyed 40.8 miles of streams in the two sub-watersheds (Figure 9-27 and Table 9-21). They identified 76 potential environmental problems. At the time of the survey, the most frequently observed potential problem sites were erosion, reported at 30 sites. Other potential environmental problems recorded during the survey included: 6 fish barriers, 12 inadequate buffers, 6 pipe outfalls, 8 unusual conditions, 1 in or near streams construction and 13 trash dumping sites. Additionally, crews recorded descriptive habitat condition data at 60 representative sites.

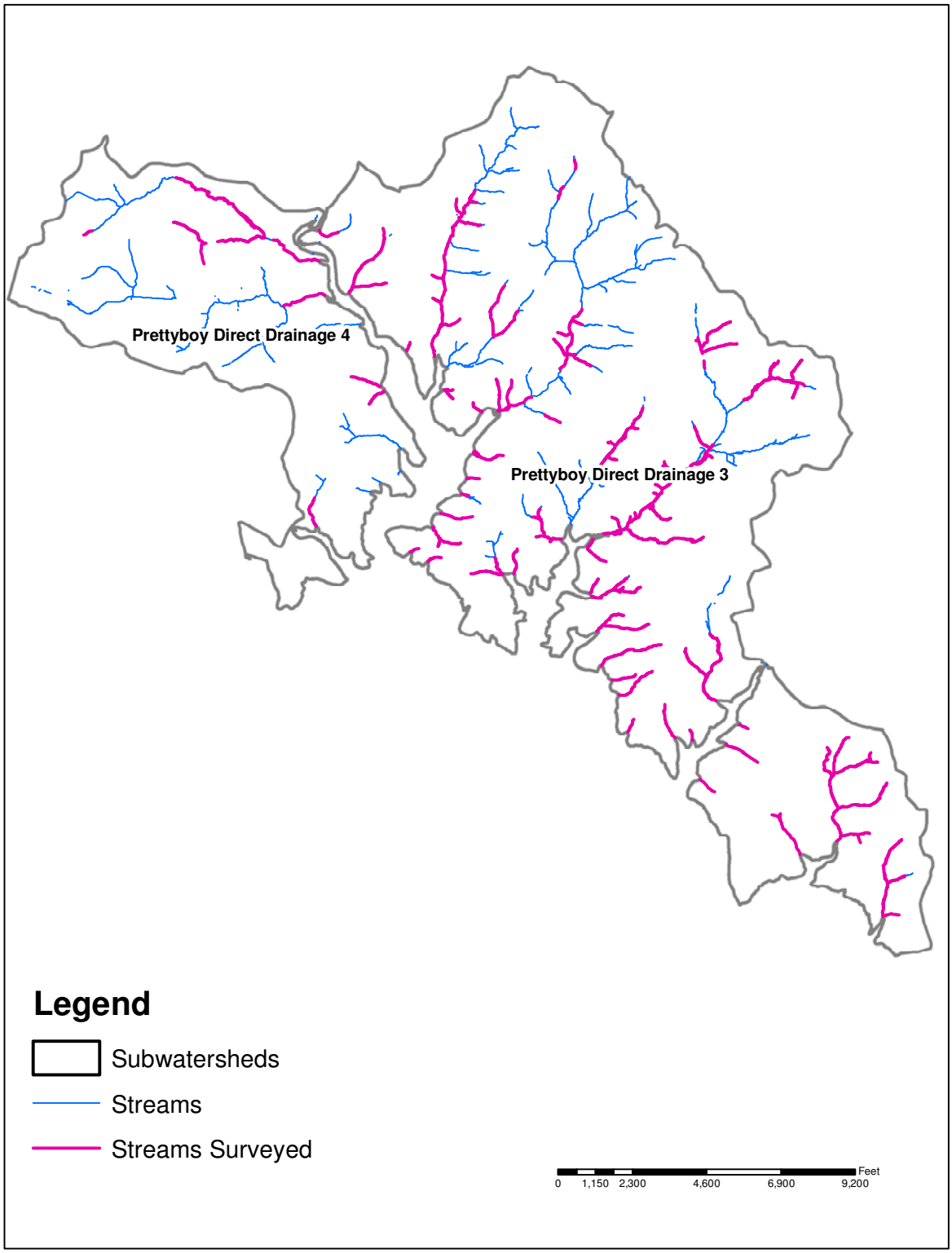

Figure 9-27 Map of the Streams Surveyed for the Two Subwatersheds.

Table 9-22 and 9-23 presents a summary of survey results by problem type by sub-watershed. Figure 9-28 provdies a histogram of potential problems found by sub-watershed. Table 9-24 provides a listing of information by site number. In Table 9-25, the data are presented by problem type and lists the collected descriptive data. Presenting the data by problem type allows the reader to see which problems are rated as most severe or easiest to correct within each category. Result categories are discussed further in order of those with the greatest number of sites to those with the least. As mentioned earlier, the number of potential problem sites is not the only measure of the overall extent of the problem, but is used here to order the data.

Table 9-21 Total Stream Miles and Stream Miles Surveyed, by Subwatershed

Subwatershed	Total Stream Miles	Miles Surveyed	Percentage
Prettyboy Direct Drainage 3	31.6	18.5	58.5 %
Prettyboy Direct Drainage 4	9.2	2.9	31.5 %
Total	40.8	21.4	52.5 %

Table 9-22 Summary of Results From Prettyboy Direct Drainage 3 Subwatershed

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Erosion	24	25,963 ft (4.9 mi)	3	2	2	17	0
Trash Dumping	11		0	1	1	3	6
Inadequate Buffer	8	4,907.9 ft (0.9 mi)	0	3	2	2	1
Unusual Condition or Comment	8		1	3	2	1	1
Fish Barrier	5		0	4	0	1	0
Pipe Outfall	2		0	0	1	0	1
In or Near Stream Construction	1		0	1	0	0	0
Channel Alteration	0		0	0	0	0	0
Exposed Pipe	0		0	0	0	0	0
Total	59		4	14	8	24	9
Representative Sites	53						

Table 9-23 Summary of results from Prettyboy Direct Drainage 4 Subwatershed

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Erosion	6	7270.8 ft (1.4 mi)	0	2	2	2	0
Trash Dumping	2		0	0	1	1	0
Inadequate	4	1189.2 ft	0	1	0	3	0

Buffer		(0.4 mi)					
Unusual Condition or Comment	0		0	0	0	0	0
Fish Barrier	1		1	0	0	0	0
Pipe Outfall	4		0	0	0	3	1
In or Near Stream Construction	0		0	0	0	0	0
Channel Alteration	0		0	0	0	0	0
Exposed Pipe	0		0	0	0	0	0
Total	17		1	3	3	9	1
Representative Sites	7						

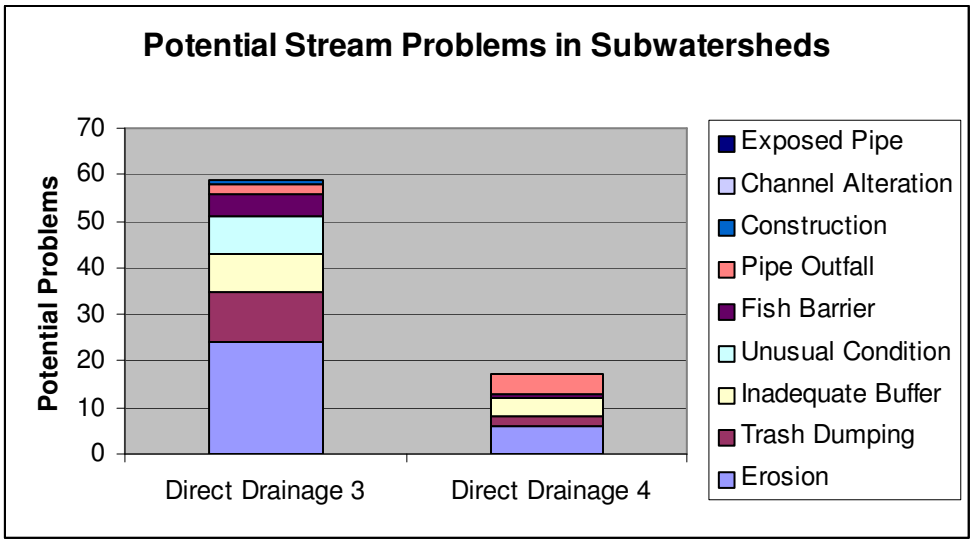

Figure 9-28 Potential Stream Problems By Subwatershed

9.6.3 Summary of Erosion

The survey teams reported 30 eroding stream banks that totaled 33,233.8 feet or 6.3 miles (29% of the 21.4 miles surveyed). Figure 9-29 shows the severity distribution of these sites, and Figure 9-30 shows their location and severity. In this survey, unstable eroding streams are defined as areas where the stream banks are almost vertical, and the vegetative roots along the stream are unable to hold the soil onto the banks. The severity rating of the site is based on the length and height of the eroding streambank. An erosion site was rated as very severe if it was a long section of stream (>1000 ft.) with unstable banks on both sides; a site was ranked as minor if it was a short section of stream (<300 ft.) with limited bank instability. While survey teams are asked to visually assess whether the stream was down cutting, widening, or headcutting at a specific site, the only way to evaluate the full significance of the erosion processes at a specific site is to do more detailed monitoring over time.

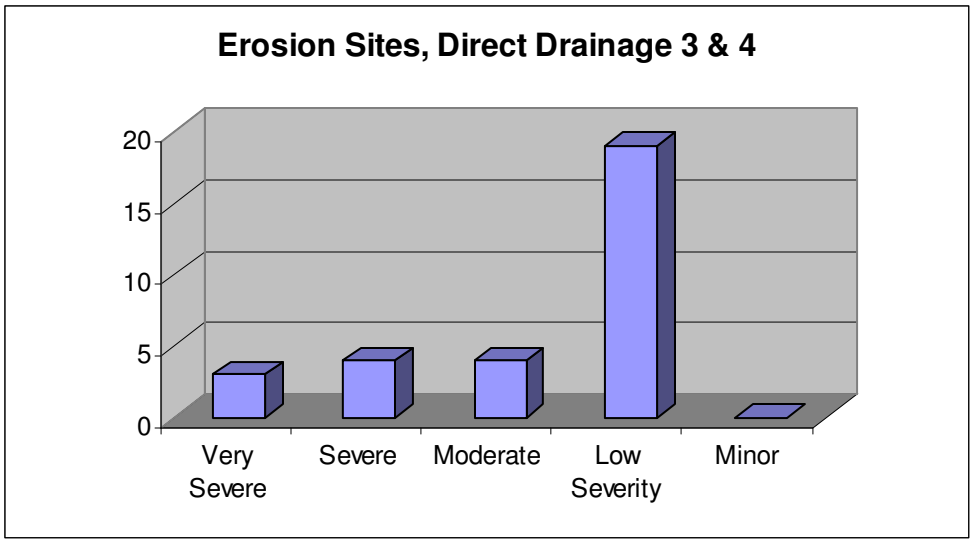

Figure 9-29 Severity Distribution of Sites

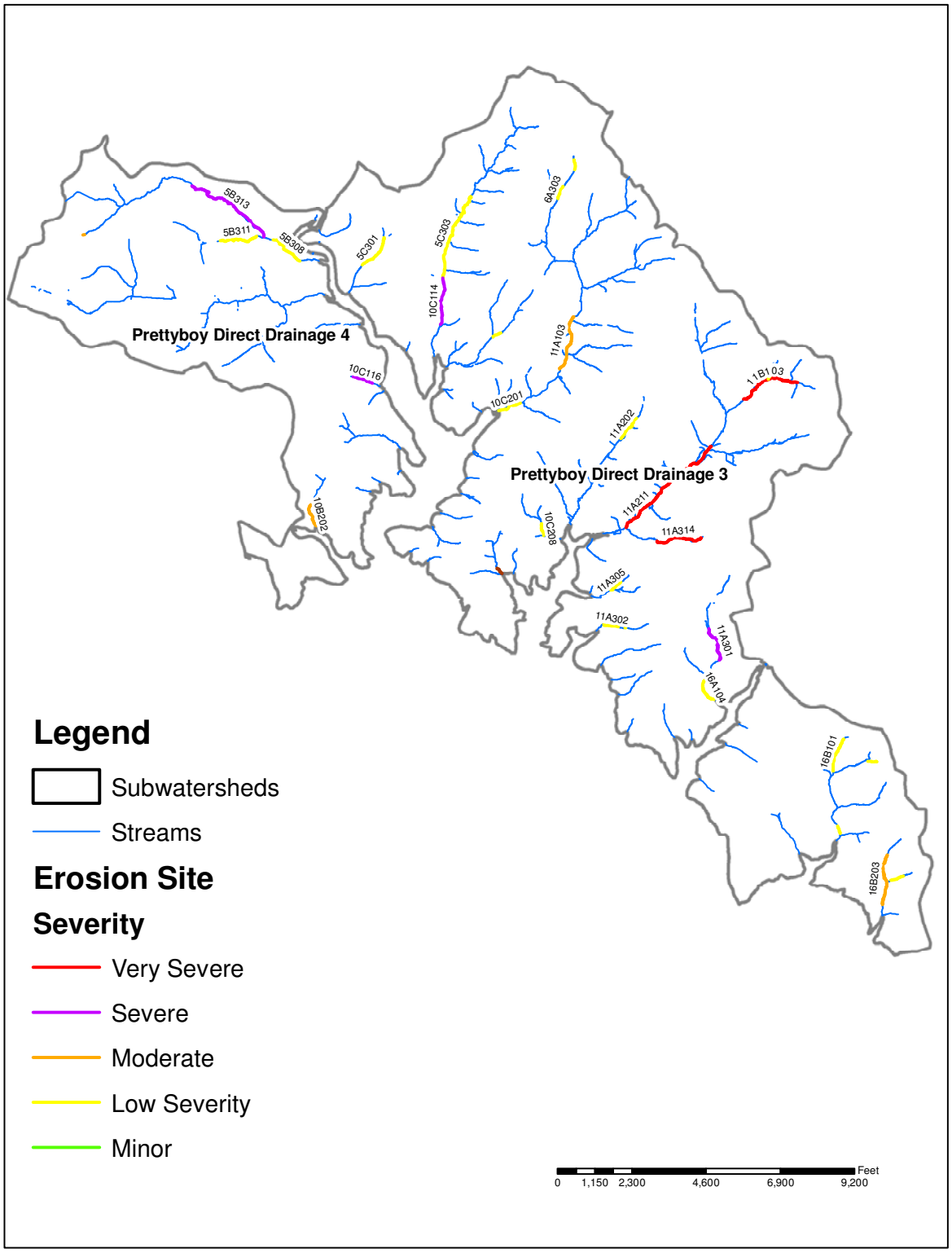

Figure 9-30 Map of Erosion Severity and Location

9.6.4 Summary of Trash Dumping

Survey crews documented 13 trash-dumping sites, and placed 1 site in the severe category, 2 in moderate, 4 in low severity, and 6 in minor (Figure 9-31). Eight of the trash-dumping sites were residential, 2 consisted of flotables, and 2 consisted primarily of tires. Figure 9-32 shows the location and severity of each site. Trash dumps are rated as being of very high severity when there is a large amount of trash spread over a very large and inaccessible area. A site is rated as minor if it is a small amount of trash located inside a park with easy access.

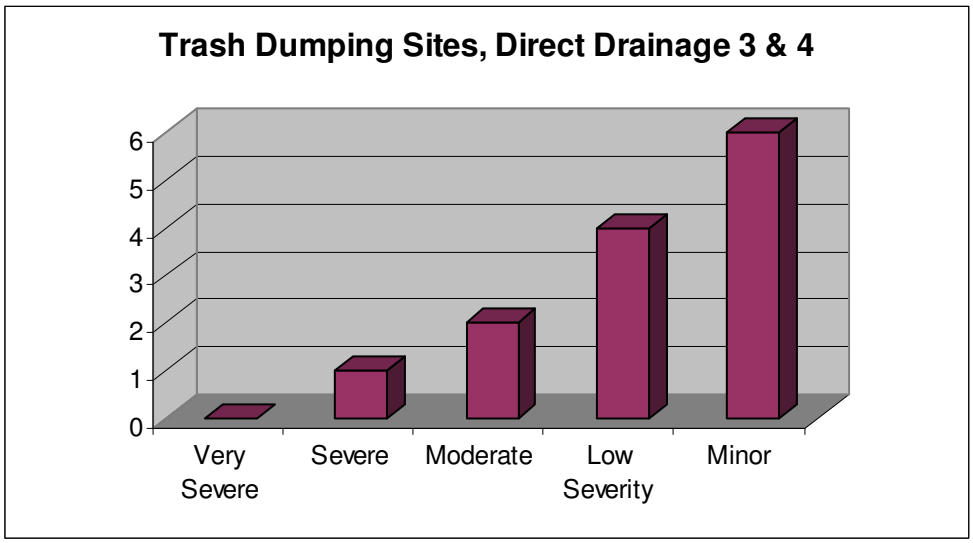

Figure 9-31 Severity Distribution of Sites

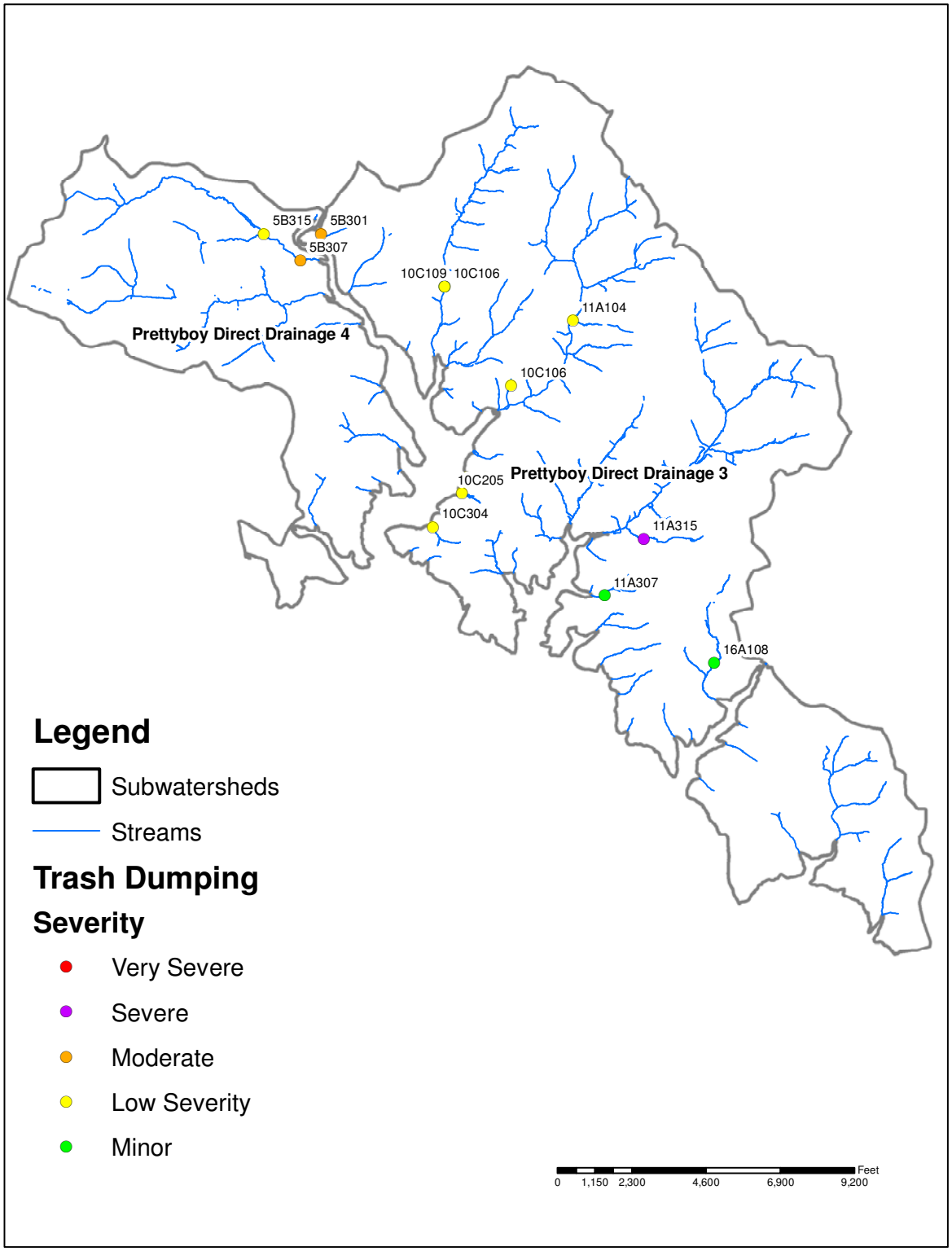

Figure 9-32 Map of Trash Dumping Severity and Location

9.6.5 Summary of Inadequate Buffer

The Baltimore County survey teams identified 12 inadequate buffers in the study area, with a total length of 6,097.1 ft (1.2 miles). This accounted for approximately 5.6% of the 21.4 miles surveyed. The severity distribution of these inadequate buffers is shown in Figure 9-33, and their location and severity are shown in Figure 9-34. While there is no single minimum standard for how wide a stream buffer should be in Maryland, for the purposes of this study a forest buffer is considered inadequate if it is less than 50 feet wide, measured from the edge of the stream. The severity of inadequate forest buffers is based on both the length and width of the site. Those sites over 1,000 feet long with no forest on either side of the stream rank as the most severe. Four of the 12 sites had inadequate buffers on both sides of the stream, while the other 8 were forested on one side. One of the inadequate buffer sites had livestock present, primarily cattle or horses. Livestock in riparian areas are associated with elevated inputs of nutrients and sediment in the associated streams. Land use in the buffers was approximately evenly distributed between forests, lawns and pastures.

Because the inadequate buffer measure is cumulative along the stream segment, the number of inadequate buffers observed is not necessarily the best indication of the level of the problem. One alternative is to examine the most severe potential problems. A ranked order of the severity of potential problems (Figure 9-33) shows 4 in severe, 2 in moderate, 5 in low severity, and 1 in minor.

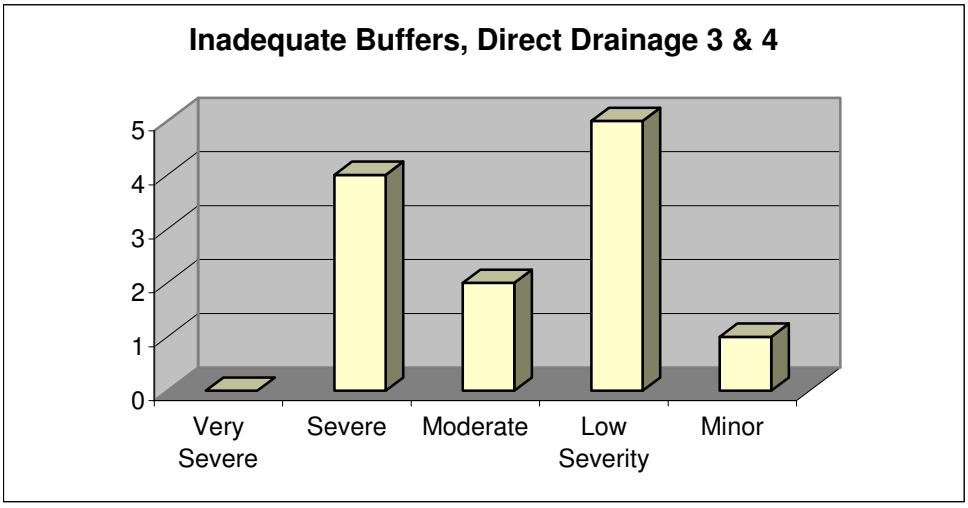

Figure 9-33 Severity Distribution of Sites

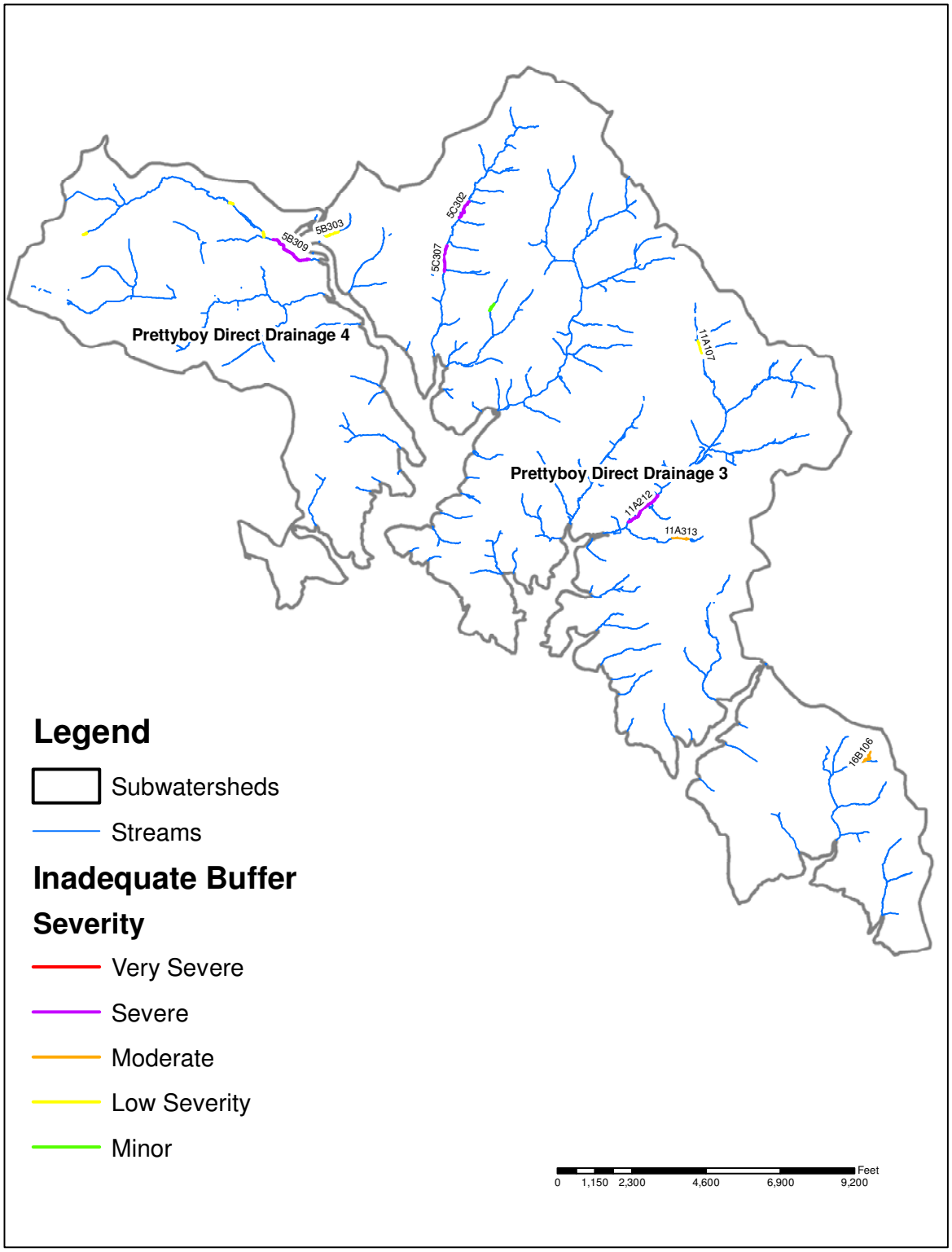

Figure 9-34 Map of Inadequate Buffer Severity and Location

9.6.6 Summary of Unusual Conditions and Comments

The Baltimore County SCA teams documented a total of 8 unusual conditions and comments. The most common unusual conditions were excessive growth of multi-flora rose, found at 5 sites, and mowed riparian areas, documented at 2 sites. Figure 9-35 shows the severity distribution of the unusual condition sites, and Figure 9-36 shows their location and severity. An unusual condition site was ranked as very severe if the survey crew judged that the potential problem would have a direct and wide-reaching impact on the stream's aquatic resources, and was among the worst that field teams would expect to observe. A site was ranked of minor severity if it was a potential problem that did not appear to have a significant impact on aquatic resources. One site was ranked as being very severe, and four sites were ranked as severe. Field crews also assessed the possible causes for the unusual conditions. In some cases, the causes are apparent. For example, at the sites with excessive multi-flora rose, the cause is most likely due to disturbances such as deer.

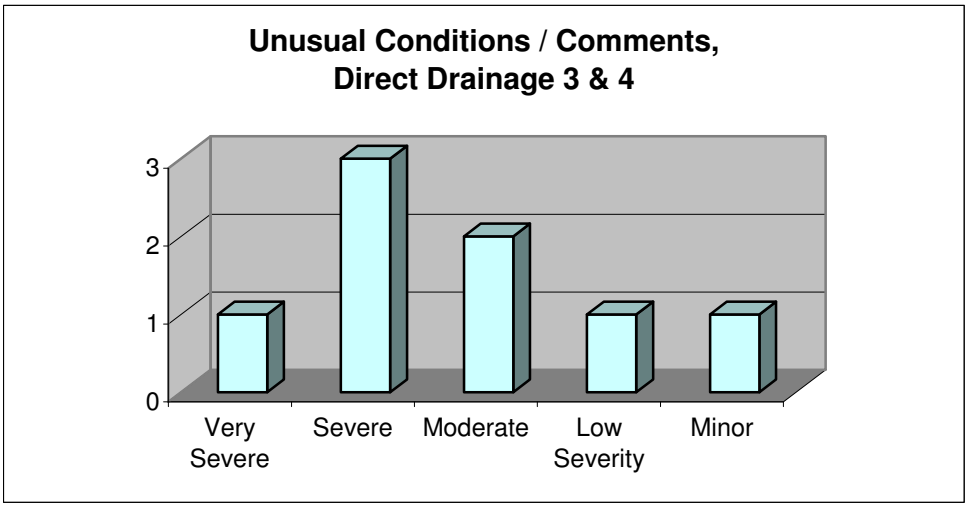

Figure 9-35 Severity Distribution of Sites

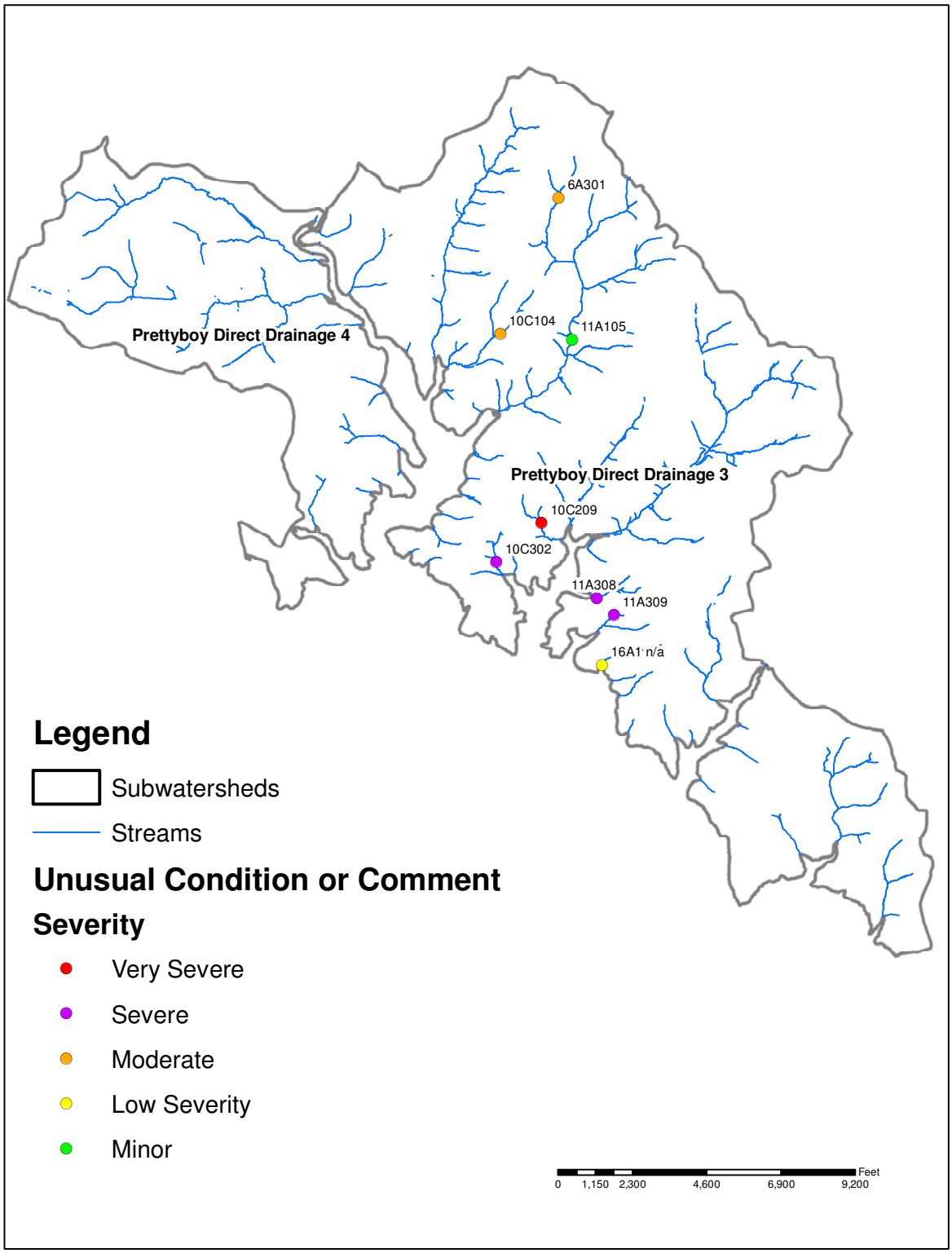

Figure 9-36 Map of Unusual Condition/Comment Severity and Location

9.6.7 Summary of Fish Barrier

The Baltimore County SCA team identified 6 barriers to fish migration. Figure 9-37 shows the severity distribution of these barriers, and figure 9-38 shows their location and severity. Most of these barriers are caused by road crossing culverts that result in water that is too shallow or drops that are too high for fish to pass. Other causes include man-made dams, natural falls, and beaver dams. A fish barrier is rated very severe when it is a structure that totally blocks a large stream or river, and is considered minor when it is a temporary barrier that blocks very little in-stream habitat. Most observed fish barriers were high severity problems with 1 ranking as very severe, 4 as severe, and 1 as low severity.

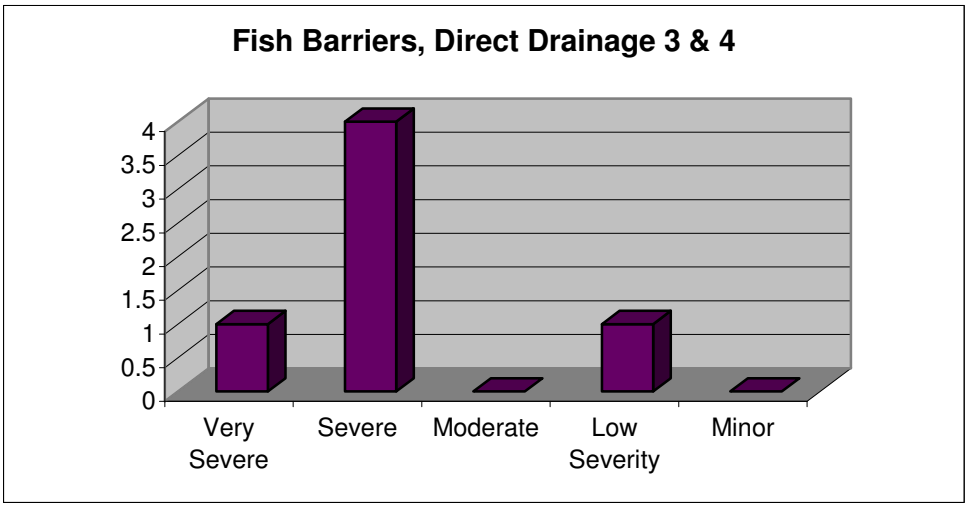

Figure 9-37 Severity Distribution of Sites

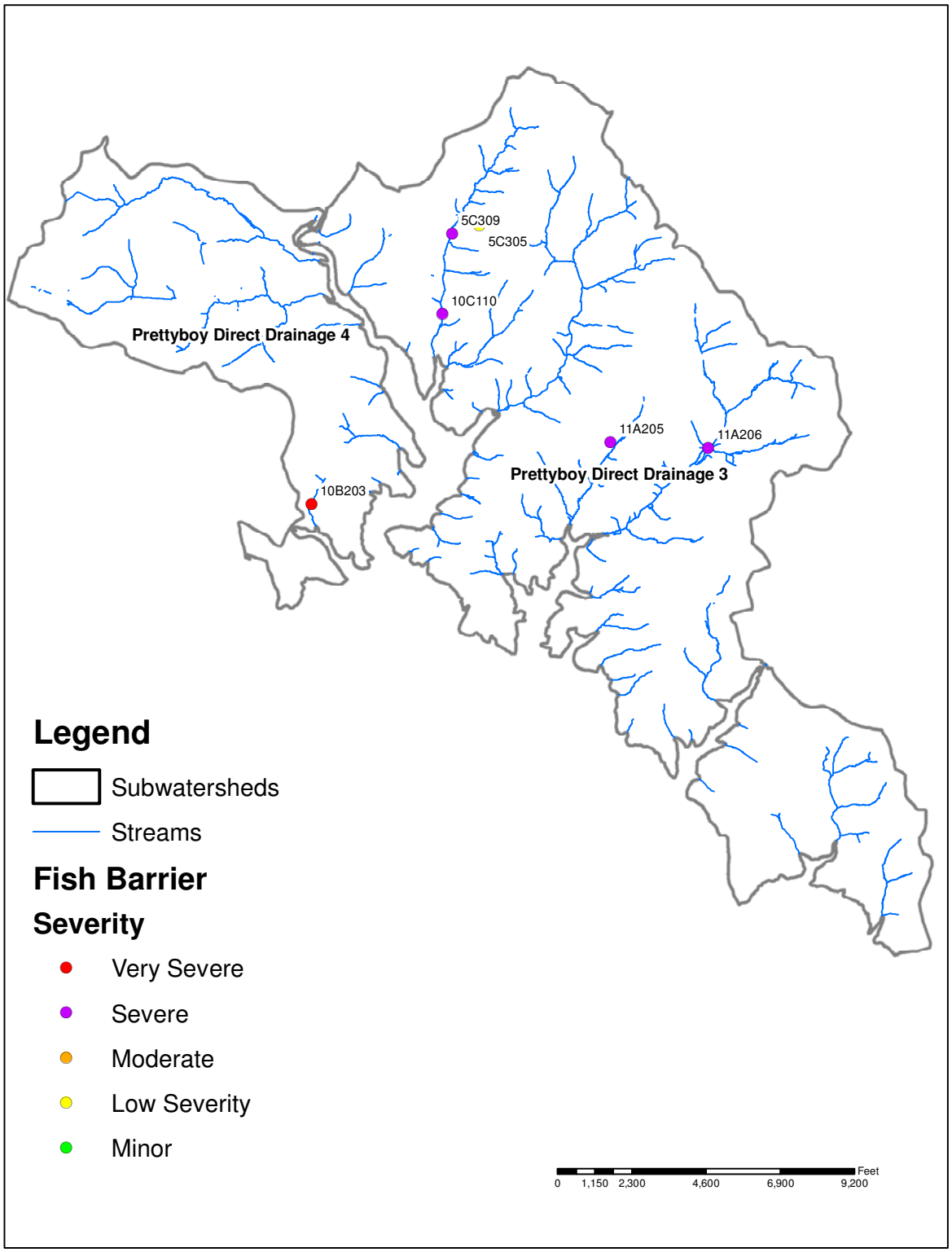

Figure 9-38 Map of Fish Barrier Severity and Location

9.6.8 Summary of Pipe Outfall

Survey crews identified 6 pipe outfalls. The severity distribution of these outfalls is shown in Figure 9-39. Figure 9-40 shows the location and severity of representative pipe outfall sites. The labels on this and all subsequent maps refer to the unique site number assigned to each potential problem. Four of the pipe outfalls had a clear discharge, and 2 had no discharge. A pipe outfall warrants a very severe rating when it has a strong discharge and a distinct color or odor, and a minor rating when it is a storm water outfall with no dry weather discharge. Most of the pipe outfalls serve as pond overflow, and have a moderate to minor severity ranking.

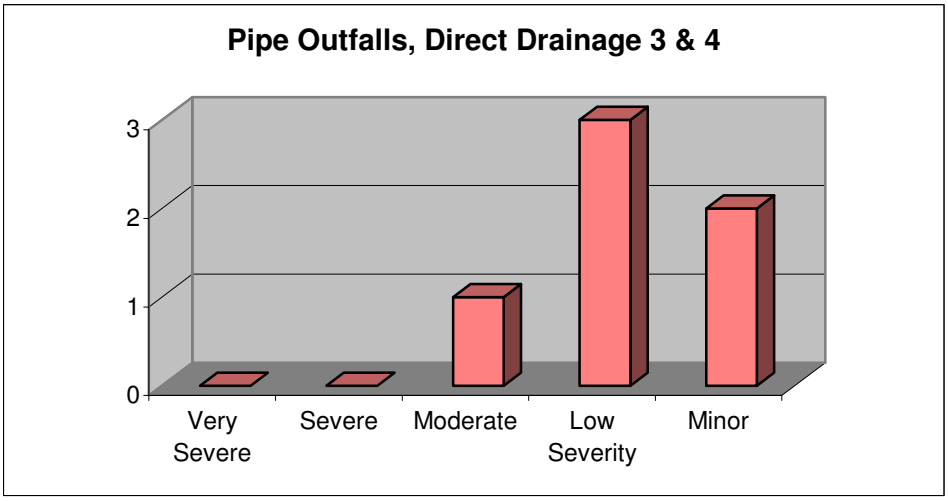

Figure 9-39 Severity Distribution of Sites

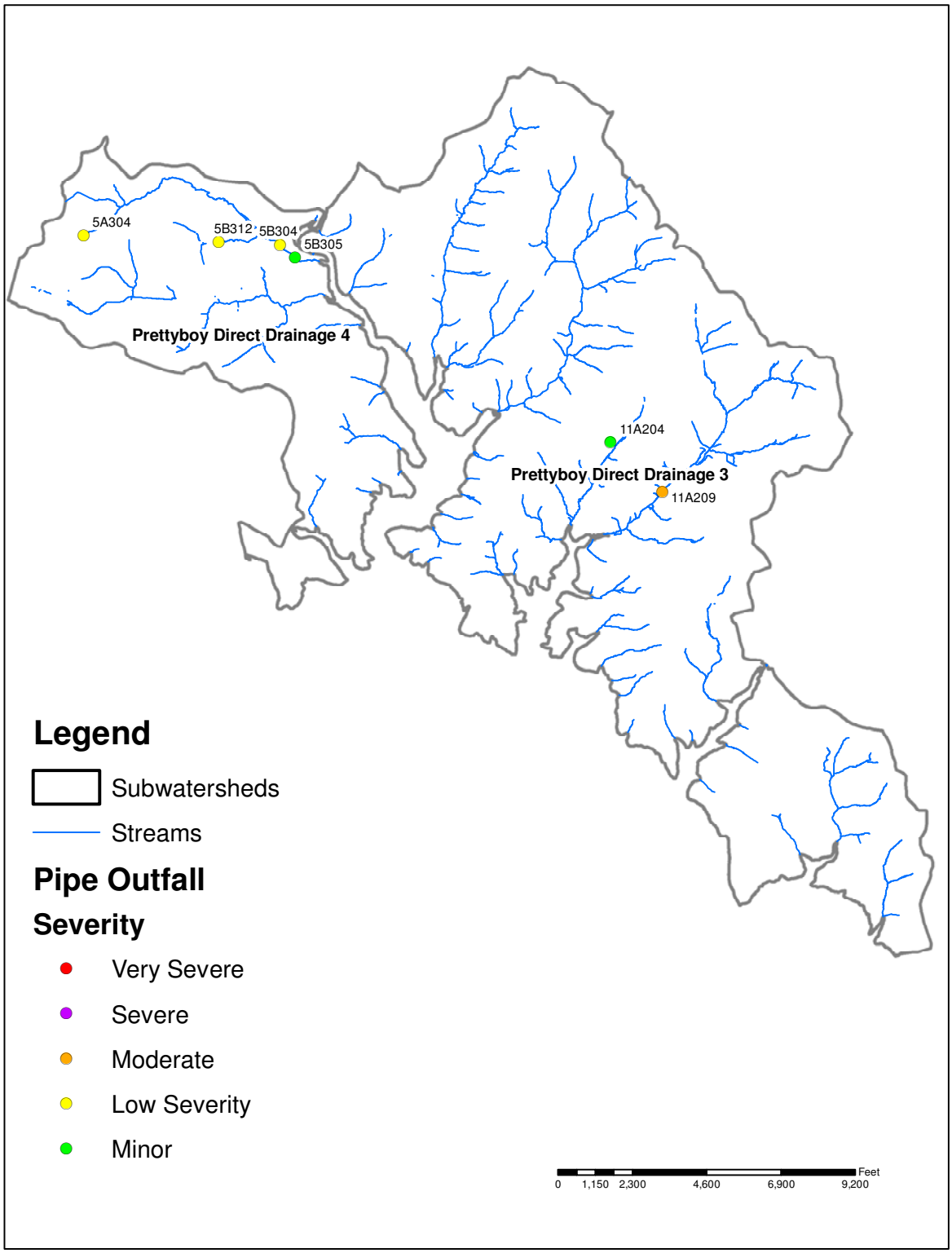

Figure 9-40 Map of Pipe Outfall Severity and Location

9.6.9 Summary of In or Near Stream Construction

The survey team identified only one in-stream construction site, which rated severe because of inadequate sediment control. The severity distribution of the site is shown in Figure 9-41, and figure 9-42 shows its location and severity.

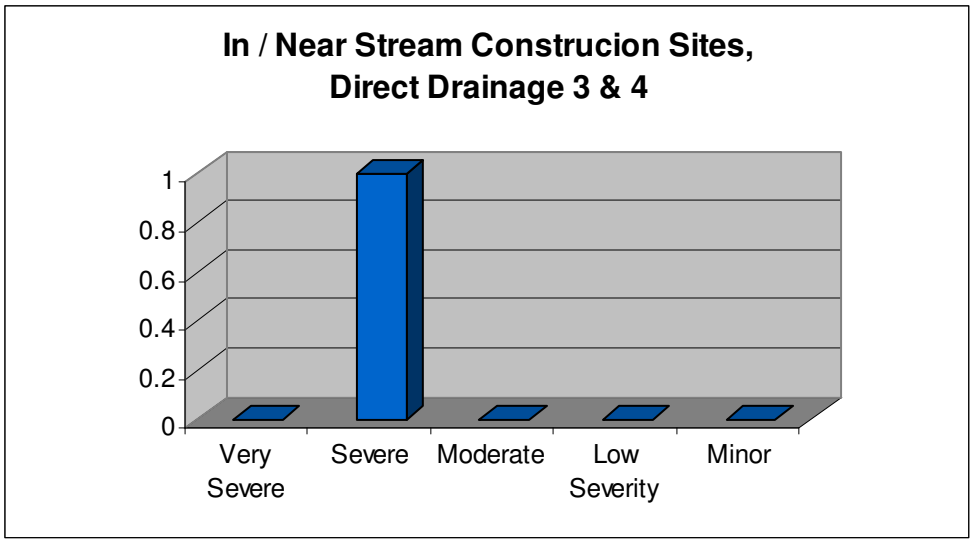

Figure 9-41 Severity Distribution of Sites

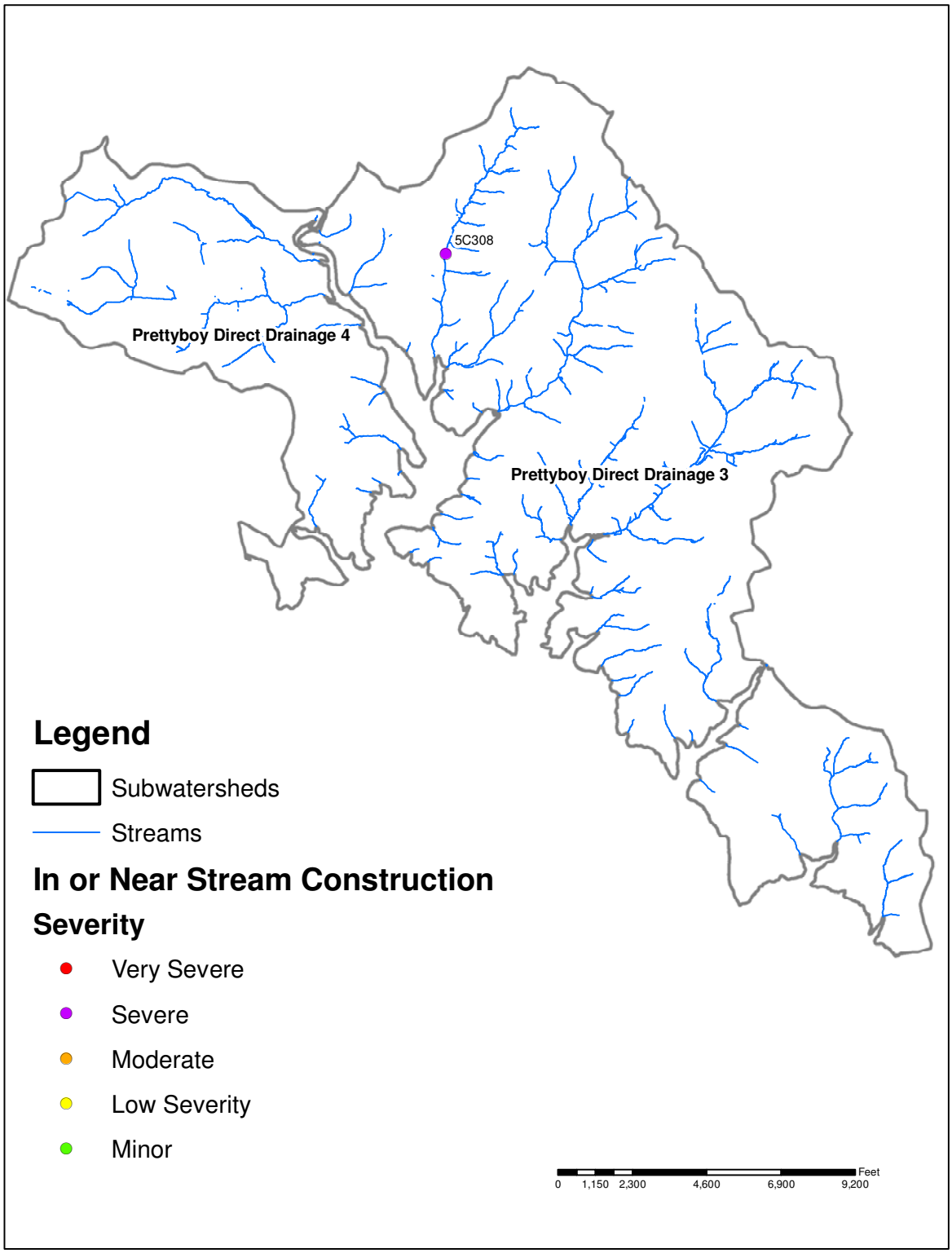

Figure 9-42 Map of In or Near Stream Construction Severity and Location

9.6.10 Summary of Representative Sites

Representative sites are used to document the general condition of both in-stream habitat and the adjacent riparian corridor (including and up to 50 feet beyond the stream bank). The SCA survey's representative site evaluations are based on the habitat assessment procedures outlined in EPA's rapid bioassessment protocols (Plafkin, et. al., 1989), and they are very similar to the habitat evaluations of Maryland Save-Our-Stream's Heartbeat Program. At each representative site, the following 10 separate categories related to stream habitat health are evaluated: Attachment Sites for Macroinvertebrates; Embeddedness; Shelter for Fish; Channel Alteration; Sediment Deposition; Velocity and Depth Regime; Channel Flow Status; Bank Vegetation Protection; Condition of Banks; and Riparian Vegetative Zone Width.

Under each category, field crews base a rating of optimal, suboptimal, marginal or poor on established grading criteria developed to reflect ideal wildlife habitat for rocky bottom streams. In addition to the habitat ratings, teams collect data on the stream's wetted width and pool depths at both runs and riffles at each representative site. Depth measurements are taken along the stream thalweg (main flow channel). At representative sites, field crews also indicate whether the bottom sediments are primarily silt, sand, gravel, cobble, boulder, or bedrock.

Representative sites are located at approximately ½- to one-mile intervals along the stream. Baltimore County survey teams evaluated stream conditions at 60 representative sites. Figure 9-43 shows the location of these sites. Substrate conditions for macroinvertebrates averaged suboptimal, with eight of the sites rating poor. Some sites were moderately embedded by sediment, however, the average embeddedness of all sites was optimal-suboptimal. Shelter conditions for fish showed wide variability, with most sites ranking marginal or poor. It is important to note that many of the streams were small springs and would not normally be expected to have the conditions that would put them in the optimal categories. None of the sites showed channel alteration. Sediment deposition conditions averaged optimal-suboptimal, with very few sites rating poor. Velocity/depth characteristics of the sites averaged marginal, with no sites rating optimal. Channel flow conditions averaged optimal-suboptimal and no sites rated poor. The teams reported no sites with poor stream bank vegetation, and the majority of the sites were optimal. There was some stream bank erosion, and most sites were rated optimal or suboptimal, while only one site rated poor. Riparian vegetation conditions showed mostly optimal conditions, with only 5 sites rating suboptimal or marginal, and none rating poor.

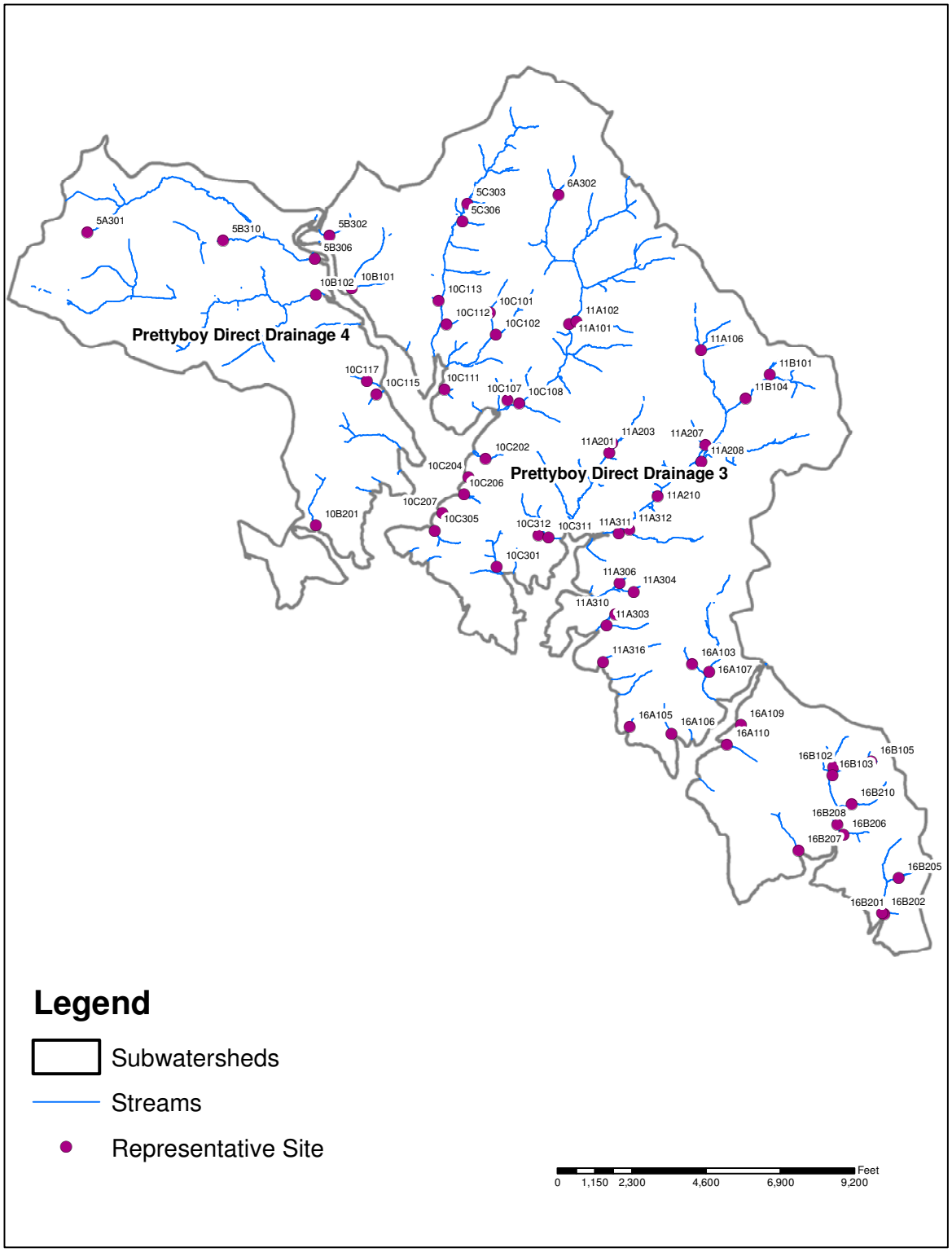

Figure 9-43 Map of Representative Site Locations

9.6.11 Discussion

The results of the Prettyboy Reservoir SCA survey list, summarize, and show the location of the observable environmental problems along the stream corridor network in this watershed. Each potential problem site has a corresponding ranking for severity, correctibility, and access and a photograph of the site. The data from this effort can be used to target future restoration efforts. After this list of potential problem sites is compiled and distributed, county planners, resource managers, and others can initiate a dialog to cooperatively set the direction and goals for the watershed's management and plan future restoration work at specific problem sites. In addition, this data can be combined with other GIS data and local information to prioritize areas for restoration.

Projects can be further targeted to restoring areas where rare or threatened species, gaps in continuous forest or the state's Green Infrastructure, or quality fish and wildlife habitat are found. In addition, sites can be prioritized for restoration based on their location in headwater areas, streams that deposit directly into the Chesapeake Bay, areas of specific local interest, or sites where the surrounding land use is particularly suited to restoration projects. The values of the present survey is its help in placing individual stream problems into their watershed context and its potential common use among resource managers and land-use planners to cooperatively and consistently prioritize future restoration work. Results of the present survey will be given to the Prettyboy Reservoir Watershed WRAS committee, which is in the implementation phase of the Watershed Restoration Action Strategy for the Prettyboy Reservoir.

Table 9-24 Listing of Information by Site

Site	Category	Severity	Correctability	Access
05A301	Representative Site			
05A302	Inadequate Buffer	4	2	1
05A303	Erosion Site	3	4	1
05A304	Pipe Outfall	4	5	1
05B301	Trash	3	2	1
05B302	Representative Site			
05B303	Inadequate Buffer	4	1	1
05B304	Pipe Outfall	5	1	1
05B305	Pipe Outfall	5	1	1
05B306	Representative Site			
05B307	Trash	3	2	1
05B308	Erosion Site	4	3	1
05B309	Inadequate Buffer	2	2	1
05B310	Representative Site			
05B311	Erosion Site	4	3	3
05B312	Pipe Outfall	4	3	2
05B313	Erosion Site	2	4	5
05B314	Inadequate Buffer	4	1	1
05B315	Trash	4	2	1
05B316	Inadequate Buffer	4	1	1
05C301	Erosion Site	4	3	3

05C302	Inadequate Buffer	2	2	1
05C303	Representative Site			
05C304	Erosion Site	4	3	2
05C305	Fish Barrier	4	3	1
05C306	Representative Site			
05C307	Inadequate Buffer	2	3	2
05C308	In or near stream construction	2	n/a	n/a
05C309	Fish Barrier	2	4	1
06A301	Unusual Condition or Comment	3	1	1
06A302	Representative Site			
06A303	Erosion Site	4	3	1
10B101	Representative Site			
10B102	Representative Site			
10B201	Representative Site			
10B202	Erosion Site	3	3	4
10B203	Fish Barrier	1	3	2
10C101	Representative Site			
10C102	Representative Site			
10C103	Erosion Site	4	2	3
10C104	Unusual Condition or Comment	2	3	3
10C105	Inadequate Buffer	5	3	1
10C106	Trash	4	2	2
10C107	Representative Site			
10C108	Representative Site			
10C109	Trash	5	3	2
10C110	Fish Barrier	2	2	2
10C111	Representative Site			
10C112	Representative Site			
10C113	Representative Site			
10C114	Erosion Site	2	5	4
10C115	Representative Site			
10C116	Erosion Site	2	4	5
10C117	Representative Site			
10C201	Erosion Site	4	3	5
10C202	Representative Site			
10C203	Trash	4	2	3
10C204	Representative Site			
10C205	Trash	4	2	3
10C206	Representative Site			
10C207	Representative Site			
10C208	Erosion Site	4	3	2
10C209	Unusual Condition or Comment	1	4	2

10C301	Representative Site			
10C302	Unusual Condition or Comment	2	5	5
10C304	Trash	4	2	3
10C305	Representative Site			
10C311	Representative Site			
10C312	Representative Site			
11A101	Representative Site			
11A102	Representative Site			
11A103	Erosion Site	3	4	3
11A103	Representative Site			
11A104	Trash	4	2	2
11A105	Unusual Condition or Comment	5	1	1
11A106	Representative Site			
11A107	Inadequate Buffer	4	2	1
11A201	Representative Site			
11A202	Erosion Site	4	3	4
11A203	Representative Site			
11A204	Pipe Outfall	5	1	3
11A205	Fish Barrier	2	4	1
11A206	Fish Barrier	2	1	1
11A207	Representative Site			
11A208	Representative Site			
11A209	Pipe Outfall	3	4	5
11A210	Representative Site			
11A211	Erosion Site	1	5	5
11A212	Inadequate Buffer	2	2	1
11A301	Erosion Site	2	4	5
11A302	Erosion Site	4	2	5
11A304	Erosion Site	4	2	4
11A304	Representative Site			
11A305	Erosion Site	4	3	5
11A306	Representative Site			
11A307	Trash	5	1	1
11A308	Unusual Condition or Comment	2	3	1
11A309	Unusual Condition or Comment	2	5	5
11A310	Representative Site			
11A311	Representative Site			
11A312	Representative Site			
11A313	Inadequate Buffer	3	3	5
11A314	Erosion Site	1	5	5
11A315	Trash	2	4	5
11B101	Representative Site			

11B102	Erosion Site	4	3	5
11B103	Erosion Site	1	5	5
11B104	Representative Site			
16A101	Representative Site			
16A102	Representative Site			
16A103	Representative Site			
16A104	Erosion Site	4	2	5
16A105	Representative Site			
16A106	Representative Site			
16A107	Representative Site			
16A108	Trash	5	1	5
16A109	Representative Site			
16A110	Representative Site			
16A1n/a	Unusual Condition or Comment	4	1	5
16B101	Erosion Site	4	4	5
16B102	Representative Site			
16B103	Representative Site			
16B104	Erosion Site	4	2	2
16B105	Representative Site			
16B106	Inadequate Buffer	3	3	1
16B201	Representative Site			
16B202	Representative Site			
16B203	Erosion Site	3	4	5
16B204	Erosion Site	4	3	5
16B205	Representative Site			
16B206	Representative Site			
16B207	Representative Site			
16B208	Representative Site			
16B209	Erosion Site	4	3	5
16B210	Representative Site			

Table 9-25 Listing of Sites by Problem Category

Erosion Sites

Site	Type	Possible Cause	Length (ft)	Height (ft)	Land use left	Land use right	Infrastructure Threatened?	Severity	Correctability	Access
05A303	Widening	pond	60	2	Lawn	Lawn	No	3	4	1
05B311	Widening	Land use change upstream	1000	2.5	Forest	Forest	No	4	3	3
05B308	Widening	unknown	900	3	Forest	Lawn	No	4	3	1
05B313	Widening	unknown	2600	3.75	Forest	Forest	No	2	4	5
05C301	Widening	unknown	1000	2.75	Forest	Forest	No	4	3	3
05C304	Widening	unknown	650	2.5	Forest	Forest	No	4	3	2

06A303	Widening	Land use change upstream	740	2	Lawn	Lawn	No	4	3	1
10B202	Widening	Land use change upstream	630	4	Forest	Forest	No	3	3	4
10C103	Widening	Unknown	160	4	Forest	Forest	No	4	2	3
10C114	Widening	Land use change upstream	2500	2.25	Forest	Forest	No	2	5	4
10C116	Widening	unknown	600	2	Forest	Forest	No	2	4	5
10C201	Widening	unknown	600	2.75	Forest	Forest	No	4	3	5
10C208	Downcutting	unknown	575	3	Multiflora Rose	Multiflora Rose	No	4	3	2
11A103	Widening	Land use change upstream	1300	5.5	Forest	Forest	No	3	4	3
11A211	Widening	Land use change upstream	2900	3	Forest	Forest	No	1	5	5
11A202	Widening	unknown	625	2	Forest	Forest	No	4	3	4
11A301	Widening	Land use change upstream	1400	6	Forest	Forest	No	2	4	5
11A302	Widening	drainage from road?	500	3.25	Forest	Forest	No	4	2	5
11A304	Headcutting	Drainage from road?	20	5	Forest	Forest	No	4	2	4
11A35	Widening	unknown	400	2	Forest	Forest	No	4	3	5
11A314	Widening	unknown	2000	3	Forest	Forest	No	1	5	5
11B103	Widening	unknown	1900	4.5	Forest	Forest	No	1	5	5
11B102	Widening	Land use change upstream	150	3.5	Forest	Forest	No	4	3	5
16A104	Widening	Unknown	900	2.5	Forest	Forest	No	4	2	5
16B104	Widening	unknown	200	1.75	Forest	Forest	No	4	2	2
16B101	Widening	Land use change upstream	975	3	Forest	Forest	No	4	4	5
16B204	Widening	Pond at headwaters	528	3.25	Forest	Forest	No	4	3	5
16B203	Widening	Other	1600	3	Forest	Forest	No	3	4	5
16B209	Widening	Land use change upstream	325	4	Forest	Forest	No	4	3	5

Trash Dumping Sites

Site	Type	Truckloads	Other measure	Extent	Volunteer Project?	Owner Type	Owner Name	Severity	Correctability	Access
05B301	Yard waste, Tires	9		Single Site	Yes	Public	Prettyboy Reservoir	3	2	1

05B307	Residential	4.5		Large Area	Yes	Public	Prettyboy Reservoir	3	2	1
05B315	Residential	2		Single Site	Yes	Public	Prettyboy Reservoir	4	2	1
10C106	Residential	3.5		Single Site	Yes	Private		4	2	2
10C109	Residential	0.25		Single Site	No	Private		5	3	2
10C203	Floatables		4.5 trash bags	Single Site	Yes	Public	Prettyboy Reservoir	4	2	3
10C205	Floatables		5 trash bags	Single Site	Yes	Public	Prettyboy Reservoir	4	2	3
10C304	Residential	1		Single Single	Yes	Public	Prettyboy Reservoir	4	2	3
11A104	Residential	0.125		Single Site	Yes	Private		4	2	2
11A307	Residential	1		Single Site	Yes	Public	Prettyboy Reservoir	5	1	1
11A315	Tires	1		Large Area	Yes	Private		2	4	5
16A108	Residential	1		Single Site	Yes	Public	Prettyboy Reservoir	5	1	5

Inadequate Buffers

Site	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right (ft)	Land Use Left	Land Use Right	Recently established	Livestock	Severity	Correctability	Access	Wetland
05A302	Left	Right		0		150	Forest	Lawn	No	No	4	2	1	3
05B309	Right	Neither		10		1400	Forest	Lawn	No	No	2	2	1	5
05B303	Left	Neither	17		440		Lawn	Forest	No	No	4	1	1	5
05B316	Left	Left			150		Lawn	Forest	No	No	4	1	1	4
05B314	Both	Both	0	0	150	150	Lawn	Lawn	No	No	4	1	1	3
05C302	Both	Neither	20	20	550	550	Forest	Forest	No	No	2	2	1	3
05C307	Both	Neither	5	7	750	750	Pasture	Pasture	No	No	2	3	2	3
10C105	Right	Neither		13.5		160	Forest	Lawn	No	No	5	3	1	4
11A107	Right	Right		10		295	Other	Other	No	No	4	2	1	1
11A212	Both	Both	5	5	800	550	Lawn	Lawn	Yes	No	2	2	1	3
11A313	Right	Right		6.5		450	Forest	Lawn	No	No	3	3	5	5
16B106	Right	Right		12.5		500	Forest	Lawn	No	No	3	3	1	3

Unusual Conditions

Site	Type	Description	Potential Cause	Severity	Correctability	Access
06A301	Comment	Stream has some mature trees, but stream is unshaded partly & owner mows around trees to edge of stream. Kept as lawn.		3	1	1
10C104	Unusual Condition	Excessive multiflora		2	3	3
10C209	Unusual Condition	EXCESSIVE multiflora & invasive vines. Smothering all other vegetation.		1	4	2
10C302	Unusual Condition	Excessive multi-flora rose and excessive stilt grass.	Invasive species and deer.	2	5	5

11A105	Comment	A few mature trees present, area around them is kept as lawn.		5	1	1
11A308	Unusual Condition	Excessive growth of multi-flora rose that is blocking a path to the stream.	Invasive species.	2	3	1
11A309	Unusual Condition	Excessive multi-flora rose and excessive stilt grass.	Invasive species and deer.	2	5	5
16A1n/a	Comment	Excessive amount of bottles floating at bottom of stream where it meets the reservoir.	Trash could be from the reservoir or could have floated down from the road.	4	1	5

Fish Barriers

Site	Blockage	Type	Reason	Drop (In)	Depth (In)	Severity	Correctability	Access
05C305	Total	Road crossing	Too high	15		4	3	1
05C309	Total	Road crossing	Too high	7		2	4	1
10B203	Total	Pipe crossing	Too shallow		2	1	3	2
10C110	Total	Dam	Too high	14		2	2	2
11A205	Total	Road crossing	Too high	7		2	4	1
11A206	Total	Other	Too shallow		0.25	2	1	1

Pipe Outfalls

Site	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Discharge	Color	Odor	Severity	Correctability	Access
05A304	Pond Overflow	Smooth Metal Pipe	Head of stream	8	Yes	Clear	None	4	5	1
05B312	Pond Outfall	Corrugated Metal	Head of stream	15.6	Yes	Clear	None	4	3	2
05B304	Stormwater	Concrete Pipe	Right Bank	18	No			5	1	1
05B305	Stormwater	Concrete Pipe	Right bank	19.2	No			5	1	1
11A204	pond	Smooth Metal Pipe	Head of stream	6	Yes	Clear	None	5	1	3
11A209	unknown - old drainage?	Smooth Metal Pipe	Right bank	3	Yes	Clear	None	3	4	5

In or Near Stream Construction

Site	Type of Activity	Sediment Control	Why, if inadequate	Excess Sediment?	Length	Company	Location	Severity
05C308	Other	Inadequate	None, sediment fence is absent.	No	10	n/a	property on cotter	2

Representative Sites

Site	Subst-rate	Embed-dedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/ Depth	Flow	Veget-ation	Bank Condition	Riparian Vegetation	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
05A301	2	2	1	3	2	1	3	2	2	2	50.4	43.2		3	3.6		Sand
05B302	3	2	2	3	3	2	3	2	3	2	24	43		1.5	2.25		Sand
05B310	3	2	0	3	2	1	3	3	1	3	72			4.5			Sand
05B306	3	2	1	3	0	1	1	2	2	3	72	55		4.5	6.5		Cobble
05C303	2	2	1	3	1	1	3	3	3	3	55		42	4		5	Gravel
05C306	2	2	0	3	3	1	3	3	2	3	43	18		2.5	2		Sand
06A302	2	1	2	3	1	1	3	2	1	2	67	64		2	4.5		Silt
10B101	3	3	2	3	3	2	3	3	2	3	54	48		3	3.5		Boulder
10B102	3	2	3	3	3	2	3	3	3	3	80.4	136.8	144	5.4	4.8	10.8	Gravel
10B201	2	2	1	3	2	1	2	2	2	3	32	40		1	4		Sand
10C117	2	2	2	3	2	1	3	3	2	3	57.6			1.08			Sand
10C113	2	2	1	3	3	1	2	3	3	3	50	56		2	2		Gravel
10C101	2	3	1	3	3	1	3	3	2	1	67		72	2		54	Boulder
10C102	2	2	3	3	2	1	3	3	1	3	69			3			Boulder
10C107	0	1	0	3	2	1	1	3	3	3	9.5	6		0.75	1		Gravel
10C108	3	3	3	3	1	1	3	3	2	3	132	116	67	7	7	11	Boulder
10C111	1	2	0	3	2	0	1	3	3	3		24			1.8		Sand
10C112	2	3	1	3	3	1	2	3	3	3	30	2.9		2	1		Gravel
10C115	2	2	1	3	3	1	3	3	3	3	31.2			0.6			Sand
10C204	2	3	1	3	3	1	3	3	3	3							
10C206	1	3	1	3	3	1	3	3	3	3	34			2			Sand
10C202	3	3	2	3	3	1	3	3	3	3	33			0.75			Sand
10C207	3	3	1	3	3	1	3	3	3	3		27			2		Sand
10C312	2	2	2	3	2	1	2	1	1	3	26			1			Silt
10C311	1	1	2	3	1	1	3	2	3	3	19			1.5			Silt
10C301	2	1	2	3	1	2	3	3	3	3	30	30		1.5	2.5		Sand
10C305	0	1	0	3	2	1	3	3	3	3	18	30		0.75	1.5		Sand
11A103	2	3	0	3	3	1	3	3	1	3	31	36	47	2.25	1.5	8.5	Gravel
11A101	3	1	2	3	2	1	3	3	2	3	130	130		7	9		Cobble
11A102	1	2	1	3	3	1	3	3	2	3	29	42		2	3		Gravel
11A106	0	1	0	3	3	1	3	1	3	1		24			12		Silt
11A207	2	2	1	3	2	1	2	3	2	3	13.2		55.2	1.5		6	Gravel
11A208	1	0	2	3	1	1	2	3	2	3	27.4			2			Silt
11A210	2	1	2	3	1	2	3	3	2	3	150.5			5			Gravel
11A201	3	3	2	3	3	1	3	3	3	3	70			1.5			Gravel
11A203	2	2	1	3	2	1	3	3	3	3	43	26		2	4.25		Silt
11A312	2	2	1	3	2	1	3	3	1	3	61	45		2	4		Gravel
11A311	2	3	2	3	3	2	3	3	1	3	68	59		5	8		Gravel
11A310	1	2	1	3	2	1	2	3	2	3	25	24		2.5	2.5		Sand
11A304	2	3	1	3	3	1	2	2	3	3	39			1.5			Sand
11A306	2	2	1	3	3	1	2	2	3	3	46	35		1	3		Sand
11B104	2	2	1	3	2	1	2	3	0	3	75.2	75.2		3	3		Gravel
11B101	1	2	0	3	2	1	2	2	1	3	55.2		81.6	1.5		4.5	Gravel
16A101	3	2	2	3	2	1	3	3	3	3	39	22	44	3.25	3.5	4.5	Gravel

16A102	1	0	0	3	0	1	2	3	3	3	36	48		2.5	2.5		Sand
16A103	2	3	0	3	3	1	3	3	3	3	45			2.5			Sand
16A105	2	3	0	3	3	1	2	3	3	3	31	17		3	4		Sand
16A106	1	3	0	3	3	1	2	3	3	3	21	17		2	3		Sand
16A107	2	2	1	3	3	1	2	3	3	3	43.5	42	50	4	7	10	Sand
16A109	3	3	1	3	3	1	3	3	3	3	37			2.5			Gravel
16A110	3	2	2	3	1	1	3	3	2	3	33	23		2	3		Gravel
16B105	0	3	0	3	3	0	3	2	2	3		31.2			2		Gravel
16B103	1	2	1	3	2	1	3	3	3	3	78	50.4		3.5	3.75		Gravel
16B102	0	3	1	3	2	1	2	3	3	3		34.4			4		Gravel
16B210	2	2	2	3	3	1	3	2	2	3	18.2	68.6	80.5	2	2.5	10.5	Gravel
16B208	3	2	1	3	3	1	3	3	3	3	62.4	103		4.5	5		Gravel
16B201	0	1	0	3	2	1	3	3	3	3	13	28		2	2		Sand
16B202	1	0	1	3	1	1	3	3	3	3	44	61	64	2	2.5	8.25	Gravel
16B205	0	0	1	3	1	1	3	3	3	3	31	22		1.5	2		Sand
16B206	0	1	1	3	1	1	3	3	3	3	12	17		1	2.5		Gravel
16B207	1	1	1	3	1	1	3	3	3	3	30	34.8		1.75	2.25		Sand

Appendix 9-1: Baseflow Monitoring Sites by Watershed

Site ID	Subwatershed	Site ID	Subwatershed
Liberty Reservoir – 6 Sites			
LI-01	Cliffs Branch	LI-09	Timber Run
LI-02	Glen Falls Run	LI-10	Locust Run
LI-03	Keysers Run		
LI-04	Norris Run		
Patapsco River – 5 Sites			
PA-04	Ben's Run	PA-12	Brice Run
PA-06	Cooper Branch	PA-13	West Branch
PA-09	Soapstone Branch		
Gwynns Falls – 6 Sites			
GW-01	Gwynns Falls – Glyndon	GW-05	Horsehead Branch
GW-03	Holly Branch	GW-07	Gwynn's Falls Trib.
GW-04	Red Run	GW-10	Dead Run – Mainstem
Jones Falls – 8 Sites			
JF-01	Western Run	JF-08	Shaughterhouse Run
JF-04	Dipping Pond Run	JF-09	Moores Run
JF-05	Deep Run	JF-10	Towson Run
JF-07	Roland Run	JF-11	Jones Falls
Back River – 10 Sites			
HR-01	West Branch – Herring Run	BR-02	Brians Run
HR-02	West Branch – Herring Run	BR-03	Redhouse Run
HR-03	East Branch – Herring Run	BR-04	Redhouse Run
HR-04	East Branch – Herring Run	BR-05A	Stemmers Run
BR-01	Bread and Cheese Creek	BR-06	Stemmers Run
Deer Creek – 4 Sites			
DC-01	Harris Mill	DC-03	Deer Creek – mainstem
DC-02	Ebaughs Creek	DC-04	Plumtree Branch
Prettyboy Reservoir – 8 Sites			
PR01	Walker Run	PR05A	Prettyboy Branch (Left facing US)
PR02	Gunpowder Falls above Prettyboy	PR05B	Prettyboy Branch (Right)
PR03	Grave Run	PR06	Frog Hollow Run
PR04	George's Run		

Loch Raven Reservoir – 32 Sites			
LR-02	Fitzhugh Run	LR-23	Charles Run
LR-03	Dulaney Valley Branch	LR-24	Little Falls
LR-10 (LQ3)	Long Quarter Branch	LR-27	Third Mine Branch
LR-13 (BR1)	Beaver Dam Run – York Road	LR-28	Owl Branch
LR-14	Baisman Run	LR-30	Beetree Run
LR-15	Beaver Dam Run – Rises Court	LR-31	Mingo Branch
LR-17 (WR1)	Western Run	LR-32	Black Rock Run – Western Run
LR-18	Green Branch	LR-34	McGill Run
LR-19 (OR1)	Overshot Run	LR-35	Piney Run
LR-20	Carroll Branch	LR-36	Piney Run
LR-21	Piney Creek	LR-38	Delaware Run
LR-22 (GF1)	Gunpowder Falls - Glencoe		
Lower Gunpowder Falls – 7 Sites			
GU-01	Bean Run	GU-06	Cowen Run
GU-03	Haystack Branch	GU-07	Jennifer Branch
GU-04	Long Green Creek – Hydes Rd.	GU-08	Minebank Run
GU-05	Long Green Creek – Hartley Mill		
Little Gunpowder Falls – 7 Sites			
LG-01	Nelson Branch	LG-05	Little Gunpowder Falls
LG-02	Parker Branch	LG-07	Little Gunpowder Falls
LG-03	Sawmill Branch	LG-09	Frannklinville Channel.
LG-04	Little Gunpowder Falls		
Bird River – 5 Sites			
BI-01	Windlass Run	BI-04	North Fork
BI-02	Honeygo Run	BI-05	Whitemarsh Run – Mainstem
BI-03	Whitemarsh Run - Headwaters		

Appendix 9-2: Baseflow Water Quality Data by Site

Site	Pollutant Parameter					
	pH			TSS		
	Mean	N	Std.Dev	Mean	N	Std.Dev
Deer Creek						
DC-01	7.48	3	0.15	1.0	3	0.9
DC-02	7.14	3	0.07	1.7	3	2.0
DC-03	7.17	3	0.45	3.7	3	5.5
DC-04	6.81	3	0.17	2.3	3	3.2
Prettyboy Reservoir						
PR-01	6.33	3	0.29	1.0	3	0.9
PR-02	6.63	4	0.48	0.5	4	0.0
PR-03	6.38	4	0.25	0.5	4	0.0
PR-04	6.25	4	0.29	0.5	4	0.0
PR-05A	6.50	3	0.50	1.0	3	0.9
PR-05B	6.83	3	1.04	0.5	3	0.0
PR-06	6.67	3	0.58	0.5	3	0.0
Loch Raven Reservoir						
LR-02	7.39	3	0.49	0.5	3	0.0
LR-03	7.56	3	0.49	19.0	3	32.0
LR-10	7.93	3	0.34	0.5	3	0.0
LR-13	7.89	3	0.47	1.0	3	0.9

LR-14	6.92	3	0.39	3.7	3	5.5
LR-15	6.84	3	0.49	0.5	3	0.0
LR-17	7.26	5	0.40	7.0	5	8.9
LR-18	7.29	4	0.35	0.5	4	0.0
LR-19	6.90	4	0.29	0.9	4	0.8
LR-20	6.92	4	0.27	6.9	4	12.8
LR-21	7.73	4	0.28	1.9	4	2.8
LR-22	7.42	4	0.27	0.5	4	0.0
LR-23	7.26	3	0.10	4.3	3	6.6
LR-24	7.37	4	0.12	3.4	4	5.8
LR-27	6.93	3	0.47	0.5	3	0.0
LR-28	6.73	3	0.48	0.5	3	0.0
LR-30	7.43	3	0.46	0.5	3	0.0
LR-31	7.02	3	0.40	1.7	3	2.0
LR-32	7.55	4	0.39	0.5	4	0.0
LR-34	7.27	2	0.09	0.5	2	0.0
LR-35	7.65	3	0.34	0.5	3	0.0
LR-36	7.61	4	0.29	0.5	4	0.0
LR-38	7.90	3	0.25	0.5	3	0.0
Site	**Pollutant Parameter**					
	pH			**TSS**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Lower Gunpowder Falls						
GU-01	7.52	3	0.53	29.5	3	43.9
GU-03	8.30	4	0.48	0.9	4	0.8
GU-04	7.77	4	0.52	0.9	4	0.8
GU-05	8.15	4	0.54	2.9	4	4.8
GU-06	8.28	4	0.66	0.5	4	0.0
GU-07	7.77	4	0.18	0.5	4	0.0
GU-08	7.25	3	0.16	0.5	3	0.0
Little Gunpowder Falls						
LG-01	7.24	3	0.44	0.5	3	0.0
LG-02	7.01	3	0.25	0.5	3	0.0
LG-03	7.02	3	0.31	5.5	3	4.8
LG-04	7.02	4	0.14	0.9	4	0.8
LG-05	7.25	3	0.24	0.5	3	0.0
LG-07	7.22	4	0.31	2.9	4	4.8
LG-09	7.46	3	0.26	0.5	3	0.0
Bird River						
BI-01	6.45	4	0.60	3.4	4	5.8
BI-02	6.78	4	0.26	1.8	4	1.7
BI-03	7.33	4	0.32	0.9	4	0.8
BI-04	7.34	4	0.11	0.5	4	0.0
BI-05	7.48	4	0.14	0.5	4	0.0
Site	**Pollutant Parameter**					
	TS			**TKN**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	115	3	21.9	0.10	3	0.0
DC-02	106	3	40.6	0.14	3	0.1
DC-03	108	3	61.0	0.18	3	0.1
DC-04	116	3	25.1	0.14	3	0.1

Prettyboy Reservoir						
PR-01	119	3	33.0	0.16	3	0.1
PR-02	92	4	46.7	0.10	4	0.0
PR-03	63	4	22.3	0.10	4	0.0
PR-04	142	4	36.1	0.16	4	0.1
PR-05A	141	3	48.0	0.35	3	0.1
PR-05B	127	3	71.7	0.29	3	0.2
PR-06	99	3	22.1	0.26	3	0.3
Loch Raven Reservoir						
LR-02	103	3	25.8	0.10	3	0.0
LR-03	207	3	90.0	0.34	3	0.2
LR-10	509	3	98.8	0.10	3	0.0
LR-13	369	3	62.9	0.10	3	0.0
LR-14	75	3	65.1	0.29	3	0.3
LR-15	120	3	12.2	0.16	3	0.1
LR-17	160	5	25.0	0.13	5	0.1
LR-18	169	4	5.0	0.25	4	0.1
LR-19	155	4	26.7	0.26	4	0.2
LR-20	120	4	42.5	0.36	4	0.5
LR-21	226	4	75.2	0.16	4	0.1
LR-22	108	4	50.1	0.21	4	0.2
LR-23	123	3	28.1	0.10	3	0.0
LR-24	114	4	86.3	0.16	4	0.1
LR-27	101	3	25.0	0.13	3	0.1
LR-28	127	3	51.9	0.10	3	0.0
LR-30	103	3	60.3	0.13	3	0.1
LR-31	314	3	87.1	0.10	3	0.0
LR-32	142	4	15.4	0.10	4	0.0
LR-34	180	2	2.8	0.29	2	0.3
LR-35	146	3	7.2	0.14	3	0.1
LR-36	181	4	110.7	0.15	4	0.1
LR-38	202	3	19.1	0.10	3	0.0
Lower Gunpowder Falls						
GU-01	58	3	100.2	0.28	3	0.3
GU-03	240	4	47.5	0.10	4	0.0
GU-04	177	4	44.3	0.10	4	0.0
GU-05	196	4	65.5	0.16	4	0.1
GU-06	259	4	42.7	0.10	4	0.0
GU-07	251	4	55.9	0.13	4	0.1
GU-08	411	3	77.4	0.10	3	0.0
Little Gunpowder Falls						
LG-01	109	3	54.9	0.10	3	0.0
LG-02	81	3	34.1	0.10	3	0.0
LG-03	160	3	40.6	0.16	3	0.1
LG-04	179	4	51.6	0.14	3	0.1
LG-05	84	3	73.9	0.13	3	0.1
LG-07	248	4	46.7	0.37	4	0.3
LG-09	242	3	54.8	0.18	3	0.1
Bird River						
BI-01	117	4	43.7	0.47	4	0.1
BI-02	244	4	55.0	0.13	4	0.1
BI-03	341	4	138.3	0.19	4	0.1
BI-04	303	4	52.6	0.58	4	0.5

BI-05	338	4	75.6	0.36	4	0.5
Site	**Pollutant Parameter**					
	NO_2-NO_3			**TP**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	4.20	3	4.9	0.05	3	0.0
DC-02	3.79	3	4.0	0.05	3	0.0
DC-03	3.19	3	3.2	0.04	3	0.0
DC-04	4.14	3	2.2	0.03	3	0.0
Prettyboy Reservoir						
PR-01	2.47	3	0.5	0.02	3	0.0
PR-02	2.46	4	1.0	0.04	4	0.0
PR-03	4.08	4	3.6	0.04	4	0.0
PR-04	3.69	4	1.2	0.04	4	0.0
PR-05A	3.02	3	0.3	0.03	3	0.0
PR-05B	2.53	3	0.6	0.04	3	0.0
PR-06	1.72	3	0.5	0.03	3	0.0
Loch Raven Reservoir						
LR-02	1.75	3	0.8	0.02	3	0.0
LR-03	2.13	3	0.8	0.04	3	0.1
LR-10	0.70	3	0.7	0.12	3	0.2
LR-13	1.40	3	0.5	0.03	3	0.0
LR-14	1.33	2	0.3	0.05	3	0.1
LR-15	1.65	2	0.5	0.03	3	0.0
LR-17	3.77	4	2.1	0.04	5	0.0
LR-18	1.19	3	0.1	0.03	4	0.0
LR-19	2.35	3	0.3	0.04	4	0.0
LR-20	1.19	3	0.3	0.08	4	0.0
LR-21	2.94	4	0.8	0.03	4	0.0
LR-22	1.78	4	0.2	0.03	4	0.0
LR-23	0.89	3	0.2	0.06	3	0.0
LR-24	2.32	4	0.3	0.04	4	0.0
LR-27	2.62	3	0.1	0.04	3	0.0
LR-28	3.27	3	2.9	0.03	3	0.0
LR-30	2.26	3	0.3	0.02	3	0.0
LR-31	0.96	3	0.2	0.02	3	0.0
LR-32	1.99	4	0.4	0.01	4	0.0
LR-34	3.46	2	0.0	0.03	2	0.0
LR-35	3.78	3	0.4	0.04	3	0.0
LR-36	4.09	4	1.2	0.05	4	0.0
LR-38	2.67	3	0.4	0.03	3	0.0
Lower Gunpowder Falls						
GU-01	0.99	3	0.5	0.09	3	0.1
GU-03	3.81	4	0.6	0.03	4	0.0
GU-04	4.03	4	0.4	0.04	4	0.0
GU-05	2.87	4	0.4	0.06	4	0.0
GU-06	1.55	4	0.3	0.11	4	0.0
GU-07	1.08	4	0.2	0.02	4	0.0
GU-08	1.06	3	0.2	0.02	3	0.0
Little Gunpowder Falls						
LG-01	0.96	3	0.1	0.03	3	0.0
LG-02	1.43	3	0.2	0.02	3	0.0
LG-03	2.33	3	0.4	0.02	3	0.0

LG-04	1.50	4	1.4	0.03	3	0.0
LG-05	1.61	3	0.2	0.03	3	0.0
LG-07	3.33	4	1.0	0.04	4	0.0
LG-09	1.60	3	0.5	0.02	3	0.0
Bird River						
BI-01	0.27	4	0.2	0.06	4	0.0
BI-02	0.84	4	0.4	0.04	4	0.0
BI-03	0.30	4	0.2	0.04	4	0.0
BI-04	0.40	4	0.3	0.04	4	0.0
BI-05	0.55	4	0.2	0.03	4	0.0
Site	**Pollutant Parameter**					
	Cd			**Cd-dissolved**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	0.001	3	0.0	0.001	3	0.0
DC-02	0.001	3	0.0	0.001	3	0.0
DC-03	0.001	3	0.0	0.001	3	0.0
DC-04	0.001	3	0.0	0.001	3	0.0
Prettyboy Reservoir						
PR-01	0.001	3	0.0	0.001	3	0.0
PR-02	0.001	4	0.0	0.001	4	0.0
PR-03	0.001	4	0.0	0.001	4	0.0
PR-04	0.001	4	0.0	0.001	4	0.0
PR-05A	0.001	3	0.0	0.001	3	0.0
PR-05B	0.001	3	0.0	0.001	3	0.0
PR-06	0.001	3	0.0	0.001	3	0.0
Loch Raven Reservoir						
LR-02	0.001	3	0.0	0.001	3	0.0
LR-03	0.001	3	0.0	0.001	3	0.0
LR-10	0.001	3	0.0	0.001	3	0.0
LR-13	0.001	3	0.0	0.001	3	0.0
LR-14	0.001	3	0.0	0.001	3	0.0
LR-15	0.001	3	0.0	0.001	3	0.0
LR-17	0.001	5	0.0	0.001	5	0.0
LR-18	0.001	4	0.0	0.001	4	0.0
LR-19	0.001	4	0.0	0.001	4	0.0
LR-20	0.001	4	0.0	0.001	4	0.0
LR-21	0.001	4	0.0	0.001	4	0.0
LR-22	0.001	4	0.0	0.001	4	0.0
LR-23	0.001	3	0.0	0.001	3	0.0
LR-24	0.001	4	0.0	0.001	4	0.0
LR-27	0.001	3	0.0	0.001	3	0.0
LR-28	0.001	3	0.0	0.001	3	0.0
LR-30	0.001	3	0.0	0.001	3	0.0
LR-31	0.001	3	0.0	0.001	3	0.0
LR-32	0.001	4	0.0	0.001	4	0.0
LR-34	0.001	2	0.0	0.001	2	0.0
LR-35	0.001	3	0.0	0.001	3	0.0
LR-36	0.001	4	0.0	0.001	4	0.0
LR-38	0.001	3	0.0	0.001	3	0.0
Lower Gunpowder Falls						
GU-01	0.001	3	0.0	0.001	3	0.0
GU-03	0.001	4	0.0	0.001	4	0.0

GU-04	0.001	4	0.0	0.001	4	0.0
GU-05	0.001	4	0.0	0.001	4	0.0
GU-06	0.001	4	0.0	0.001	4	0.0
GU-07	0.001	4	0.0	0.001	4	0.0
GU-08	0.001	3	0.0	0.001	3	0.0
Little Gunpowder Falls						
LG-01	0.001	3	0.0	0.001	3	0.0
LG-02	0.001	3	0.0	0.001	3	0.0
LG-03	0.001	3	0.0	0.001	3	0.0
LG-04	0.001	4	0.0	0.001	4	0.0
LG-05	0.001	3	0.0	0.001	3	0.0
LG-07	0.001	4	0.0	0.001	4	0.0
LG-09	0.001	3	0.0	0.001	3	0.0
Bird River						
BI-01	0.001	4	0.0	0.001	4	0.0
BI-02	0.001	4	0.0	0.001	4	0.0
BI-03	0.001	4	0.0	0.001	4	0.0
BI-04	0.001	4	0.0	0.001	4	0.0
BI-05	0.001	4	0.0	0.001	4	0.0
Site	**Pollutant Parameter**					
	Cu			**Cu-dissolved**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	0.003	3	0.0	0.001	3	0.0
DC-02	0.003	3	0.0	0.001	3	0.0
DC-03	0.003	3	0.0	0.001	3	0.0
DC-04	0.002	3	0.0	0.001	3	0.0
Prettyboy Reservoir						
PR-01	0.001	3	0.0	0.001	3	0.0
PR-02	0.002	4	0.0	0.001	4	0.0
PR-03	0.002	4	0.0	0.001	4	0.0
PR-04	0.002	4	0.0	0.001	4	0.0
PR-05A	0.001	3	0.0	0.001	3	0.0
PR-05B	0.001	3	0.0	0.001	3	0.0
PR-06	0.002	3	0.0	0.001	3	0.0
Loch Raven Reservoir						
LR-02	0.004	3	0.0	0.002	3	0.0
LR-03	0.007	3	0.0	0.002	3	0.0
LR-10	0.004	3	0.0	0.001	3	0.0
LR-13	0.005	3	0.0	0.002	3	0.0
LR-14	0.008	3	0.0	0.003	3	0.0
LR-15	0.012	3	0.0	0.003	3	0.0
LR-17	0.009	5	0.0	0.005	5	0.0
LR-18	0.021	4	0.0	0.004	4	0.0
LR-19	0.023	4	0.0	0.005	4	0.0
LR-20	0.022	4	0.0	0.005	4	0.0
LR-21	0.004	4	0.0	0.002	4	0.0
LR-22	0.006	4	0.0	0.002	4	0.0
LR-23	0.009	3	0.0	0.002	3	0.0
LR-24	0.010	4	0.0	0.003	4	0.0
LR-27	0.001	3	0.0	0.001	3	0.0
LR-28	0.001	3	0.0	0.001	3	0.0
LR-30	0.002	3	0.0	0.001	3	0.0

LR-31	0.003	3	0.0	0.001	3	0.0
LR-32	0.004	4	0.0	0.002	4	0.0
LR-34	0.007	2	0.0	0.003	2	0.0
LR-35	0.004	3	0.0	0.001	3	0.0
LR-36	0.002	4	0.0	0.001	4	0.0
LR-38	0.008	3	0.0	0.003	3	0.0
Lower Gunpowder Falls						
GU-01	0.004	3	0.0	0.003	3	0.0
GU-03	0.004	4	0.0	0.002	4	0.0
GU-04	0.005	4	0.0	0.002	4	0.0
GU-05	0.004	4	0.0	0.002	4	0.0
GU-06	0.007	4	0.0	0.003	4	0.0
GU-07	0.006	4	0.0	0.002	4	0.0
GU-08	0.009	3	0.0	0.004	3	0.0
Little Gunpowder Falls						
LG-01	0.005	3	0.0	0.001	3	0.0
LG-02	0.005	3	0.0	0.001	3	0.0
LG-03	0.005	3	0.0	0.001	3	0.0
LG-04	0.004	4	0.0	0.002	4	0.0
LG-05	0.004	3	0.0	0.002	3	0.0
LG-07	0.004	4	0.0	0.002	4	0.0
LG-09	0.004	3	0.0	0.002	3	0.0
Bird River						
BI-01	0.008	4	0.0	0.002	4	0.0
BI-02	0.006	4	0.0	0.002	4	0.0
BI-03	0.004	4	0.0	0.001	4	0.0
BI-04	0.004	4	0.0	0.001	4	0.0
BI-05	0.005	4	0.0	0.001	4	0.0
Site	**Pollutant Parameter**					
	Pb			**Pb-dissolved**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	0.001	3	0.0	0.001	3	0.0
DC-02	0.001	3	0.0	0.001	3	0.0
DC-03	0.001	3	0.0	0.001	3	0.0
DC-04	0.001	3	0.0	0.001	3	0.0
Prettyboy Reservoir						
PR-01	0.001	3	0.0	0.001	3	0.0
PR-02	0.001	4	0.0	0.001	4	0.0
PR-03	0.001	4	0.0	0.001	4	0.0
PR-04	0.001	4	0.0	0.001	4	0.0
PR-05A	0.001	3	0.0	0.001	3	0.0
PR-05B	0.001	3	0.0	0.001	3	0.0
PR-06	0.001	3	0.0	0.001	3	0.0
Loch Raven Reservoir						
LR-02	0.001	3	0.0	0.001	3	0.0
LR-03	0.001	3	0.0	0.001	3	0.0
LR-10	0.001	3	0.0	0.001	3	0.0
LR-13	0.001	3	0.0	0.001	3	0.0
LR-14	0.001	3	0.0	0.001	3	0.0
LR-15	0.001	3	0.0	0.001	3	0.0
LR-17	0.001	5	0.0	0.001	5	0.0
LR-18	0.002	4	0.0	0.001	4	0.0

LR-19	0.001	4	0.0	0.001	4	0.0
LR-20	0.001	4	0.0	0.001	4	0.0
LR-21	0.001	4	0.0	0.001	4	0.0
LR-22	0.001	4	0.0	0.001	4	0.0
LR-23	0.001	3	0.0	0.001	3	0.0
LR-24	0.001	4	0.0	0.001	4	0.0
LR-27	0.001	3	0.0	0.001	3	0.0
LR-28	0.001	3	0.0	0.001	3	0.0
LR-30	0.001	3	0.0	0.001	3	0.0
LR-31	0.001	3	0.0	0.001	3	0.0
LR-32	0.001	4	0.0	0.001	4	0.0
LR-34	0.001	2	0.0	0.001	2	0.0
LR-35	0.001	3	0.0	0.001	3	0.0
LR-36	0.001	4	0.0	0.001	4	0.0
LR-38	0.001	3	0.0	0.001	3	0.0
Lower Gunpowder Falls						
GU-01	0.001	3	0.0	0.001	3	0.0
GU-03	0.001	4	0.0	0.001	4	0.0
GU-04	0.001	4	0.0	0.001	4	0.0
GU-05	0.001	4	0.0	0.001	4	0.0
GU-06	0.001	4	0.0	0.001	4	0.0
GU-07	0.001	4	0.0	0.001	4	0.0
GU-08	0.001	3	0.0	0.001	3	0.0
Little Gunpowder Falls						
LG-01	0.001	3	0.0	0.001	3	0.0
LG-02	0.001	3	0.0	0.001	3	0.0
LG-03	0.001	3	0.0	0.001	3	0.0
LG-04	0.001	4	0.0	0.001	4	0.0
LG-05	0.001	3	0.0	0.001	3	0.0
LG-07	0.001	4	0.0	0.001	4	0.0
LG-09	0.001	3	0.0	0.001	3	0.0
Bird River						
BI-01	0.001	4	0.0	0.001	4	0.0
BI-02	0.001	4	0.0	0.001	4	0.0
BI-03	0.001	4	0.0	0.001	4	0.0
BI-04	0.001	4	0.0	0.001	4	0.0
BI-05	0.000	4	0.0	0.001	4	0.0
Site	**Pollutant Parameter**					
	Zn			**Zn-dissolved**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	0.007	3	0.0	0.002	3	0.0
DC-02	0.005	3	0.0	0.002	3	0.0
DC-03	0.006	3	0.0	0.001	3	0.0
DC-04	0.006	3	0.0	0.001	3	0.0
Prettyboy Reservoir						
PR-01	0.001	3	0.0	0.001	3	0.0
PR-02	0.007	4	0.0	0.002	4	0.0
PR-03	0.005	4	0.0	0.001	4	0.0
PR-04	0.002	4	0.0	0.001	4	0.0
PR-05A	0.001	3	0.0	0.001	3	0.0
PR-05B	0.002	3	0.0	0.001	3	0.0
PR-06	0.002	3	0.0	0.001	3	0.0

Loch Raven Reservoir						
LR-02	0.003	3	0.0	0.001	3	0.0
LR-03	0.001	3	0.0	0.001	3	0.0
LR-10	0.003	3	0.0	0.001	3	0.0
LR-13	0.010	3	0.0	0.004	3	0.0
LR-14	0.009	3	0.0	0.002	3	0.0
LR-15	0.008	3	0.0	0.002	3	0.0
LR-17	0.013	5	0.0	0.003	5	0.0
LR-18	0.030	4	0.0	0.009	4	0.0
LR-19	0.016	4	0.0	0.004	4	0.0
LR-20	0.014	4	0.0	0.004	4	0.0
LR-21	0.022	4	0.0	0.006	4	0.0
LR-22	0.021	4	0.0	0.005	4	0.0
LR-23	0.018	3	0.0	0.005	3	0.0
LR-24	0.014	4	0.0	0.003	4	0.0
LR-27	0.006	3	0.0	0.002	3	0.0
LR-28	0.003	3	0.0	0.001	3	0.0
LR-30	0.003	3	0.0	0.001	3	0.0
LR-31	0.001	3	0.0	0.001	3	0.0
LR-32	0.001	4	0.0	0.001	4	0.0
LR-34	0.001	2	0.0	0.001	2	0.0
LR-35	0.003	3	0.0	0.001	3	0.0
LR-36	0.001	4	0.0	0.001	4	0.0
LR-38	0.002	3	0.0	0.001	3	0.0
Lower Gunpowder Falls						
GU-01	0.007	3	0.0	0.002	3	0.0
GU-03	0.003	4	0.0	0.001	4	0.0
GU-04	0.007	4	0.0	0.003	4	0.0
GU-05	0.003	4	0.0	0.001	4	0.0
GU-06	0.008	4	0.0	0.003	4	0.0
GU-07	0.010	4	0.0	0.003	4	0.0
GU-08	0.011	3	0.0	0.003	3	0.0
Little Gunpowder Falls						
LG-01	0.013	3	0.0	0.003	3	0.0
LG-02	0.010	3	0.0	0.003	3	0.0
LG-03	0.010	3	0.0	0.003	3	0.0
LG-04	0.010	4	0.0	0.003	4	0.0
LG-05	0.011	3	0.0	0.003	3	0.0
LG-07	0.008	4	0.0	0.002	4	0.0
LG-09	0.008	3	0.0	0.002	3	0.0
Bird River						
BI-01	0.022	4	0.0	0.006	4	0.0
BI-02	0.011	4	0.0	0.004	4	0.0
BI-03	0.010	4	0.0	0.003	4	0.0
BI-04	0.008	4	0.0	0.002	4	0.0
BI-05	0.015	4	0.0	0.004	4	0.0
Site	**Pollutant Parameter**					
	BOD			**COD**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	1	3	0.0	9	3	5.8
DC-02	1	3	0.0	5	3	3.8
DC-03	1	3	0.0	7	3	3.9

DC-04	1	3	0.0	6	3	3.2
Prettyboy Reservoir						
PR-01	1	3	0.0	5	3	4.3
PR-02	1	4	0.0	8	4	5.9
PR-03	1	4	0.0	4	4	3.8
PR-04	1	4	0.0	4	3	2.0
PR-05A	1	3	0.0	15	3	1.0
PR-05B	1	3	0.0	15	3	3.2
PR-06	1	3	0.0	6	3	6.1
Loch Raven Reservoir						
LR-02	2	3	1.2	11	3	10.8
LR-03	2	3	1.2	15	3	7.5
LR-10	1	3	0.0	13	3	10.8
LR-13	1	3	0.0	14	3	11.3
LR-14	1	3	0.0	11	3	4.2
LR-15	1	3	0.0	11	3	7.1
LR-17	1	5	0.0	8	5	6.8
LR-18	1	4	0.0	8	4	6.5
LR-19	1	4	0.0	6	4	3.5
LR-20	1	4	0.0	9	4	5.9
LR-21	1	4	0.0	5	4	4.0
LR-22	1	4	0.0	7	4	5.4
LR-23	1	3	0.0	8	3	5.3
LR-24	1	4	0.0	6	4	4.5
LR-27	1	3	0.0	11	3	10.8
LR-28	1	3	0.0	10	3	5.5
LR-30	1	3	0.0	9	3	9.5
LR-31	1	3	0.0	7	3	7.8
LR-32	1	4	0.0	10	4	8.7
LR-34	1	2	0.0	11	2	11.7
LR-35	1	3	0.0	15	3	10.7
LR-36	1	4	0.0	11	4	9.7
LR-38	1	3	0.0	13	3	8.7
Lower Gunpowder Falls						
GU-01	1	3	0.0	11	3	3.5
GU-03	1	4	0.0	5	4	3.3
GU-04	1	4	0.0	5	4	4.3
GU-05	1	4	0.0	7	4	8.3
GU-06	1	4	0.0	6	4	5.0
GU-07	1	4	0.0	7	4	3.3
GU-08	1	3	0.0	3	3	0.0
Little Gunpowder Falls						
LG-01	1	3	0.0	9	3	3.0
LG-02	1	3	0.0	8	3	0.6
LG-03	1	3	0.0	7	3	3.9
LG-04	1	4	0.0	5	4	3.2
LG-05	1	3	0.0	8	3	2.0
LG-07	1	4	0.0	8	4	6.4
LG-09	1	3	0.0	10	3	5.8
Bird River						
BI-01	1	4	0.5	24	4	6.2
BI-02	1	4	0.0	10	4	5.4
BI-03	1	4	0.0	7	4	3.6

BI-04	1	4	0.0	13	4	6.8
BI-05	1	4	0.0	6	4	3.8
Site	**Pollutant Parameter**					
	Cl			**TN**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	79.49	3	45.9	4.30	3	4.9
DC-02	36.82	3	14.8	3.92	3	3.9
DC-03	41.74	3	14.9	3.37	3	3.1
DC-04	45.93	3	21.2	4.28	3	2.3
Prettyboy Reservoir						
PR-01	25.92	3	5.6	2.63	3	0.5
PR-02	16.58	4	3.7	2.56	4	1.0
PR-03	31.34	4	24.9	4.18	4	3.6
PR-04	37.23	4	10.2	3.84	4	1.4
PR-05A	25.66	3	6.8	3.37	3	0.3
PR-05B	24.55	3	6.4	2.82	3	0.5
PR-06	25.44	3	3.5	1.97	3	0.5
Loch Raven Reservoir						
LR-02	31.28	3	13.7	1.85	3	0.8
LR-03	46.25	3	22.0	2.47	3	0.6
LR-10	79.43	3	73.0	0.80	3	0.7
LR-13	74.95	3	38.9	1.50	3	0.5
LR-14	64.37	2	37.9	1.71	2	0.7
LR-15	81.54	2	61.7	1.75	2	0.5
LR-17	37.51	4	14.0	3.87	4	2.1
LR-18	52.02	3	2.1	1.44	3	0.2
LR-19	73.40	3	4.9	2.53	3	0.2
LR-20	17.88	3	0.4	1.29	3	0.3
LR-21	73.18	4	17.3	3.09	4	0.8
LR-22	31.54	4	6.6	1.99	4	0.3
LR-23	22.86	3	0.6	0.99	3	0.2
LR-24	32.63	4	4.0	2.48	4	0.4
LR-27	26.14	3	1.3	2.75	3	0.1
LR-28	102.34	3	85.3	3.37	3	2.9
LR-30	34.73	3	1.2	2.40	3	0.4
LR-31	128.90	3	6.0	1.06	3	0.2
LR-32	28.95	4	2.4	2.09	4	0.4
LR-34	36.50	2	0.5	3.75	2	0.3
LR-35	38.79	3	3.9	3.92	3	0.3
LR-36	49.23	4	7.1	4.24	4	1.2
LR-38	23.74	3	1.1	2.77	3	0.4
Lower Gunpowder Falls						
GU-01	39.59	3	9.4	1.27	3	0.2
GU-03	23.74	4	2.5	3.91	4	0.6
GU-04	36.80	4	2.3	4.13	4	0.4
GU-05	24.54	4	2.9	3.03	4	0.4
GU-06	54.94	4	14.1	1.65	4	0.3
GU-07	78.98	4	12.4	1.20	4	0.2
GU-08	115.49	3	6.2	1.16	3	0.2
Little Gunpowder Falls						
LG-01	21.06	3	1.6	1.06	3	0.1
LG-02	10.57	3	0.9	1.53	3	0.2

LG-03	53.30	3	1.8	2.49	3	0.5
LG-04	40.25	4	10.0	1.17	3	1.3
LG-05	20.23	3	2.2	1.75	3	0.2
LG-07	60.70	4	9.8	3.70	4	0.8
LG-09	43.44	3	6.8	1.78	3	0.5
Bird River						
BI-01	24.26	4	12.7	0.74	4	0.2
BI-02	99.45	4	31.3	0.97	4	0.4
BI-03	123.13	4	28.0	0.49	4	0.1
BI-04	86.55	4	30.5	0.98	4	0.6
BI-05	150.02	4	47.5	0.91	4	0.4
Site	**Pollutant Parameter**					
	Na			**Hardness**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	32.23	3	4.0	47.65	3	9.9
DC-02	16.43	3	4.8	54.85	3	11.0
DC-03	20.93	3	4.8	56.91	3	11.8
DC-04	20.80	3	3.1	48.93	3	7.4
Prettyboy Reservoir						
PR-01	17.60	3	2.5	33.45	3	3.1
PR-02	13.76	4	5.9	48.08	4	13.1
PR-03	17.18	4	3.4	40.84	4	3.0
PR-04	22.80	4	2.4	57.26	4	4.6
PR-05A	12.37	3	3.2	49.14	3	6.0
PR-05B	11.55	3	2.6	56.88	3	7.3
PR-06	23.95	3	10.5	34.09	3	3.1
Loch Raven Reservoir						
LR-02	17.98	3	7.2	45.03	3	7.5
LR-03	20.75	3	6.4	102.60	3	19.1
LR-10	81.25	3	37.8	167.72	3	79.6
LR-13	54.07	3	16.9	147.02	3	58.9
LR-14	15.78	3	10.3	35.30	3	5.0
LR-15	17.90	3	3.8	40.96	3	5.5
LR-17	19.73	5	4.2	83.12	5	23.5
LR-18	22.30	4	5.6	90.15	4	9.8
LR-19	30.60	4	4.1	65.55	4	14.0
LR-20	13.05	4	3.6	46.87	4	7.2
LR-21	30.34	4	6.0	113.32	4	30.7
LR-22	20.43	4	9.4	58.36	4	15.9
LR-23	16.85	3	5.9	44.05	3	8.4
LR-24	19.61	4	5.4	49.49	4	9.0
LR-27	13.40	2	1.9	45.93	3	5.5
LR-28	25.15	2	4.9	48.23	3	9.7
LR-30	16.75	2	5.0	50.09	3	7.6
LR-31	31.53	2	24.2	70.25	3	15.0
LR-32	14.86	4	6.1	70.11	4	16.1
LR-34	24.93	2	0.4	62.01	2	0.6
LR-35	25.00	3	2.4	68.40	3	18.9
LR-36	46.48	4	8.9	68.20	4	15.8
LR-38	12.60	3	4.3	141.16	3	48.4
Lower Gunpowder Falls						
GU-01	23.75	3	3.6	99.03	3	27.7

GU-03	11.81	4	2.6	117.16	4	48.1
GU-04	15.53	4	5.1	112.23	4	39.8
GU-05	11.06	4	2.3	111.58	4	43.3
GU-06	27.19	4	9.7	175.05	4	102.9
GU-07	35.63	4	6.6	128.51	4	81.4
GU-08	52.83	3	2.5	265.48	3	175.8
Little Gunpowder Falls						
LG-01	10.87	3	2.4	44.31	3	3.9
LG-02	7.77	3	3.3	31.86	3	4.2
LG-03	27.00	3	6.1	45.73	3	3.8
LG-04	20.40	4	2.9	48.90	4	6.0
LG-05	12.58	3	2.1	45.45	3	4.3
LG-07	29.05	4	9.2	60.17	4	7.5
LG-09	20.38	3	5.7	73.48	3	6.4
Bird River						
BI-01	27.29	4	18.9	36.63	4	3.9
BI-02	71.93	4	60.7	99.44	4	17.9
BI-03	87.41	4	45.5	141.45	4	40.0
BI-04	77.44	4	40.9	171.13	4	54.9
BI-05	97.64	4	42.8	191.43	4	65.1
Site	**Pollutant Parameter**					
	Mg			**Ca**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
Deer Creek						
DC-01	4.07	3	1.9	12.37	3	0.8
DC-02	4.06	3	1.9	15.28	3	1.4
DC-03	4.17	3	2.1	15.92	3	1.2
DC-04	3.92	3	1.7	13.13	3	0.2
Prettyboy Reservoir						
PR-01	3.03	3	0.1	8.40	3	1.1
PR-02	2.86	4	0.1	14.54	4	5.0
PR-03	2.84	4	0.1	11.60	4	1.0
PR-04	3.00	4	0.1	17.99	4	1.8
PR-05A	3.04	3	0.1	14.67	3	2.2
PR-05B	3.03	3	0.1	17.79	3	2.7
PR-06	2.99	3	0.1	8.72	3	1.1
Loch Raven Reservoir						
LR-02	3.85	3	1.8	11.68	3	0.5
LR-03	5.69	3	4.5	31.71	3	3.9
LR-10	13.66	3	17.8	44.64	3	8.7
LR-13	10.76	3	12.9	41.14	3	5.8
LR-14	3.72	3	1.7	7.99	3	0.9
LR-15	3.86	3	1.8	10.04	3	1.2
LR-17	7.58	5	4.2	20.78	5	7.3
LR-18	8.16	4	5.8	22.64	4	7.4
LR-19	5.83	4	3.2	16.63	4	2.4
LR-20	4.04	4	1.6	12.07	4	1.5
LR-21	9.97	4	7.9	28.94	4	1.7
LR-22	3.95	4	1.6	16.86	4	7.1
LR-23	4.16	3	2.4	10.78	3	0.6
LR-24	4.16	4	2.5	12.97	4	1.1
LR-27	2.81	2	0.1	12.59	2	1.4
LR-28	2.93	2	0.0	12.32	2	1.6

LR-30	3.01	2	0.2	13.37	2	0.6
LR-31	3.35	2	0.1	19.21	2	1.8
LR-32	4.38	4	2.4	20.87	4	9.0
LR-34	5.38	2	3.2	15.97	2	5.5
LR-35	4.47	3	2.4	20.02	3	10.4
LR-36	3.10	4	0.1	22.21	4	6.3
LR-38	7.66	3	7.4	43.90	3	8.0
Lower Gunpowder Falls						
GU-01	5.88	3	3.6	29.96	3	9.5
GU-03	6.39	4	6.5	36.38	4	8.7
GU-04	9.13	4	7.6	28.00	4	10.6
GU-05	5.60	4	5.0	36.15	4	10.6
GU-06	10.90	4	10.0	52.13	4	24.8
GU-07	7.82	4	9.5	38.57	4	17.1
GU-08	13.77	3	18.3	83.60	3	44.7
Little Gunpowder Falls						
LG-01	2.99	3	0.1	12.78	3	1.4
LG-02	2.67	3	0.2	8.36	3	1.3
LG-03	3.22	3	0.2	13.00	3	1.3
LG-04	3.17	4	0.2	14.35	4	2.5
LG-05	3.14	3	0.2	13.02	3	1.5
LG-07	3.28	4	0.3	18.69	4	2.6
LG-09	3.41	3	0.3	23.83	3	2.2
Bird River						
BI-01	4.53	4	1.5	7.12	4	3.0
BI-02	9.54	4	4.3	23.70	4	8.3
BI-03	9.98	4	4.5	40.22	4	10.7
BI-04	11.35	4	5.4	49.82	4	17.3
BI-05	13.95	4	7.3	53.67	4	14.6

Appendix 9-3: Tidal Waters Chemical Monitoring Results

Site	TSS			TS		
	Mean	N	Std.Dev	Mean	N	Std.Dev
BC	133.4	16	162.3	7385.3	16	3567.7
BD	30.5	31	25.5	828.8	31	1078.6
BR	55.0	31	61.9	2505.7	31	2312.8
DD	69.4	15	99.3	3197.4	15	2941.4
GR	50.6	14	64.8	2527.7	14	2497.7
HM	50.2	11	92.1	3570.2	11	2633.6
MR	55.5	14	78.2	3643.0	14	3005.8
MS	79.5	15	103.8	4492.6	15	3316.3
ORB	130.5	15	169.5	6895.5	15	4045.8
PR	137.1	16	188.0	8359.0	16	4012.5
PSF	9.6	17	24.2	219.2	17	59.8
PSE	70.7	17	85.1	4710.4	17	3544.4
Site	**TKN**			**NO_2-NO_3**		
	Mean	N	Std.Dev	Mean	N	Std.Dev
BC	1.1406	17	0.4648	0.3727	15	1.0606
BD	0.9519	31	0.3801	0.1130	27	0.2559
BR	1.7087	31	0.6934	0.3659	27	0.5805
DD	0.4227	15	0.1673	0.0600	13	0.0000
GR	0.3736	14	0.1674	0.0575	12	0.0087

HM	0.4900	11	0.1281	0.1500	8	0.2546
MR	0.3857	14	0.1582	0.1233	12	0.1480
MS	0.3673	15	0.1209	0.1015	13	0.1498
ORB	0.7319	16	0.3443	0.2964	14	0.7920
PR	0.8753	17	0.4465	0.1040	15	0.1051
PSF	0.4029	17	0.2643	0.8221	14	0.5158
PSE	0.6841	17	0.2286	0.2667	15	0.2785
Site	**TP**			**Cu**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	0.1362	17	0.0856	0.0109	17	0.0126
BD	0.1377	31	0.0533	0.0082	31	0.0085
BR	0.2158	31	0.1079	0.0073	31	0.0091
DD	0.0653	15	0.0188	0.0054	15	0.0070
GR	0.0871	14	0.0414	0.0088	14	0.0075
HM	0.0536	11	0.0441	0.0045	11	0.0062
MR	0.0707	14	0.0279	0.0053	14	0.0049
MS	0.0573	15	0.0198	0.0047	15	0.0048
ORB	0.0803	16	0.0397	0.0096	16	0.0099
PR	0.0856	17	0.0462	0.0060	17	0.0053
PSF	0.0735	17	0.0741	0.0077	17	0.0078
PSE	0.0812	17	0.0369	0.0090	17	0.0106
Site	**Cu-dissolved**			**Pb**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	0.0033	17	0.0034	0.0011	17	0.0010
BD	0.0026	31	0.0026	0.0008	31	0.0006
BR	0.0023	31	0.0027	0.0009	31	0.0007
DD	0.0020	15	0.0021	0.0009	15	0.0005
GR	0.0029	14	0.0027	0.0008	14	0.0005
HM	0.0019	11	0.0023	0.0009	11	0.0006
MR	0.0016	14	0.0014	0.0008	14	0.0004
MS	0.0015	15	0.0014	0.0008	15	0.0004
ORB	0.0031	16	0.0026	0.0010	16	0.0009
PR	0.0020	17	0.0016	0.0008	17	0.0006
PSF	0.0026	17	0.0026	0.0009	17	0.0005
PSE	0.0029	17	0.0028	0.0009	17	0.0006
Site	**Pb-dissolved**			**Zn**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	0.0007	17	0.0004	0.0191	17	0.0252
BD	0.0005	31	0.0002	0.0137	31	0.0110
BR	0.0006	31	0.0002	0.0137	31	0.0144
DD	0.0006	15	0.0002	0.0135	15	0.0125
GR	0.0006	14	0.0002	0.0109	14	0.0072
HM	0.0005	11	0.0002	0.0163	11	0.0165
MR	0.0005	14	0.0001	0.0125	14	0.0105
MS	0.0005	15	0.0001	0.0123	15	0.0075
ORB	0.0007	16	0.0004	0.0251	16	0.0395
PR	0.0006	17	0.0004	0.0180	17	0.0243
PSF	0.0005	17	0.0001	0.0181	17	0.0136
PSE	0.0006	17	0.0002	0.0151	17	0.0133
Site	**Zn-dissolved**			**BOD**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	0.0056	17	0.0070	6.5	17	2.5
BD	0.0037	31	0.0025	4.2	31	2.2

BR	0.0040	31	0.0037	6.5	29	2.4
DD	0.0042	15	0.0031	1.3	15	0.6
GR	0.0033	14	0.0023	1.1	14	0.5
HM	0.0046	11	0.0044	1.5	11	0.7
MR	0.0048	14	0.0032	1.5	14	0.7
MS	0.0039	15	0.0024	1.1	15	0.5
ORB	0.0067	16	0.0094	2.5	16	1.4
PR	0.0044	17	0.0046	3.6	17	2.3
PSF	0.0052	17	0.0034	1.0	17	0.0
PSE	0.0048	17	0.0033	2.3	17	2.1
Site	**COD**			**CL**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	30.5	17	17.4	4132.3	15	2859.7
BD	13.5	31	8.2	538.2	27	1034.8
BR	23.2	31	14.3	1373.4	27	1532.3
DD	13.0	15	8.2	2285.4	14	2275.0
GR	11.2	14	7.8	1579.4	11	1695.5
HM	16.3	11	8.7	1681.8	8	1743.8
MR	16.2	14	12.5	1951.5	13	1971.1
MS	16.8	15	15.5	2990.3	14	3145.3
ORB	24.0	16	17.7	3917.1	14	2709.6
PR	28.4	17	19.4	4834.6	15	3242.5
PSF	8.1	17	6.9	40.5	15	21.1
PSE	18.1	17	9.2	2528.7	15	2239.3
Site	**Fl**			**SO_4**		
	Mean	**N**	**Std.Dev**	**Mean**	**N**	**Std.Dev**
BC	0.3	16	0.1	611.3	15	391.2
BD	0.2	27	0.0	72.1	26	115.8
BR	0.3	27	0.3	205.1	27	217.9
DD	0.3	14	0.1	328.4	14	284.4
GR	0.3	12	0.1	234.9	11	231.1
HM	0.3	9	0.3	285.2	9	251.9
MR	0.3	13	0.3	281.0	13	278.6
MS	0.3	14	0.3	406.2	14	344.0
ORB	0.3	14	0.0	582.9	14	383.7
PR	0.3	15	0.1	683.3	15	418.7
PSF	0.3	15	0.1	13.0	15	6.5
PSE	0.3	15	0.1	370.8	15	322.5
Site	**TN**					
	Mean	**N**	**Std.Dev**			
BC	1.5400	15	1.2020			
BD	1.0767	27	0.4166			
BR	2.1019	27	0.7623			
DD	0.4638	13	0.1698			
GR	0.4250	12	0.1780			
HM	0.6250	8	0.2237			
MR	0.4958	12	0.2039			
MS	0.4585	13	0.1612			
ORB	1.0293	14	0.8705			
PR	0.9133	15	0.3939			
PSF	1.2164	14	0.3726			
PSE	0.9373	15	0.3224			

Appendix 9-4: Results of 2008 Probabilistic Monitoring

Station ID	Subwatershed	DNR 12 Digit Subsheds	Benthic Index of Biotic Integrity Score	Rating
Prettyboy Reservoir				
0204014	Prettyboy Direct Drainage-A	0313	4.00	Good
0204033	Georges Run	0314	3.67	Fair
0208001	Gunpowder Falls	0316	4.00	Good
0208005	Walker Run	0316	4.33	Good
0208006	Grave Run	0315	4.00	Good
0208009	Gunpowder Falls	0316	3.67	Fair
0208012	Peggy's Run	0314	3.33	Fair
0208013	Prettyboy Branch	0313	3.67	Fair
0208018	Prettyboy Branch	0313	4.00	Good
0208019	Peggy's Run	0314	2.33	Poor
0208022	Frog Hollow	0313	4.33	Good
0208036	Grave Run	0315	4.00	Good
0208038	Peggy's Run	0314	3.67	Fair
Loch Raven Reservoir				
0304021	Fourth Mine Branch	0309	4.33	Good
0304084	Piney Run	0308	4.33	Good
0304121	Blackrock Run	0307	4.00	Good
0304197	Baisman Run	0302	4.00	Good
0304208	Goodwin Run	0302	1.00	Very Poor
0304214	Merryman's Branch	0300	2.67	Poor
0308007	Piney Creek	0305	3.67	Fair
0308016	Blackrock Run	0307	4.00	Good
0308018	First Mine Branch	0309	2.00	Poor
0308028	Beetree Run	0311	4.00	Good
0308036	Gunpowder Falls	0306	4.00	Good
0308042	Little Falls	0312	4.00	Good
0308044	Loch Raven Reservoir-E	0300	3.33	Fair
0308046	Deadman's Run	0303	4.00	Good
0308048	Little Falls	0312	4.00	Good
0308049	Goodwin Run	0302	1.67	Very Poor
0308050	Slade Run	0303	4.67	Good
0308055	McGill Run	0308	4.00	Good
0308061	Indian Run-Loch Raven	0307	4.33	Good
0308064	Overshot Run	0301	4.33	Good
0308068	Western Run-Loch Raven-A	0303	3.33	Fair
0308072	Little Falls	0312	4.33	Good
0308078	Buffalo Creek	0305	4.33	Good
0308083	Blackrock Run	0307	3.67	Fair
0308086	Beaver Dam Run	0302	4.00	Good

0308092	Bush Cabin	0306	4.67	Good
0308093	Gunpowder Falls	0304	2.00	Poor
0308095	Fitzhugh Run	0300	4.00	Good
0308097	Piney Run	0308	4.00	Good
0308102	Second Mine Branch	0309	4.33	Good
0308107	Loch Raven Reservoir-F	0300	3.33	Fair
0308109	Little Falls	0312	4.00	Good
0308112	Indian Run-Loch Raven	0307	4.67	Good
0308115	Piney Run	0308	3.00	Fair
0308117	Little Piney Run	0308	3.00	Fair
0308118	Oregon Run	0302	2.00	Poor
0308120	Piney Creek	0305	3.33	Fair
0308128	Bush Cabin	0306	4.00	Good
0308139	Indian Run-Loch Raven	0307	3.33	Fair
0308144	Dulaney Valley Branch	0300	4.00	Good
0308146	Piney Run	0308	3.33	Fair
0308152	Little Falls	0312	3.33	Fair
0308157	Beetree Run	0311	4.67	Good
0308160	Bush Cabin	0306	4.00	Good
0308164	Bush Cabin	0306	4.67	Good
0308165	Gunpowder Falls	0306	4.00	Good
0308174	Blackrock Run	0307	4.00	Good
Deer Creek				
0404001	Harris Mill	0332	4.33	Good
0404006	Plumtree Branch	0332	3.67	Fair
0408023	Deer Creek-A	0332	4.00	Good
0408024	Deer Creek-A	0332	4.00	Good
0408026	Deer Creek-A	0332	2.67	Poor
0408029	Harris Mill	0332	2.67	Poor
0408030	Ebaughs Creek	0332	3.33	Fair
0408032	Harris Mill	0332	1.67	Very Poor
0408036	Deer Creek-A	0332	4.00	Good
0408041	Ebaughs Creek	0332	3.67	Fair
0408042	Harris Mill	0332	1.33	Very Poor
0408044	Ebaughs Creek	0332	3.33	Fair
Little Gunpowder Falls				
0904008	Parker Branch	0299	3.67	Fair
0908001	Little Gunpowder Falls-C	0298	3.67	Fair
0908002	Little Gunpowder Falls-A	0298	4.33	Good
0908003	Little Gunpowder Falls-C	0298	4.00	Good
0908004	Sawmill Branch	0299	4.33	Good

0908005	Little Gunpowder Falls-A	0298	3.67	Fair
0908008	Little Gunpowder Falls-A	0299	3.67	Fair
0908010	Little Gunpowder Falls-A	0298	3.67	Fair
0908011	Little Gunpowder Falls-A	0299	3.67	Fair
0908014	Little Gunpowder Falls-A	0298	3.67	Fair
0908025	Sawmill Branch	0299	4.33	Good
Lower Gunpowder Falls				
1004002	Jennifer Branch	0297	1.33	Very Poor
1004029	Long Green Creek	0297	2.00	Poor
1008001	Lower Gunpowder Falls	0297	1.00	Very Poor
1008003	Lower Gunpowder Falls	0296	3.00	Fair
1008006	Lower Gunpowder Falls	0297	1.00	Very Poor
1008020	Lower Gunpowder Falls	0296	2.67	Poor
1008024	Long Green Creek	0297	1.33	Very Poor
1008029	Jennifer Branch	0297	1.33	Very Poor
1008037	Minebank Run	0297	1.67	Very Poor
1008038	Minebank Run	0297	1.00	Very Poor
1008040	Sweathouse Run	0296	4.33	Good
1008041	Sweathouse Run	0296	4.33	Good
Bird River				
1108001	Bird River-D	0294	1.67	Very Poor
1108003	Whitemarsh Run	0295	1.00	Very Poor
1108004	Whitemarsh Run (S.Fo)	0295	1.67	Very Poor
1108008	Honeygo Run	0295	1.33	Very Poor
1108016	Whitemarsh Run (S.Fo)	0295	1.67	Very Poor

10.0 Permit Requirements

Part IV. Program Review and Annual Progress Reporting

A. Annual Reporting

1. Annual progress reports, required under 40 CFR 122.42(c), will facilitate the long-term assessment of Baltimore County's NPDES stormwater program. The County shall submit annual reports on or before June 15th of each year that include:

   e. The identification of water quality improvements or degradation

10.1 Introduction

The following analysis provides a recalculation of watershed pollutant loads for nitrogen and phosphorus based on guidance from Maryland Department of the Environment on pollutant loading analysis for the Water Resources Element and the Chesapeake Bay Program – Phase 4.3 Watershed Model (10.2). It also presents a summary of the pollutant load reductions (water quality improvements) that have resulted from implementation of the management programs required under this permit. It includes reductions due to implementation of stormwater Best Management Practices (Section 1), reductions due to street sweeping and storm drain cleaning programs (Section 3), and reductions due to capital restoration projects (Section 7). Further reductions resulting from illicit connection removals (Section 5) and education activities (Section 4) are discussed under the appropriate section. Actual pollutant load reductions due to illicit connection removals and education activities have not been determined.

With the completion of a number of Total Maximum Daily Load analyses for impaired waters, target load reductions for nutrient, sediment, and bacteria have been determined for a number of watersheds. In addition, additional Water Quality Analyses and proposed modification of the biological listing criteria have resulted in changes to the impairment listings (2008 Integrated Report). Table 10-1 summarizes the reductions required for urban stormwater where they have been determined, on a percentage basis.

Table 10-1: Status of TMDLs and TMDL Reduction Requirements for Urban Stormwater

Watershed	Total Phosphorus	Total Nitrogen	Sediment	Bacteria	Biological	Other (Metals, Toxics)
Deer Creek	NA	NA	NA	NA	NA.	NA
Prettyboy	54% (15% Urban)	NA	NA	In Process	NA	Complete
Loch Raven	50% (15% Urban)	NA	25%	In Process	Not Comp.	Complete
Lower Gunpowder	Not Comp.	Not Comp.	NA	NA	Not Comp.	NA
Little Gunpowder	NA	NA	NA	NA	NA	NA
Bird River	NA	NA	Not Comp.	NA	Not Comp.	NA
Gunpowder River	Not Comp.	Not Comp.	Not Comp.	NA	Not Comp.	Not Comp.

Middle River	Not Comp.	Not Comp.	Not Comp.	NA	NA	Not Comp.
Liberty Res.	Not Comp.	Not Comp.	Not Comp.	In Process	Not Comp.	Complete
Patapsco	15%*	15%*	Not Comp.	NA	Not Comp.	Not Comp.
Gwynns Falls	15%*	15%*	Not Comp.	67.2-93.2%	Not Comp.	NA
Jones Falls	15%*	15%*	Not Comp.	92.4-95.3%	Not Comp.	Not Comp.
Back River	15%	15%	Not Comp.	95%	Not Comp.	Complete
Baltimore Harbor	15%*	15%*	Not Comp.	Not Comp.	Not Comp.	Complete

* Based on TMDL developed for tidal Baltimore Harbor

Additional TMDLs have been completed for chlordane (Back River and Lake Roland), and for mercury in fish tissue (Prettyboy Reservoir, Loch Raven Reservoir, and Liberty Reservoir (not EPA approved)). However, these TMDLs have limited options to address inputs from stormwater discharge due to the nature of the source of pollution (chlordane – historic, mercury – air deposition). A number of listings for impairment have been removed due to Water Quality Assessments that have indicated that the level of particular pollutants is below the existing standards. The most recent Water Quality Assessments have indicated that Jones Falls is not impaired for zinc, and the Patapsco in not impaired for lead or zinc. A summary of the current status of all TMDLs and Water Quality Assessments can be found on the Maryland Department of the Environment web site; http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Sumittals/index.asp.

The Maryland Tributary Strategies for meeting the Chesapeake Bay Program goals has identified a 24% reduction in nitrogen and a 42% reduction of phosphorus from urban non-point sources. This provides an additional reduction target for nutrients that in some cases exceeds the reductions determined by the TMDL analysis. The differences are due to the target water body being local tidal waters or reservoirs versus the entire Chesapeake Bay. Thus it may be possible to meet local tidal water quality standards, but additional nutrient reductions may be needed to permit the Chesapeake Bay to meet its water quality standards. In the case of the reservoirs the TMDLs are for phosphorus only due to the fact that fresh water is usually phosphorus limited. The models indicate that reductions in nitrogen would result in limited improvement in reservoir water quality.

The Chesapeake Bay Program – Watershed Model Phase 5.0 will be available in December 2009. The Chesapeake Bay TDML for nutrients and sediment will be based on this model, as well as, the Airshed Model and the Estuarine Model.

10.2 Pollutant Load Calculations

The pollutant load calculations were revised from last years' report. The pollutant loading rates for nitrogen and phosphorus were derived from two sources, the technical guidance provided by Maryland Department of the Environment (MDE) entitled *User's Guide for Nutrient Load Analysis Spreadsheet in Support of the Water Resources Element* (MDE 2008) and the Chesapeake Bay Program – Watershed Model Phase 4.3.

The MDE technical guidance provided loading rates for Baltimore County based on three basins, Western Shore (above the fall line), Western Shore (below the fall line), and Susquehanna (above the fall line). These loading rates are based on the Chesapeake Bay Program Watershed Phase 4.3 and include the full implementation of the Maryland Tributary Strategy for nutrient reduction, thereby eliminating the need to consider nutrient

controls. For consideration of the impacts related to urban development, Baltimore County determined that the urban loading rates without the implementation of urban BMPs would best serve the intent of the MS4 Permit in tracking restorations actually taken and the progress in meeting the various TMDLs that have been developed to date. Thus the final model of nutrient loads was a hybrid between the MDE guidance document for loading rates for all non-urban land uses and the segment specific nutrient loading rates for urban land uses.

The Chesapeake Bay Program (CBP) Watershed Model Phase 4.3 provides loading rates by model segment with the urban land uses divided into pervious urban and impervious urban. The loading rate for urban pervious and urban impervious were determined by dividing the 2010 – no BMP model results by the 2010 acreage derived for each segment. For Baltimore County there are five Model Phase 4.3 segments, however, the Gunpowder Basin is designated as all one segment (there are seven 8-digit watersheds in the segment), with the effect of Prettyboy and Loch Raven Reservoirs already taken into consideration. Since the Prettyboy Reservoir and the Loch Raven Reservoir have individual TMDLs for phosphorus, it was determined to develop loadings by applying the loading rates for comparable piedmont and coastal plain segments in Baltimore County. The loading rates applied to each watershed, the MDE segment and the CBP segment used in the pollutant loading analysis are displayed in Table 10-2 for nitrogen and Table 10-3 for phosphorus.

Table 10-2: Nitrogen Per Acre Pollutant Rate, MDE Segment and CBP Segment

	Deer Creek	**Prettyboy Loch Raven Lower Gunpowder Little Gunpowder Falls Gwynns Falls Jones Falls**	**Bird River Gunpowder River Middle River Back River Baltimore Harbor**	**Liberty Patapsco River**
MDE Seg	Sus	AFL	BFL	AFL
CBP Seg	140	480	860	490
Impervious Urban	8.44	8.06	8.06	8.06
Pervious Urban	11.03	14.86	15.77	12.84
Crop	12.23	16.55	13.54	16.55
Pasture	8.42	7.35	5.64	7.35
Livestock	15.62	24.87	19.68	24.87
Forest	2.36	1.41	1.29	1.41
Water	10.61	10.05	10	10.05
Bare soil	8.42	7.35	5.64	7.35

Table 10-3: Phosphorus Per Acre Pollutant Rate, MDE Segment and CBP Segment

	Deer Creek	Prettyboy Loch Raven Lower Gunpowder Little Gunpowder Falls Gwynns Falls Jones Falls	Bird River Gunpowder River Middle River Back River Baltimore Harbor	Liberty Patapsco River
MDE Seg	Sus	AFL	BFL	AFL
CBP Seg	140	480	860	490
Impervious Urban	0.51	0.51	0.51	0.51
Pervious Urban	0.67	2.11	2.28	1.79
Crop	0.85	0.72	0.69	0.72
Pasture	0.44	0.73	0.66	0.73
Livestock	1.60	1.18	0.99	1.18
Forest	0.03	0.02	0.02	0.02
Water	0.57	0.57	0.57	0.57
Bare soil	0.44	0.73	0.66	0.73

In order to determine the acres of impervious cover associated with urban land use, the MDP 2002 (modified to make it current with the 2005 planimetric layer) land use GIS layer was overlain with the planimetric buildings and roadways developed from the 2005 aerials for each watershed. This is another revision from last years' report where the 1996-1997 planimetric layer was used. The estimated pollutant loads by watershed are present in Table 10-4 for nitrogen and Table 10-5 for phosphorus. Each watershed load is broken down into the urban load, the agricultural load, and the forest load with the percentages of each. Note that the nitrogen load calculations include an estimate of the septic load for each watershed.

Table 10-4: Watershed Nitrogen Loads (%)

Watershed	Urban Load	Septic Load	Agricultural Load	Forest Load	Total Load
Deer Creek	5,455 (8.6)	5,027 (8.0)	46,764 (74.0)	5,948 (9.4)	63,194
Prettyboy	24,831 (12.1)	15,312 (7.5)	147,713 (72.0)	17,356 (8.5)	205,212
Loch Raven	371,774 (27.6)	149,751 (11.1)	743,460 (55.2)	82,929 (6.2)	1,347,914
Lower Gunpowder Falls	125,190 (41.6)	36,297 (12.1)	123,950 (41.2)	15,357 (5.1)	300,794
Little Gunpowder Falls	40,636 (23.8)	25,172 (14.7)	95,007 (55.7)	9,654 (5.7)	170,469
Bird River	113,591 (72.8)	8,401 (5.4)	26,621 (17.1)	7,387 (4.7)	156,000
Gunpowder River	27,561 (72.3)	2,208 (5.8)	3,613 (9.5)	4,740 (12.4)	38,122
Middle River	57,540 (87.7)	1,871 (2.9)	3,788 (5.8)	2,401 (3.4)	65,600
Upper Western Shore Totals	**766,578 (32.7)**	**244,039 (10.4)**	**1,190,916 (50.7)**	**145,772 (6.2)**	**2,347,295**
Patapsco/Back River					
Liberty	33,628 (25.1)	18,407 (13.7)	69,369 (51.8)	12,481 (9.3)	133,885
Patapsco River	211,725 (66.3)	25,189 (7.9)	50,648 (15.8)	15,870 (5.0)	303459
Gwynns Falls	280,749 (88.5)	15,529 (4.9)	12,854 (4.1)	7,990 (2.5)	317,122
Jones Falls	195,435 (68.7)	37,575 (13.2)	39,726 (14.0)	11,541 (4.1)	284,277
Back River	226,221 (93.0)	4,045 (1.7)	5,993 (2.5)	7,079 (2.9)	243,338
Baltimore Harbor	124,379 (94.2)	962 (0.7	4,650 (3.5)	2,053 (1.6)	132,044
Patapsco/Back River	**1,072,137 (81.6)**	**101,706 (7.7)**	**183,240 (13.9)**	**57,014 (4.3)**	**1,314,097**
County Load	***1,838,715 (48.9)***	***345,745 (9.2)***	***1,374,156 (36.5)***	***202,786 (5.4)***	***3,761,402***

Table 10-5: Watershed Phosphorus Loads (%)

Watershed	Urban Load	Agricultural Load	Forest Load	Total Load
Deer Creek	331 (9.4)	3,108 (88.4)	76 (2.2)	3,515
Prettyboy	3,369 (31.2)	7,181 (66.5)	246 (2.3)	10,796
Loch Raven	49,393 (56.5)	36,871 (42.2)	1,176 (1.3)	87,440
Lower Gunpowder Falls	16,437 (70.6)	6,620 (28.4)	218 (0.9)	23,275
Little Gunpowder Falls	5,429 (49.6)	5,382 (49.2)	137 (1.3)	10,948
Bird River	14,785 (90.8)	1,376 (8.5)	115 (0.7)	16,276
Gunpowder River	3,757 (93.6)	184 (4.6)	74 (1.8)	4,015
Middle River	7,425 (96.9)	199 (2.3)	37 (0.5)	7,661
Upper Western Shore	**100,926 (61.8)**	**60,290 (36.9)**	**2,078 (1.3)**	**163,294**
Patapsco/Back River				
Liberty	4,362 (55.5)	3,316 (42.2)	177 (2.3)	7,855
Patapsco River	26,928 (89.8)	2,822 (9.4)	225 (0.8)	29,975
Gwynns Falls	35,611 (97.9)	704 (1.9)	113 (0.3)	36,428
Jones Falls	25,272 (92.2)	1,970 (7.2)	164 (0.6)	27,406
Back River	29,005 (98.6)	308 (1.0)	110 (0.4)	29,423
Baltimore Harbor	15,984 (98.3)	237 (1.5)	32 (0.2)	16,253
Patapsco/Back River	**137,161 (93.1)**	**9,358 (6.4)**	**821 (0.6)**	**147,340**
County Load	***238,087 (76.5)***	***70,278 (22.6)***	***2,899 (0.9)***	***311,264***

The same type of analysis was used to determine the loading rates to stormwater management facilities (Section 1) and for stormwater management retrofits and conversions (Section 7).

10.3 New Nutrient Reduction and Impervious Cover Addressed Tracking Added This Year

Starting with the 2009 Annual Report, the nutrient reductions attributable to the Baltimore County Community Reforestation Program and the efforts of Watershed Associations are included. See Section 7 for a description of how the reductions were calculated. We will continue to seek methods for tracking other efforts to include in future reports. These other efforts include the Treemendous Program, the Growing Home Campaign, and the number of septic connections to the sanitary sewer. Assessing the effects of education on nutrient reduction is anticipated to take longer and would best be done through cooperation of other MS4 permittees and MDE.

The impervious cover addressed by the Storm Drain Cleaning Program and the Street Sweeping Program was calculated for the first time this year. The methods are detailed in Section 3.

10.4 Summary of Pollutant Reduction Programs

Six components of the County's overall effort to reduce pollutant loads are summarized in Tables 10-6 and 10-7, which address the Upper Western Shore and the Patapsco/Back River drainages, respectively. The components are the Stormwater Management Program (Section 1), the Storm Drain Cleaning Program (Section 3), the Street Sweeping Program (Section 3), the Capital Improvement Program (Section 7), the Community Reforestation Program (Section 7), and Watershed Association restoration actions (Section 7). The urban loads for each watershed are presented in each table, along with the progress to date in reducing phosphorus and nitrogen, and in addressing impervious cover. This is a

change from previous reports where TSS reductions were reported. We currently have not developed a satisfactory TSS loading rate analysis. This will be done in the future.

If a TMDL has been developed, the pollutant load reduction expressed as a percentage is shown. In the nutrient TMDLs developed to date, the expectation for the urban non-point source load reduction is 15%. In the case of Prettyboy and Loch Raven Reservoirs, this is less than the over all load reduction needed to meet water quality standards in the receiving waters. The Maryland Tributary Strategies urban pollutant load reduction for nitrogen and phosphorus are 24% and 42%, respectively. However, with the results from the development of the Chesapeake Bay Program – Phase 5 Watershed Model available in December 2009, it is expected that the urban reductions will be assigned by tidal segment and will therefore change for the next annual report.

Table 10-6: Pollutant Removal (Pounds) by Upper Western Shore Watersheds Attributed to BMP's

Upper Western Shore			
Deer Creek			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	0	0	0
Inlet Cleaning	1.6	0.8	2
Street Sweeping	0	0	0
Restoration Projects	0	0	0
Reforestation Projects	0	0	0
Watershed Association Projects	0	0	0
Totals	1.6	0.8	2
Urban Watershed Imp./Load	**166**	**331**	**5,455**
% Urban Load Removed	**0.4**	**0.2**	**0.0**
Prettyboy Reservoir			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	4.6	25.0	184
Inlet Cleaning	0	0	0
Street Sweeping	0	0	0
Restoration Projects	0	0	0
Reforestation Projects	0	0	0
Watershed Association Projects	0	0	0
Totals	4.6	25.0	184
Urban Watershed Imp./Load	**506.5**	**3,369**	**24,831**
TMDL % Reduction/Imp.		54% (15% Urban)	NA
% Urban Load Removed	**0.9**	**0.7**	**0.7**
Loch Raven Reservoir			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	615.4	1,619.8	12,595
Inlet Cleaning	20.8	10.6	27
Street Sweeping	394	200.8	518
Restoration Projects	472.8	370.6	5,608
Reforestation Projects	0	244.5	1,645
Watershed Association Projects	0	46.4	326
Totals	1503	2,492.7	20,719
Urban Watershed Imp./Load	**6,560**	**49,393**	**371,774**
TMDL % Reduction		50% (15% Urban)	NA
% Urban Load Removed	**22.9**	**5.0**	**5.6**

Table 10-6: Pollutant Removal (Pounds) by Upper Western Shore Watersheds Attributed to BMP's (continued)

Lower Gunpowder River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	256.8	710.6	5,872
Inlet Cleaning	45.5	23.2	60
Street Sweeping	219	111.7	288
Restoration Projects	433.9	251.4	4,743
Reforestation Projects	0	5.3	36
Watershed Association Projects	0	0	0
Totals	955.2	1102.2	10,999
Urban Watershed Imp./Load	**2,282**	**16,437**	**125,190**
% Urban Load Removed	**41.9**	**6.7**	**8.8**
Little Gunpowder River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	27.8	173.0	1,329
Inlet Cleaning	3.7	1.9	5
Street Sweeping	48	24.5	63
Restoration Projects	0	0	0
Reforestation Projects	0	0	0
Watershed Association Projects	0	0	0
Totals	79.5	199.4	1,397
Urban Watershed Imp./Load	**611.9**	**5,429**	**40,636**
% Urban Load Removed	**13.0**	**3.7**	**3.4**
Bird River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	414.5	974.0	8,380
Inlet Cleaning	8.0	4.1	11
Street Sweeping	202	103.0	266
Restoration Projects	513.8	595.0	8,659
Reforestation Projects	0	23.2	167
Watershed Association Projects	0	0	0
Totals	1138.3	1699.3	17,483
Urban Watershed Imp./Load	**2,553**	**14,785**	**113,591**
% Urban Load Removed	**44.6**	**11.5**	**15.4**
Gunpowder River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	27.7	70.7	547
Inlet Cleaning	2.9	1.5	4
Street Sweeping	21	10.5	27
Restoration Projects	17.6	46.3	367
Reforestation Projects	0	74.9	488
Watershed Association Projects	0	0	0
Totals	69.2	203.9	1433
Urban Watershed Imp./Load	**396**	**3,757**	**27,561**
% Urban Load Removed	**17.5**	**5.4**	**5.2**

Table 10-6: Pollutant Removal (Pounds) by Upper Western Shore Watersheds Attributed to BMP's (continued)

Middle River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	82.5	158.9	1,217
Inlet Cleaning	1.4	0.7	2
Street Sweeping	75	38.4	99
Restoration Projects	69.6	686.2	2,325
Reforestation Projects	0	20.0	133
Watershed Association Projects	0	0	0
Totals	228.5	904.2	3,776
Urban Watershed Imp./Load	**1,162**	**7,425**	**57,540**
% Urban Load Removed	**19.7**	**12.2**	**6.6**

Table 10-7: Pollutant Removal (Pounds) by Patapsco/Back River Watersheds Attributed to BMP's

Patapsco / Back River			
Liberty Reservoir			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	33.2	85.0	699
Inlet Cleaning	0.0	0.0	0
Street Sweeping	21	10.5	27
Restoration Projects	0	0	0
Reforestation Projects	0	3.6	24
Watershed Association Projects	0	0	0
Totals	54.2	99.1	750
Urban Watershed Imp./Load	**562**	**4,362**	**33,628**
% Urban Load Removed	**9.6**	**2.3**	**2.2**
Patapsco River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	395.2	786.6	5,891
Inlet Cleaning	42.5	21.7	56
Street Sweeping	473	241.0	262
Restoration Projects	138.7	100.3	1,413
Reforestation Projects	0	92.1	617
Watershed Association Projects	0	8.6	59
Totals	1049.4	1250.3	8,298
Urban Watershed Imp./Load	**3,853**	**26,928**	**211,725**
TMDL % Reduction		15%	15%
% Urban Load Removed	**27.2**	**4.6**	**3.9**
Gwynns Falls			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	1,209.3	1,744.8	15,569
Inlet Cleaning	141.4	72.1	186
Street Sweeping	890	454.0	1,171
Restoration Projects	70.5	69.7	880
Reforestation Projects	0	6.3	43
Watershed Association Projects	0	0	0
Totals	2,311.2	2,346.9	17,849
Urban Watershed Imp./Load	**6,262**	**35,611**	**280,749**
TMDL % Reduction		15%	15%
% Urban Load Removed	**36.9**	**7.4**	**6.4**

Table 10-7: Pollutant Removal (Pounds) by Patapsco/Back River Watersheds Attributed to BMP's (continued)

Jones Falls			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	371.9	1,119.5	10,147
Inlet Cleaning	45.3	23.1	60
Street Sweeping	188	96.0	248
Restoration Projects	323.1	244.7	3,204
Reforestation Projects	0	48.6	332
Watershed Association Projects	0	26.7	183
Totals	928.3	1,558.6	14,174
Urban Watershed Imp./Load	**3,423**	**25,272**	**195,435**
TMDL % Reduction		15%	15%
% Urban Load Removed	**27.1**	**6.2**	**7.3**
Back River			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	518.0	788.0	6,733
Inlet Cleaning	68.2	34.8	90
Street Sweeping	633	323.0	833
Restoration Projects	469.4	2,853.1	8,640
Reforestation Projects	0	40.6	270
Watershed Association Projects	0	2.2	15
Totals	1688.6	4,041.7	16,581
Urban Watershed Imp./Load	**5,298**	**29,005**	**226,221**
TMDL % Reduction		15%	15%
% Urban Load Removed	**31.9**	**13.9**	**7.3**
Baltimore Harbor			
	Impervious Cover (ac.)	**TP**	**TN**
Stormwater Management	48.1	83.4	566
Inlet Cleaning	29.6	15.1	39
Street Sweeping	260	132.7	342
Restoration Projects	271.7	1,006	4,547
Reforestation Projects	0	13.6	91
Watershed Association Projects	0	0	0
Totals	609.4	1,250.8	5,585
Urban Watershed Imp./Load	**2,813**	**15,984**	**124,379**
TMDL % Reduction		15%	15%
% Urban Load Removed	**21.7**	**7.8**	**4.5**

10.5 Progress in Meeting MS4 Impervious Restoration, TMDLs, and Maryland Tributary Strategies

This section discusses the progress made to date in meeting the impervious cover addressed by water quality and restoration efforts in the current MS4 Permit (Section 10.4.1), the TMDLs urban non-point nutrient reduction targets (10.4.2), and the current Maryland Tributary Strategies (10.4.3)

10.5.1 MS4 Impervious Restoration

The current MS4 Permit required that Baltimore County address 20% of the County controlled impervious cover by June 15, 2010. The next term of the permit is anticipated to require an additional 10% impervious cover be addressed over the 5-year term of the

permit. Table 10-8 summarizes the Baltimore County efforts to date. The data is compiled from Tables 10-6 and 10-7 above.

Table 10-8: Impervious Cover Addressed by Water Quality Improvement Efforts to Date

Watershed	Impervious Cover to Be Addressed	20% Target	Impervious Cover Addressed	% Addressed
Upper Western Shore				
Deer Creek	166	33.2	1.6	0.4
Prettyboy	507	101.4	4.6	0.9
Loch Raven	6,560	1,312	1,503	22.9
Lower Gunpowder Falls	2,282	456.4	955.2	41.9
Little Gunpowder Falls	612	122.4	79.5	13.0
Bird River	2,553	510.6	1,138.3	44.6
Gunpowder River	396	79.2	69.2	17.5
Middle River	1,162	232.4	228.5	19.7
Upper Western Shore	**14,238**	**2,847.6**	**3,979.9**	**28.0**
Patapsco/Back River				
Liberty	562	112.4	54.2	9.6
Patapsco River	3,853	770.6	1,049.4	27.2
Gwynns Falls	6,262	1,252.4	2,311.2	36.9
Jones Falls	3,423	684.6	928.3	27.1
Back River	5,298	1,059.6	1,688.6	31.9
Baltimore Harbor	2,813	562.2	609.4	21.7
Patapsco/Back River	**22,211**	**4,441.8**	**6,641.1**	**29.9**
County Impervious	***36,449***	***7,289.4***	***10,621.0***	***29.1***

With the inclusion of street sweeping and storm drain cleaning, the county is currently addressing 29.1% of the impervious cover controlled by Baltimore County. That estimate is a liberal estimate, in that it does not account for the overlap in the various water quality improvement efforts. Future reports will attempt to correct this deficiency. It is anticipated that the ability to address additional impervious cover will become more difficult over time as the easier projects are completed. We will rely on our Small Watershed Action Plans to identify actions needed to meet the various TMDLs that are developed for each watershed for a variety of constituents. Implementation of those plans and meeting the TMDL reduction requirements will be considered as meeting the impervious cover requirement in each planning area. It is not anticipated that a water quality device will treat every impervious acre.

10.5.2 TMDL Progress

Baltimore County has not yet developed a mechanism for estimating bacteria loads, nor efficiencies of the various urban best management practices in reducing bacteria loads. Table 10-9 presents the progress in meeting TMDLs for nutrients.

Table 10-9: Progress in Meeting Nutrient TMDLs Where Developed

Watershed	Phosphorus		Nitrogen	
	Target	Progress	Target	Progress
Prettyboy	15% (54%)	0.7%	NA	NA
Loch Raven	15% (50%)	5.0%	NA	NA
Patapsco	15%	4.6%	15%	3.9%
Gwynns Falls	15%	7.4%	15%	6.4%
Jones Falls	15%	6.2%	15%	7.3%

Back River	15%	13.9%	15%	7.3%
Baltimore Harbor	15%	7.8%	15%	4.5%

As can be seen from Table 10-9 the target reductions for phosphorus and nitrogen have not been met. In the cases of Prettyboy and Loch Raven Reservoir watersheds, the target phosphorus reduction is much higher (shown in parentheses), however, the reduction scenario developed by Maryland Department of the Environment indicates a 15% reduction of phosphorus from urban lands.

10.5.3 Maryland Tributary Strategies

Based on modeling by the federal EPA – Chesapeake Bay Program, nutrient and sediment pollutant load reductions needed for the Chesapeake Bay to attain water quality standards have been determined. These load reductions have been allocated to the various states within the Chesapeake Bay drainage area. Maryland has developed Tributary Strategies for the 10 basins within the state. Baltimore County lies within two of the tributary basins, the Upper Western Shore and the Patapsco/Back River basins. The Tributary Strategies identify the actions needed to achieve tidal Chesapeake Bay water quality standards. Actions to address urban non-point source reductions are expected to achieve a 24% reduction in nitrogen and a 42% reduction in phosphorus from urban lands. These goals may be revised, and made more specific to tidal water segments when the Phase 5 watershed model is complete in December 2009.

At this point in time, Baltimore County is not tracking all of the strategies for which pollution reduction credit can be awarded. We are uncertain on how to obtain credit for the educational activities that fall under the designation of urban and mixed nutrient management. Our tracking for reforestation needs to be improved to differentiate between urban pervious and mixed-open planting. For now, the acreage is combined.

The strategies developed apply to all of the jurisdictions within a Tributary Strategy basin, and have not been partitioned by jurisdiction. Table 10-10 presents the urban strategy for the Upper Western Shore, while Table 10-11 presents the urban strategy for the Patapsco/Back River. The strategy column in both tables represents the target for all jurisdictions within the Tributary Strategy basin, while the progress column only represents Baltimore County progress in meeting the urban strategy.

Stormwater Management: The stormwater management strategy represents the acreage of land that flows to a stormwater management facility (see Section 1), and includes only those facilities that have been built. It also includes the construction of new stormwater management facilities through the capital program (see Section 7), but not the conversion of existing facilities.

Erosion and Sediment Control: The acreage of disturbance for calendar year 2008 only is included (see Section 2). This represents the acreage under sediment control. Missing the target for this measure does not represent a failure, but reflects the pattern of development through time. Under the current economic conditions development is down. A better measure for this BMP would be that 100% of the acreage under development is under sediment control.

Stream Restoration: The stream restoration strategy represents the target linear feet of urban stream restoration. The information for this measure comes from the individual watershed restoration tables in Section 7.

10-10: Upper Western Shore Urban Tributary Strategy

Urban BMP Type	Units	Strategy	Progress
Stormwater Management	Acres	56,784	12,278
Erosion and Sediment Control	Acres/Yr	5,576	327.7
Nutrient Management, Urban	Acres	67,206	NT
Nutrient Management, Mixed	Acres	86,984	NT
Buffers Forested, Urban	Acres	93	69.9
Tree Planting, Mixed Open	Acres	433	17.7
Tree Planting, Urban Pervious	Acres	597	
Stream Restoration, Urban	Linear feet	87,368	80,810

NT = Not Tracked

10-11: Patapsco/Back River Urban Tributary Strategy

Urban BMP Type	Units	Strategy	Progress
Stormwater Management	Acres	99,252	16,797
Erosion and Sediment Control	Acres/Yr	11,063	341.8
Nutrient Management, Urban	Acres	112,861	NT
Nutrient Management, Mixed	Acres	28,171	NT
Buffers Forested, Urban	Acres	160	24.0
Tree Planting, Mixed Open	Acres	691	43.0
Tree Planting, Urban Pervious	Acres	205	
Stream Restoration, Urban	Linear feet	82,421	44,238

NT = Not Tracked

In order to assess the progress in meeting the Maryland Tributary Strategy nutrient load reduction, the individual watershed load reductions from Tables 10-6 and 10-7 were summed, along with the individual watershed urban non-point nutrient loads. The overall percentage reduction for nitrogen and phosphorus due to urban BMPs for each tributary basin was calculated. The results are presented in Table 10-12.

10-12: Tributary Strategy Urban Non-point Nutrient Load Reduction Progress

	Upper Western Shore		Patapsco/Back River	
	Nitrogen	Phosphorus	Nitrogen	Phosphorus
Urban Load (#s)	**766,578**	**100,926**	**1,072,137**	**137,161**
Urban BMP Load Reduction (#s)	55,975	6,628	63,237	10,547
Urban BMP Load Reduction (%)	7.3 %	6.6 %	5.9 %	7.7%
Trib Strategy – Target Reduction (%)	24 %	42 %	24 %	42 %

10.6 Summary

Nutrient pollutant load reduction from urban sources is progressing through the use of a variety of urban best management practices. As of this time, we have not achieved the target percentage reductions for either the TMDLs developed to date, nor the Tributary Strategies. However, we are meeting the NPDES Permit requirement in addressing impervious cover through water quality improvements. Baltimore County will work towards establishing a mechanism to account for urban nutrient management progress through our education programs.

11.0 Permit Requirements

A. Permit Administration

Baltimore County shall designate an individual to act as a liaison with the Maryland Department of the Environment (MDE) and provide the coordinator's name, title, address, phone number, and email address. Additionally, the County shall submit to MDE an organizational chart detailing personnel and groups responsible for major National Pollutant Discharge Elimination System (NPDES) program tasks with each annual report.

B. Legal Authority

Adequate legal authority shall be maintained in accordance with the NPDES regulation 40 CFR 122.26(d)(2)(i) throughout the term of this permit. In the event that any provisions of its legal authority are found to be invalid, the County shall make the necessary changes to maintain adequate legal authority.

I. Program Funding

1. Annually, a fiscal analysis of the capital, operation, and maintenance expenditures necessary to comply with all conditions of this permit shall be submitted as required in Part IV below.
2. Adequate program funding to comply with all conditions of this permit shall be maintained.

11.1 Permit Administration

The designated individual to act as a liaison with Maryland Department of the Environment is:

Steve Stewart
Manager, Watershed Management and Monitoring Section
Baltimore County Department of Environmental Protection and Resource Management
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Towson, MD 21204
410-887-4488 x240
sstewart@baltimorecountymd.gov

The major NPDES program tasks are listed in Table 11-1, along with the Baltimore County Departments and associated bureaus or sections responsible for implementation. The County has designated an NPDES Management Committee, composed of representatives from agencies involved in NPDES activities, that meets on a periodic basis for updates and coordination. The main focus of the NPDES Management Committee over the last year has been County property management.

Table 11-1: Major NPDES Program Tasks and Responsible Baltimore County Agencies

NPDES Program Task	Department - Section
Program Administration	DEPRM – Watershed Management and Monitoring
Legal Authority	DEPRM - Administration Baltimore County – Law Office
Source Identification	DEPRM – Watershed Management and Monitoring DEPRM – Policy, Research, Education, and Communication OIT – Geographic Information Systems
Stormwater Management – Review	DEPRM – Stormwater Engineering
Stormwater Management – Inspections	DEPRM – Stormwater Engineering DEPRM – Capital Program and Operations
Erosion and Sediment Control	DEPRM – Inspection and Enforcement
Illicit Discharge Detection and Elimination	DEPRM – Watershed Management and Monitoring DEPRM – Environmental Health
County Property Management	DPW – Highways Bureau DPW – Utilities Bureau Department of Recreation and Parks Community College of Baltimore County Dept. of Education
Road Maintenance	DPW – Highways Bureau – Street Sweeping DPW – Utilities Bureau – Storm Drain Cleaning DEPRM – Watershed Management and Monitoring – Data Management
Public Education	DEPRM – All Sections DEPRM – Policy, Research, Education, and Communication – Major Component
Watershed Assessment and Planning	DEPRM – Watershed Management and Monitoring
Watershed Restoration	DEPRM – Capital Program and Operations
Assessment of Controls	DEPRM – Watershed Management and Monitoring
Program Funding	DEPRM – Finance and Administration
Total Maximum Daily Loads	DEPRM – Watershed Management and Monitoring
Annual Report	DEPRM – Watershed Management and Monitoring DEPRM – Policy, Research, Education, and Communication
Reapplication for NPDES Permit	DEPRM – Watershed Management and Monitoring

DEPRM = Department of Environmental Protection and Resource Management
DPW = Department of Public Works
OIT = Office of Information Technology

The organizational chart submitted as part of the budget request for fiscal year 2010 for the Baltimore County Department of Environmental Protection and Resource Management is displayed in Exhibit 11-1. Exhibit 11-2 is DEPRM's departmental organization effective April 25, 2009. The FY2010 budget includes four additional staff positions for the Department of Environmental Protection and Resource Management, two for the Environmental Health programs and two for the Stormwater Engineering Section. These two engineering positions may have a benefit to the implementation of the County's NPDES program.

11.2 Legal Authority

The County continues to maintain adequate legal authority.

11.3 Fiscal Analysis

Table 11-2 displays the operating costs for FY2009 and the projected operating costs through FY 2014. Table 11-3 summarizes the Capital Budget and Program through 2014. Both the operating budget and the Capital Budget and Program are submitted annually by the Baltimore County Executive to the Baltimore County Council for approval. The level of commitment for operating and capital funding is fixed through FY2010. For FY2010, changes may occur if requested by the County Executive and approved by the County Council.

Table 11-2: NPDES Operating Budget

FY 2009 Current	FY 2010 Budgeted	FY 2011 Projected	FY 2012 Projected	FY 2013 Projected	FY 2014 Projected
$7,579,014	$7,645,744	$7,875,116	$8,111,369	$8,354,710	$8,605,351

Table 11-3: Capital Budget and Program

FY 2008 Budgeted	FY 2009 Budgeted	FY 2010 Projected	FY 2011 Projected	FY 2012 Projected	FY 2013 Projected	FY 2014 Projected
$18,000,000	$3,235,450	$14,523,000	$0	$10,386,000	$0	$9,386,000

Not all of the operating and capital funds are directly related to the NPDES permit. While dredging projects are not directly related to the permit because they do not address stormwater, they are indirectly related because they address pollutant load reduction. The dredging projects require projects that reduce sediment loads within the same watershed as the dredged water body. These retrofit projects typically take the form of various types of stormwater management facilities that reduce pollutants.

Tables 11-4 through 11-6 displays the Capital Budget and Program expenditures by watershed. The watersheds are organized in accordance with the Maryland Tributary Strategies boundaries. There are three budget categories that are not watershed specific. These are listed separately. Each two-year funding cycle is represented as a separate table.

Table 11-4: Baltimore County Environmental Capital Improvement Program - Fiscal Year 2008 & 2009

Project	Budget Number	Total ($)
Upper Western Shore Watershed		
Deer Creek	-	0
Prettyboy Watershed	-	0
Loch Raven Watershed	221-0103	350,000
Lower Gunpowder Watershed	221-0106	881,000
Little Gunpowder Watershed	221-0104	0
Bird River Watershed	221-0105	459,000
Gunpowder Watershed	221-0107	350,000
Middle River Watershed	221-0108	100,000
Patapsco Back Watershed		
Liberty Watershed	-	0
Patapsco Watershed	221-0110	0
Gwynns Falls Watershed	221-0111	1,000,000
Jones Falls Watershed	221-0112	1,950,000
Back River Watershed	221-0114	550,000
Baltimore Harbor Watershed	221-0113	6,130,000
Non-Watershed Specific Funding		
Watershed Restoration	221-0100	1,351,000
Environmental Management	221-0200	1,630,000
Waterway Improvement Projects	221-0300	1,610,000
Comm. Conservation Waterway Impr.	221-0900	1,625,000
Total:		**17,986,000**

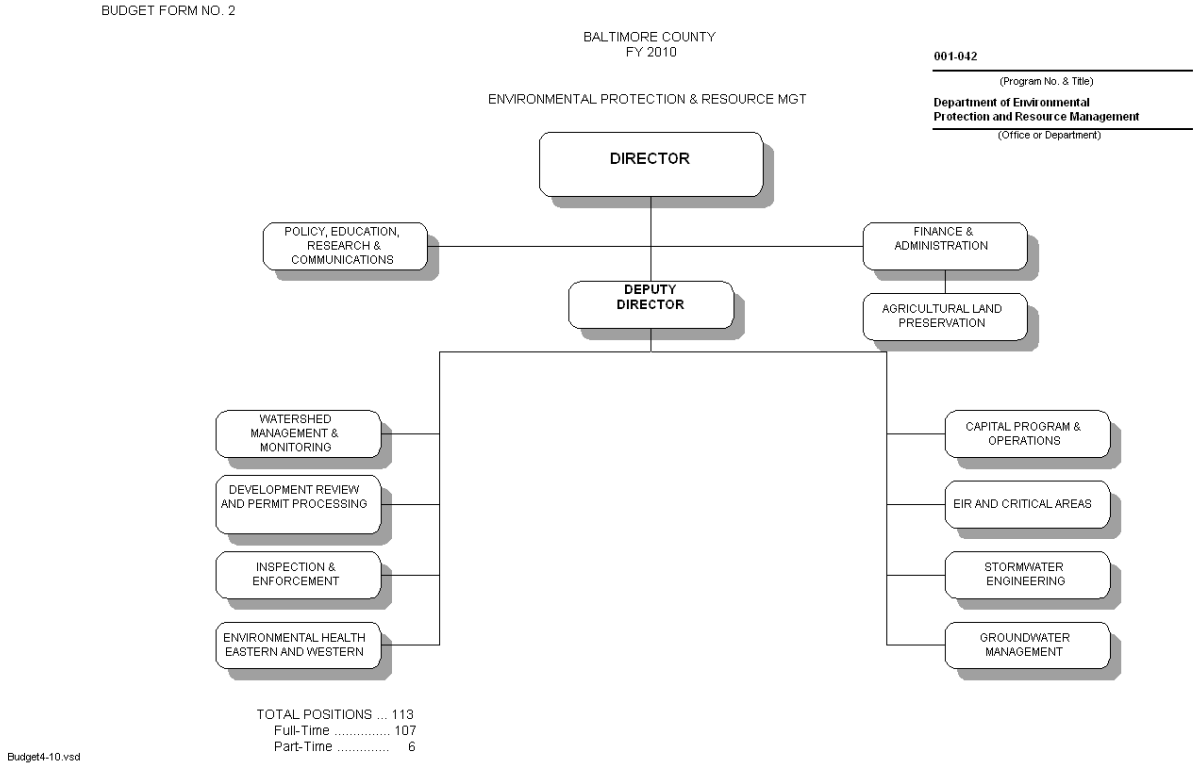
Table 11-5: Baltimore County Environmental Capital Improvement Program - Fiscal Years 2010 & 2011

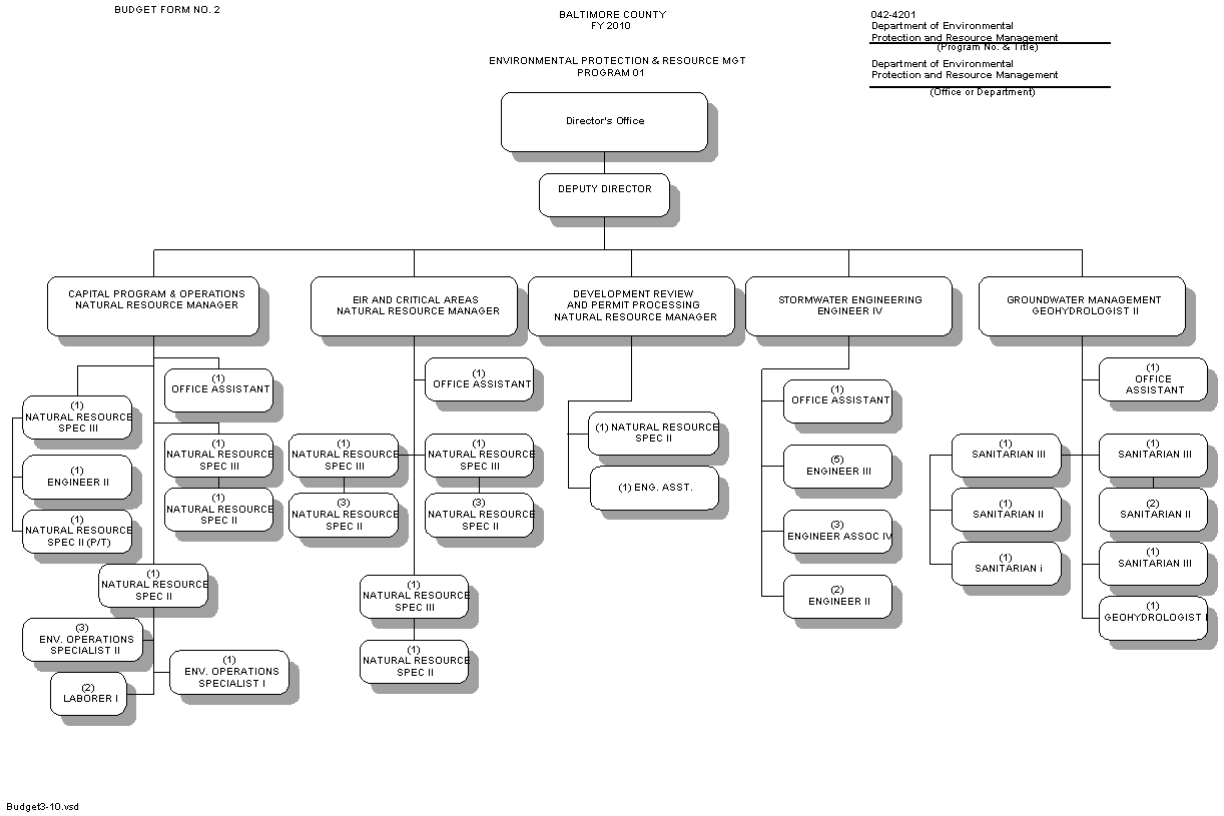
Project	Budget Number	Total ($)
Upper Western Shore Watershed		
Deer Creek	-	0
Prettyboy Watershed	-	0
Loch Raven Watershed	221-0103	850,000
Lower Gunpowder Watershed	221-0106	500,000
Little Gunpowder Watershed	221-0104	0
Bird River Watershed	221-0105	300,000
Gunpowder Watershed	221-0107	0
Middle River Watershed	221-0108	800,000
Patapsco Back Watershed		
Liberty Watershed	-	0
Patapsco Watershed	221-0110	0
Gwynns Falls Watershed	221-0111	3,100,000
Jones Falls Watershed	221-0112	400,000
Back River Watershed	221-0114	200,000
Baltimore Harbor Watershed	221-0113	50,000
Non-Watershed Specific Funding		
Watershed Restoration	221-0100	1,190,000
Environmental Management	221-0200	1,525,000
Waterway Improvement Projects	221-0300	0
Comm. Conservation Waterway Impr.	221-0900	500,000
Total:		**9,640,000**

Table 11-6: Baltimore County Environmental Capital Improvement Program - Fiscal Years 2012 & 2013

Project	Budget Number	Total ($)
Upper Western Shore Watershed		
Deer Creek	-	0
Prettyboy Watershed	221-0102	450,000
Loch Raven Watershed	221-0103	1,000,000
Lower Gunpowder Watershed	221-0106	1,050,000
Little Gunpowder Watershed	221-0104	250,000
Bird River Watershed	221-0105	850,000
Gunpowder Watershed	221-0107	0
Middle River Watershed	221-0108	0
Patapsco Back Watershed		
Liberty Watershed	-	0
Patapsco Watershed	221-0110	300,000
Gwynns Falls Watershed	221-0111	1,450,000
Jones Falls Watershed	221-0112	0
Back River Watershed	221-0114	880,000
Baltimore Harbor Watershed	221-0113	500,000
Non-Watershed Specific Funding		
Watershed Restoration	221-0100	1,405,000
Environmental Management	221-0200	1,525,000
Comm. Conservation Waterway Impr.	221-0900	500,000
Total:		**10,160,000**

Exhibit 11-1: Department of Environmental Protection and Resource Management Table of Organization for FY2009




BUDGET FORM NO. 2
BALTIMORE COUNTY
FY 2010
ENVIRONMENTAL PROTECTION & RESOURCE MGT
PROGRAM 01
042-4201
Department of Environmental
Protection and Resource Management
(Program No. & Title)
Department of Environmental
Protection and Resource Management
(Office or Department)
Director's Office
DEPUTY DIRECTOR
CAPITAL PROGRAM & OPERATIONS NATURAL RESOURCE MANAGER
EIR AND CRITICAL AREAS NATURAL RESOURCE MANAGER
DEVELOPMENT REVIEW AND PERMIT PROCESSING NATURAL RESOURCE MANAGER
STORMWATER ENGINEERING ENGINEER IV
GROUNDWATER MANAGEMENT GEOHYDROLOGIST II
(1) OFFICE ASSISTANT
(1) NATURAL RESOURCE SPEC III
(1) ENGINEER II
(1) NATURAL RESOURCE SPEC II (P/T)
(1) NATURAL RESOURCE SPEC II
(3) ENV. OPERATIONS SPECIALIST II
(2) LABORER I
(1) ENV. OPERATIONS SPECIALIST I
(1) NATURAL RESOURCE SPEC III
(1) NATURAL RESOURCE SPEC II
(3) NATURAL RESOURCE SPEC II
(1) NATURAL RESOURCE SPEC II
(1) ENG. ASST.
(5) ENGINEER III
(3) ENGINEER ASSOC IV
(2) ENGINEER II
(1) SANITARIAN III
(1) SANITARIAN II
(1) SANITARIAN i
(2) SANITARIAN II
(1) GEOHYDROLOGIST I
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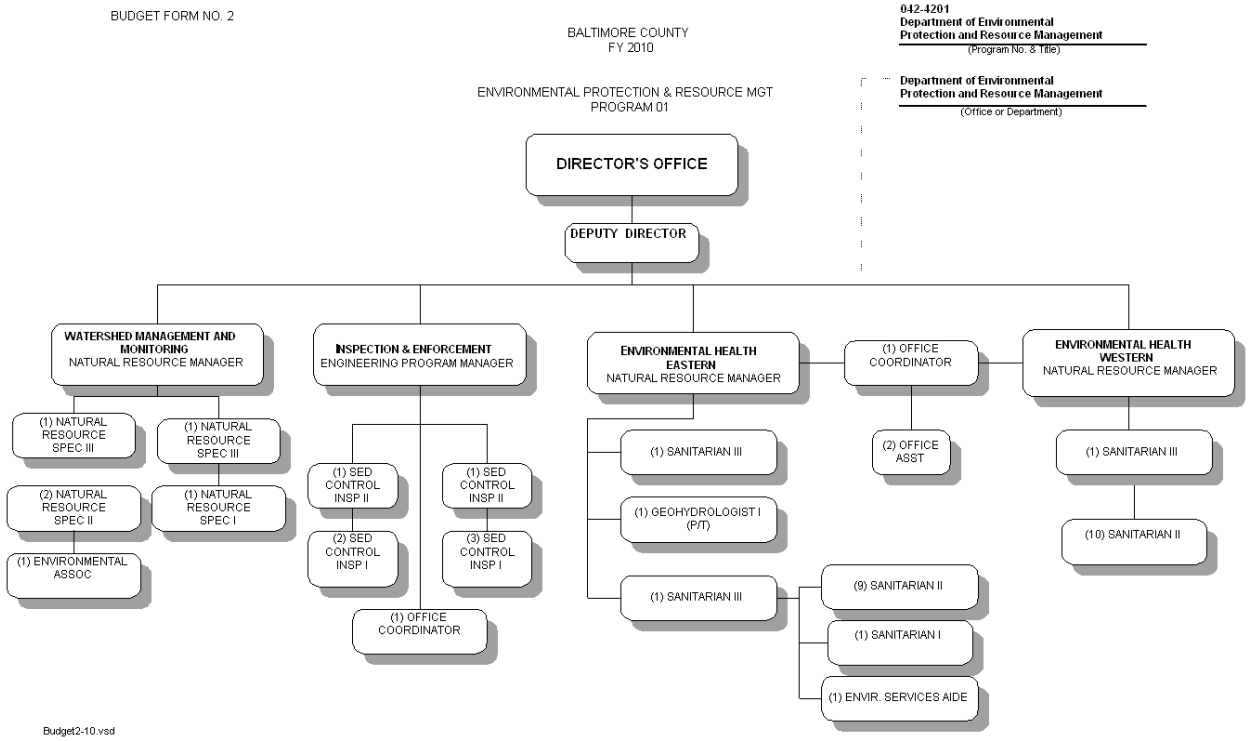
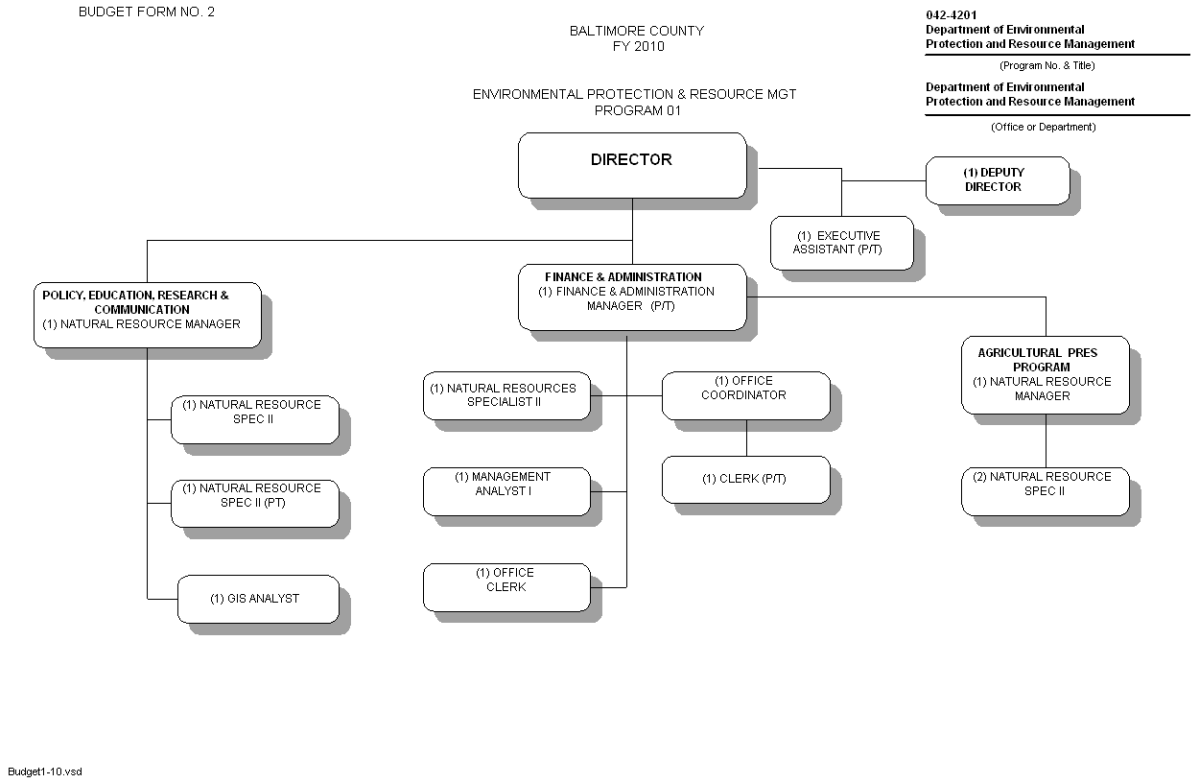

BUDGET FORM NO. 2
BALTIMORE COUNTY
FY 2010
ENVIRONMENTAL PROTECTION & RESOURCE MGT
PROGRAM 01
042-4201
Department of Environmental
Protection and Resource Management
(Program No. & Title)
Department of Environmental
Protection and Resource Management
(Office or Department)
DIRECTOR'S OFFICE
DEPUTY DIRECTOR
WATERSHED MANAGEMENT AND MONITORING
NATURAL RESOURCE MANAGER
INSPECTION & ENFORCEMENT
ENGINEERING PROGRAM MANAGER
ENVIRONMENTAL HEALTH EASTERN
NATURAL RESOURCE MANAGER
(1) OFFICE COORDINATOR
ENVIRONMENTAL HEALTH WESTERN
NATURAL RESOURCE MANAGER
(1) NATURAL RESOURCE SPEC III
(2) NATURAL RESOURCE SPEC II
(1) ENVIRONMENTAL ASSOC
(1) NATURAL RESOURCE SPEC III
(1) NATURAL RESOURCE SPEC I
(1) SED CONTROL INSP II
(2) SED CONTROL INSP I
(1) OFFICE COORDINATOR
(1) SED CONTROL INSP II
(3) SED CONTROL INSP I
(1) SANITARIAN III
(1) GEOHYDROLOGIST I (P/T)
(1) SANITARIAN III
(9) SANITARIAN II
(1) SANITARIAN I
(1) ENVIR. SERVICES AIDE
(2) OFFICE ASST
(1) SANITARIAN III
(10) SANITARIAN II
Budget2-10.vsd


BUDGET FORM NO. 2
BALTIMORE COUNTY
FY 2010
ENVIRONMENTAL PROTECTION & RESOURCE MGT
PROGRAM 01
042-4201
Department of Environmental
Protection and Resource Management
(Program No. & Title)
Department of Environmental
Protection and Resource Management
(Office or Department)
DIRECTOR
(1) DEPUTY DIRECTOR
(1) EXECUTIVE ASSISTANT (P/T)
POLICY, EDUCATION, RESEARCH & COMMUNICATION
(1) NATURAL RESOURCE MANAGER
FINANCE & ADMINISTRATION
(1) FINANCE & ADMINISTRATION MANAGER (P/T)
AGRICULTURAL PRES PROGRAM
(1) NATURAL RESOURCE MANAGER
(1) NATURAL RESOURCE SPEC II
(1) NATURAL RESOURCE SPEC II (PT)
(1) GIS ANALYST
(1) NATURAL RESOURCES SPECIALIST II
(1) MANAGEMENT ANALYST I
(1) OFFICE CLERK
(1) OFFICE COORDINATOR
(1) CLERK (P/T)
(2) NATURAL RESOURCE SPEC II
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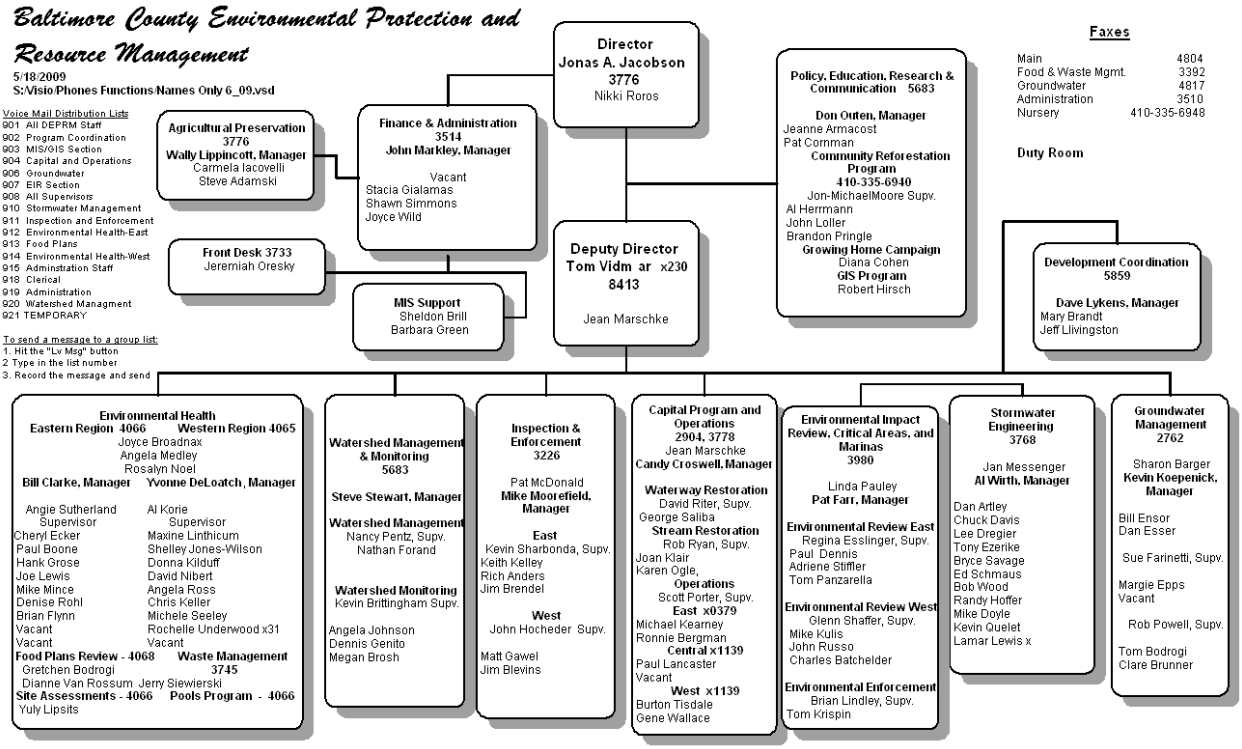
Exhibit 11-2: Department of Environmental Protection and Resource Management Staff Organizational Chart Effective April 25, 2009