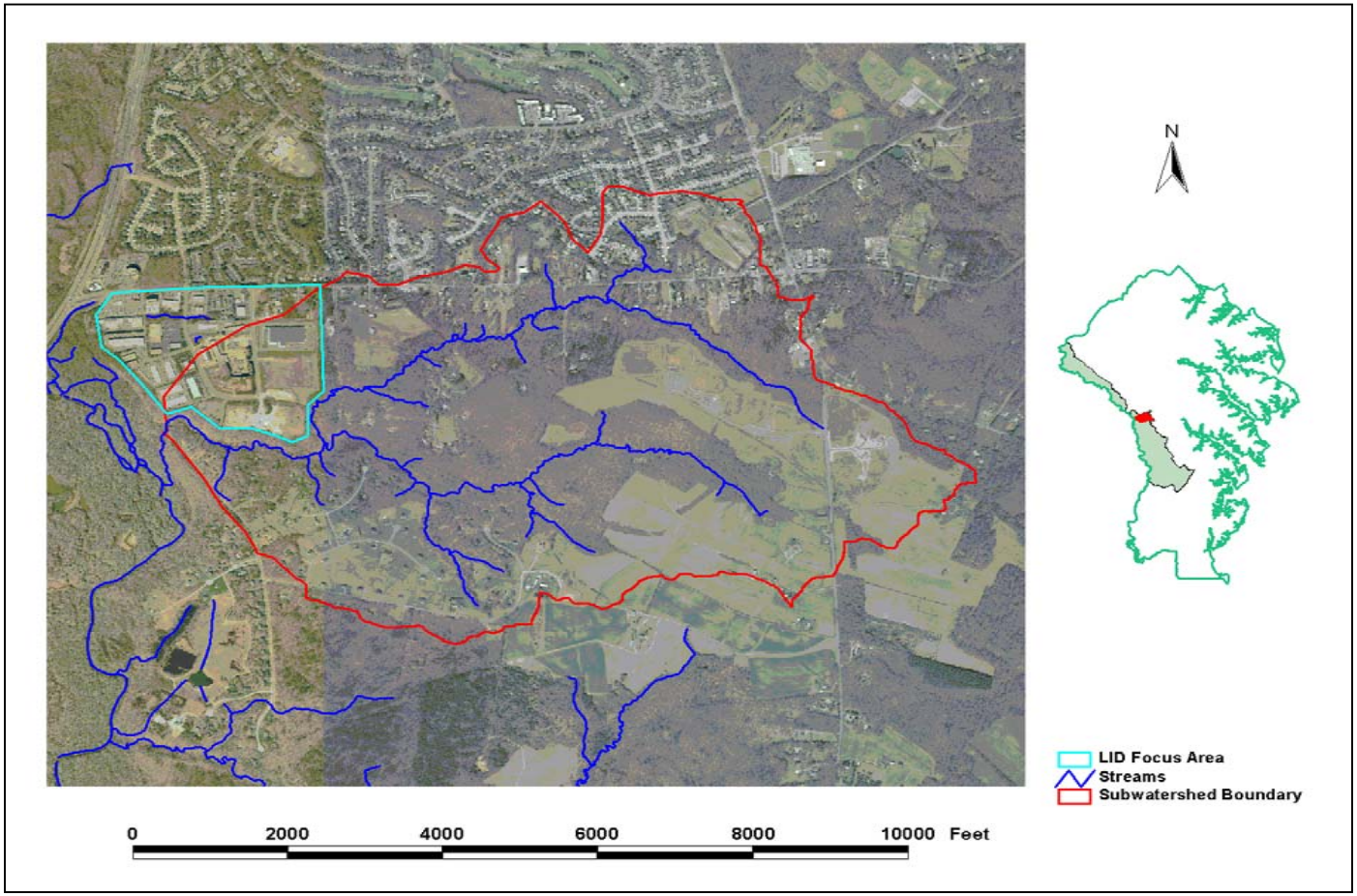


Figure II-6. Map of the LID focus area located in the Cox Branch subwatershed (UPS1) in Anne Arundel County. Additional information can be found in Section III.

Public Participation

Anne Arundel and Prince George's Counties cooperatively developed a strategy to provide for public participation in the development of the Upper Patuxent WRAS. The goals were to maximize public participation, provide a mechanism for stakeholders to be involved in the development of the WRAS and to have a major participatory element in the implementation phase. Components of the strategy included:

- Identification of Potential Stakeholders
- Development of Stakeholder Database(s)
- Formation of Committee Structure
- Stakeholder Kickoff Meeting
- Steering Committee Meetings
- Provide Opportunity for Public Comment and Participation in the Development of the Upper Patuxent WRAS
- Develop Public Outreach And Participation Strategy For The Implementation Phase Of The Upper Patuxent WRAS

Stakeholder Identification

A list of potential stakeholder groups was developed for the WRAS process. Stakeholders included government agencies, municipalities, planning committees, community organizations, watershed and environmental groups, citizen activists, businesses and landowners. Prior to initiating the Stream Corridor Assessments, property owners adjacent to targeted streams were identified. Over 1200 property owners in Prince George's County and over 400 in Anne Arundel County were identified and contacted by mail. A copy of the letters used can be found in Appendix C. The purpose of this contact was to (1) introduce the property owners to the watershed study goals and activities, (2), introduce the property owners to the field activities associated with the study, and (3) request permission to access property for in-stream and stream-side habitat assessment and monitoring. Approximately, 33% of those contacted in Prince George's County and 28 % from Anne Arundel County responded to the letter. The vast majority of respondents were positive about the study; many requested further information, described problems that the County will address (see discussion under Development of Stakeholder Database), or expressed a desire to accompany field crews during the field surveys.

Development of Stakeholder Database(s)

Prince George's County developed databases for the major commercial and industrial businesses, community organizations and individual citizen activists on the County's portion of the Upper Patuxent Watershed. The County is also developing a database on the results from the permission letter campaign. All of the databases will be incorporated into a GIS planning tool. These databases are designed for multiple uses that include:

- Identification and targeting of stakeholders for future watershed projects and studies;
- Development of an Upper Patuxent watershed organization;
- Identification of future restoration and retrofit sites;

- Stakeholder notification of watershed events, workshops and training opportunities; and
- Recruitment of volunteers for restoration and retrofit projects.

Formation of WRAS Committee Structure

The committee structure consisted of a workgroup, steering committee and watershed stakeholder oversight organization. The workgroup was responsible for the planning and development of WRAS activities, public meetings, documents, and strategies. The group members included Anne Arundel and Prince George's Counties and MDNR staff and monthly strategy sessions were held. The Steering Committee's charge was to help direct the development of the watershed plan by providing input and recommendations to the workgroup. This input would meet the needs of the watershed stakeholders. Committee members were volunteers solicited from the Stakeholder Kickoff meeting and throughout the public participation phase. Comprised mainly of individuals who attended the Stakeholder Kickoff meeting, the Stakeholder Oversight Organization consisted of many interested stakeholders in the Upper Patuxent Watershed. The relationship and structure of the committees, as well as committee participants, is shown in Figure II-7.

Stakeholder Kickoff Meeting

Major watershed stakeholders were identified by the WRAS Partners and invited to a briefing held in September 2002. The purpose of this meeting was to introduce stakeholders to the Upper Patuxent WRAS. Of those invited, over 20 stakeholders attended the briefing. Those stakeholders represented major landowners (e.g., Department of the Interior's Patuxent Wildlife Refuge), local government agencies, NRCS, Soil Conservation Districts, civic associations, citizen watershed organizations, and Maryland Tributary Strategy Teams (i.e., Patuxent River Commission). Briefing presentations included an introduction to the WRAS process, the goals of the Upper Patuxent WRAS, and a description of the work effort involved. Stakeholders were also asked to identify their watershed concerns and any opportunities they saw for enhancing, restoring, and protecting the Upper Patuxent River watershed. Stakeholders also participated in a discussion of their long-term vision for the watershed. Lastly, volunteers were solicited to serve on the Upper Patuxent WRAS Steering Committee. Stakeholders were provided with handout packages that contained an agenda, slide show summaries, contact lists for the project, maps, and educational materials

Steering Committee Meetings

The Steering Committee was comprised of representatives from the U.S. Department of the Interior (Patuxent Wildlife Refuge), the Patuxent River Greenways Committee, Anne Arundel Small Area Planning committee representatives, citizen watershed organizations, City of Bowie, Maryland-National Capital Park and Planning Commission, Soil Conservation Districts, and County government agencies. The Steering Committee met four times between December 2002 and May 2003, to discuss the WRAS progress, and provided constructive feedback on WRAS activities. Table II-7 indicates the meeting dates and subjects for the WRAS Steering Committee.

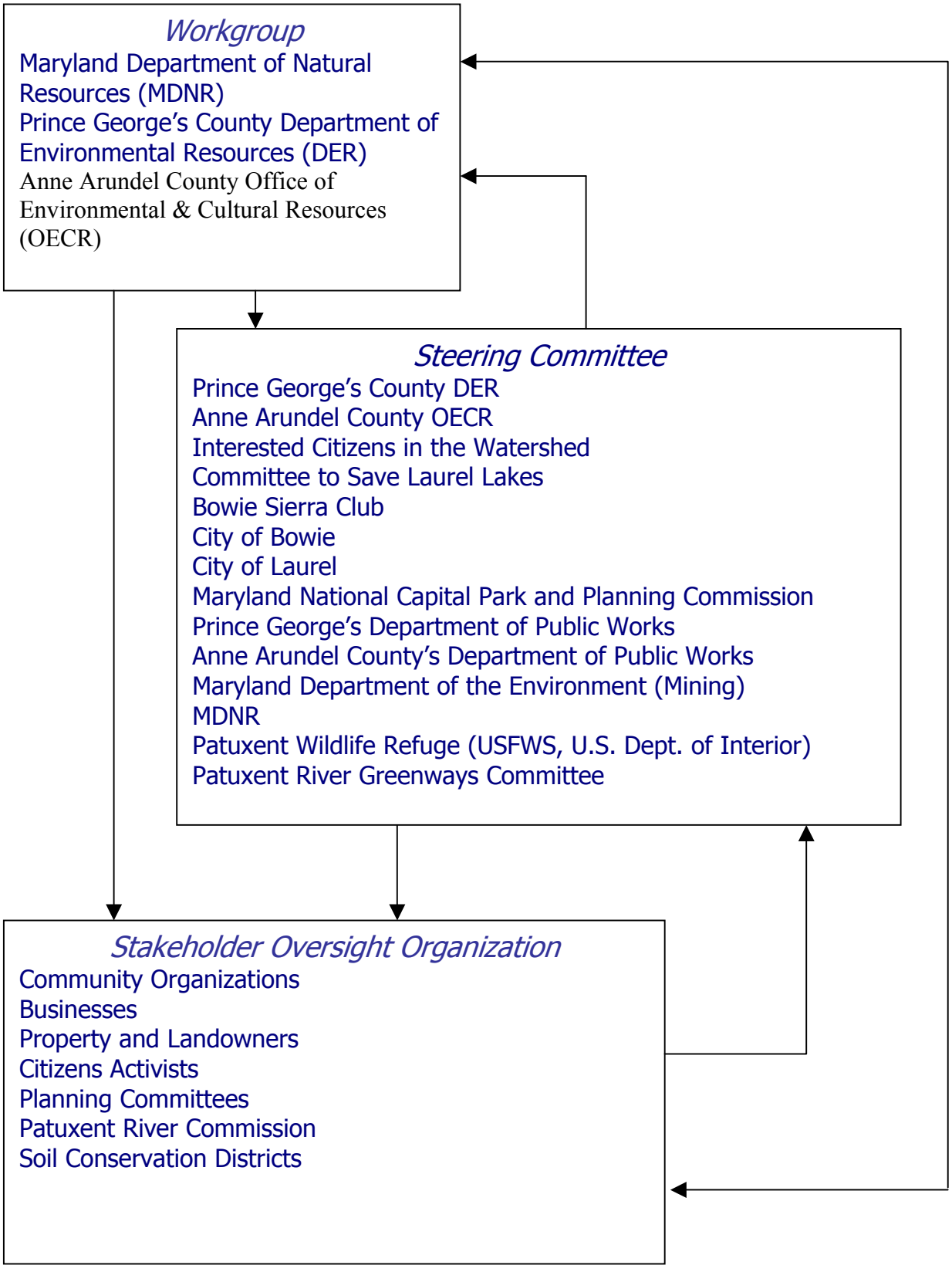


Figure II-7. Schematic of public participation process in the Upper Patuxent River WRAS.

TABLE II-7. UPPER PATUXENT WRAS STEERING COMMITTEE MEETINGS

Meeting	Topics
December 2002	Overview of WRAS Program Upper Patuxent River Watershed Characterization Synoptic Survey Results
January 2003	Stream Corridor Assessment Survey Results– Upper Patuxent River Present and discuss draft outline for WRAS report
February 2003	Cancelled due to inclement weather
March 2003	Potential restoration activities LID activities Stormwater Management Retrofits Grant opportunities to support these activities Finalize WRAS report outline
April 2003	Decentralized Demonstration Project Grant Opportunities to implement WRAS recommendations

Provide Opportunity for Public Comment and Participation in Upper Patuxent WRAS Development

In addition to the Steering Committee and Stakeholder meetings, Prince George's County solicited participation and input with the Committee to Save Laurel Lakes (CSLL), the Bowie Sierra Club, and the Cities of Bowie and Laurel at formal meetings and informal gatherings. Concerns, projects and comments were incorporated into the final strategy

Develop Public Outreach And Participation Strategy For The Implementation Phase Of The Upper Patuxent WRAS

Public outreach and participation is key to the success of the Upper Patuxent WRAS. Both Anne Arundel and Prince George's Counties have agreed that the main element in this strategy is to develop an Upper Patuxent Watershed Association. Other key elements are to provide watershed wide workshops on Low Impact Development geared for both professionals and the general public. For a more detailed discussion on this strategy, see Section IV. Implementation.

III. Results

This section summarizes the results of both MDNR's and Prince George's County's assessments for the Upper Patuxent River watershed for Prince George's County. The summaries include the results, conclusions and recommendations for each type of assessment.

Watershed Characterization

Land Use and Natural Resources

The Upper Patuxent River Watershed has about 57% of the WRAS study area in Prince George's County. Forested land occupies approximately 45% of the WRAS study area, with about one-half of that in Prince George's. Most of the developed area is also located in the County and constitutes 32 % of the study area. For more information, see "The Upper Patuxent River Watershed Characterization" at www.dnr.state.md.us/watersheds/surf/proj/wras.html.

The Upper Patuxent subwatersheds in Prince George's County range in size from 347 acres to 4332 acres. Table III-1 outlines the land use in acreage per subwatershed. Natural resources (forested, wetlands and water) are placed in the first category. These areas are proposed for conservation and protection. The urban land uses (residential, transportation and utility and industrial, commercial and institutional) are planned for LID retrofit and redevelopment.

Table III-1. Land Use for Prince George's County Upper Patuxent Subwatersheds

Land Use Watershed	Forested, Wetlands & Water	Agriculture	Other Open Lands	Trans. & Utility	Industrial, Commercial, Institutional	Residential
Bear Branch (1562 acres)	31.7	0.1	27.4	4.7	22.6	13.5
Crows Branch (868 acres)	23.2	0.0	10.2	4.2	14.2	48.2
Green Branch (1218 acres)	29.5	9.2	17.0	8.6	13.4	22.3
Horsepen Branch (4332 acres)	45.4	1.5	13.4	0.8	2.6	36.3
Marsh Branch (1053 acres)	44.1	0.0	5.7	0.8	4.8	44.6
Mill Branch (2270 acres)	36.5	20.0	14.6	2.2	2.5	24.3
Mount Nebo (1186 acres)	49.0	19.3	12.8	3.1	1.6	14.2
Patuxent Refuge (reference) (473 acres)	99.8	0.0	0.0	0.0	0.2	0.0
Tributary 1 (746 acres)	25.2	0.0	14.3	0.9	3.8	55.9

Table III-1. Land Use for Prince George's County Upper Patuxent Subwatersheds

Land Use Watershed	Forested, Wetlands & Water	Agriculture	Other Open Lands	Trans. & Utility	Industrial, Commercial, Institutional	Residential
Tributary 2 (420 acres)	30.4	0.0	6.8	0.0	3.3	59.4
Tributary 3 (1640 acres)	29.4	0.5	7.8	0.7	10.0	51.6
Tributary 4 (572 acres)	34.0	0.0	11.1	5.2	1.7	47.9
Tributary 5 (1115 acres)	35.2	1.0	15.5	3.8	15.3	29.3
Tributary 6 (1083 acres)	39.6	0.0	10.5	1.3	2.0	46.5
Tributary 7 (347 acres)	28.4	0.0	21.3	11.0	8.9	30.5
Tributary 8 (401 acres)	66.0	0.0	5.8	0.2	4.6	23.3
Walker Branch (1276 acres)	30.5	0.3	10.4	3.9	2.9	51.9

Recommendations and Actions

- Develop GIS application/tool for planning and implementation
- Identify, map all natural resources by watershed and the 18 subwatersheds and place information in GIS application/tool
- Natural resources that are specified by Federal, State and County to be of special concern and/or interest (e.g.sensitive species), will be identified and mapped per watershed and 18 subwatersheds and are of first priority for protection
- Identify, update property owners database and link to GIS application/tool
- Coordinate with Maryland National Capital Park and Planning Commission on protection efforts

Stream Corridor Assessment

Results and recommendations for both Prince George's County and MDNR's Stream Corridor Assessments are outlined in this section. Eighteen subwatersheds were evaluated.

Results

A total of 886 problem data sheets, and 113 representative data sheets, were filled out during the survey. Included in the problem data sheets were 297 pipe outfalls, 178 fish migration barriers, 119 erosion sites, 94 sites with inadequately vegetated stream buffers, 56 unusual condition sites, 50 channel alteration sites, 47 exposed pipes, 39 trash dumping sites and 6 in/near stream construction sites. Twenty-four comment data sheets were also completed during the survey to provide additional information about specific problems.

An overall summary of survey results is presented in Table III-2, while Table III-3 summarizes the data by major stream segments. For more detailed information, see the report "Upper Patuxent in Prince

George's County Stream Corridor Assessment Survey" located on MDNR's website:http://www.dnr.state.md.us/watersheds/surf/proj/wras.html). The report may be accessed at the County's website, http://www.co.pg.md.us/Government/AgencyIndex/DER/PPD/.
All data collected during the survey is presented in Appendices A and B in that report. Appendix A provides a listing of information by problem number along with its location, using Maryland State Plane northing and easting coordinates. The coordinates are meters. Information in this format is useful when working with maps showing the location of problem sites to determine what problems may be present along a specific stream reach. In Appendix B the data is presented by problem type with more detailed information about each problem. Presenting the data by problem type allows the reader to see which problems the field crews rated the most severe or easiest to fix within each category.

Table III-2. Summary of Results from Upper Patuxent River SCA Survey

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Pipe Outfalls	**297**	**NA**	2	13	108	19	152
Fish Barriers	**178**	**NA**	0	2	34	32	109
Erosion Site	**119**	**124,345 feet (23.6 miles)**	22	14	53	20	9
Inadequate Buffers	**94**	**70,880 feet (13.4 miles)**	4	9	29	31	19
Unusual Conditions	**56**	**NA**	4	2	20	17	9
Channel Alterations	**50**	**20,137 feet (3.8 miles)**	2	7	4	9	26
Exposed Pipes	**47**	**277.5 feet**	1	6	17	9	14
Trash Dumping	**39**	**NA**	0	2	17	9	11
In/Near Stream Construction	**6**	NA	-	1	2	2	1
TOTAL	**886**		34	56	284	146	349
Comments	**24**						
Representative Sites	**113**						

Table III-3. Summary of survey results by major stream segments

Stream Segment	Channel Alteration	Construction	Erosion	Exposed Pipes	Fish Barrier	Inadequate Buffer	Pipe Outfall	Representative Sites	Trash Dumping	Unusual Conditions	Total
Northern Watershed											
Crows Branch	6	1	4	3	9	11	42	19	2	2	99
Bear Branch	3	3	16	3	6	2	27	19	2	10	91
Walker Branch	2	-	9	8	8	6	15	2	1	4	55
Tributary 5	4	-	3	-	3	8	11	1	1	-	31
Tributary 8	-	-	3	2	1	1	2	-	-	1	10
Tributary 7	2	-	1	-	-	2	-	-	-	1	6
Patuxent Wildlife Refuge	-	-	2	-	2	-	-	2	-	1	7
Southern Watershed											
Horsepen Branch	11	1	25	10	54	24	57	21	10	13	226
Mill Branch	7	-	17	2	20	12	19	9	7	13	106
Tributary 3	1	-	4	4	9	7	49	12	1	-	87
Green Branch	4	-	7	6	19	8	20	10	2	5	81
Mount Nebo Branch	-	1	11	-	8	11	5	6	3	2	47
Tributary 1	2	-	5	2	7	4	11	3	6	3	43
Tributary 4	3	-	5	1	17	2	5	2	-	3	38
Marsh Branch	2	-	7	-	7	2	13	2	1	-	34
Tributary 2	1	-	-	1	1	1	18	1	-	2	25
Honey Branch	-	-	4	-	3	1	-	2	1	-	11

Prince George's County has made a first cut to prioritize the SCA problems by subwatershed. The first step in the process was to separate the pipe outfalls (except those that have discharge problems) from the other problem categories. Pipe outfalls will be assessed for retrofitting with LID techniques. The next step was summing the three scores (severity, correctibility and access) to get a total score. This list was then analyzed per problem type. In-stream construction sites were removed from the priority lists (a follow up investigation will be made to determine if still a problem). If there was a tie in the total score, the severity score was considered the most important factor. If there were 10 or less problem sites in a subwatershed, all problems were listed for that subwatershed. See Appendix D for summary tables of the subwatershed priorities.

Recommendations and Actions

- Use GIS application/tool for prioritization and planning
- Produce subwatershed maps (aerials) at scale showing all problem sites
- Review the rating of the problem sites and adjust scoring
- Determine property owner of each problem site

- Select sites to be resurveyed; sites to include are those rated as very severe and severe, the initial priority sites and any others that indicate anomalies in the data
- Package all restoration opportunities in geographical areas (stream restoration, fish barriers, LID, etc.) within each subwatershed
- Perform any necessary preliminary work (e.g. LID assessments, geo-morphological evaluations, etc.) for each priority site
- Coordinate with watershed stakeholders and property owners for final selection
- Complete the remaining stream miles in the Upper Patuxent Watershed

Synoptic Surveys

The results, conclusions and recommendations are presented in the following sections for both Prince George's County and MDNR's water quality and biological assessments. Water quality sampling was evaluated in 10 of the eighteen SCA subwatersheds and biological monitoring was performed 32 stream sites.

Water Quality Sampling

NUTRIENTS

Nutrients levels can impact both the small streams found within the subwatersheds as well at the Upper Patuxent River. Concentrations can be used as a measure of the impact on the in-stream aquatic environment while nutrient loading are of greater importance in evaluating the impacts on the Upper Patuxent River. The following sections describe the results from the sampling for nitrate/nitrite, total phosphorous and ortho-phosphorus.

Nitrate/Nitrite Levels

Nitrate is an essential nutrient for aquatic plants with natural concentrations seldom exceeding 0.1 mg/L (Chapman, 1996). Natural levels may be elevated due to municipal or industrial wastewaters and by the use of inorganic fertilizers. In well aerated waters the nitrite ion is rapidly oxidized to nitrate and is usually included with nitrate for an overall nitrate/nitrite measurement. The EPA has also published Ambient Water Quality Criteria recommendations on the reference levels of nitrate/nitrate values in rivers and streams for the 25th percentile of sites (recommended EPA reference condition) within each Ecolevel (EPA, 2000). The Upper Patuxent and its subwatersheds fall within Ecolevel 65, which has reference, level of 0.1 mg/L in the spring and 0.09 mg/L in the summer. All nitrate/nitrite baseflow samples collected by Prince George's County, except for the Patuxent Wildlife Refuge reference watershed, had concentrations above the recommended reference concentration of 0.09 mg/L. MDNR's sampling results had five of nine sites below the recommended spring level of 0.09 mg/L, but also found the lowest levels at the Patuxent Wildlife Refuge site (see Figure III-1.)

Urbanized subwatersheds had generally high baseflow loadings of nitrate when compared to the two watersheds with the most agricultural land use (Honey Branch, 38.2 % and Mount Nebo 19.3%). Daily loadings from the Patuxent Wildlife Refuge subwatershed were negligible compared to almost all other sites, except for the MDNR's sampling results from Tributary 7. Baseflow loadings of nitrate/nitrite were highest from the most urbanized areas in both the County's summer and MDNR's spring data sets (see Figure III-2)

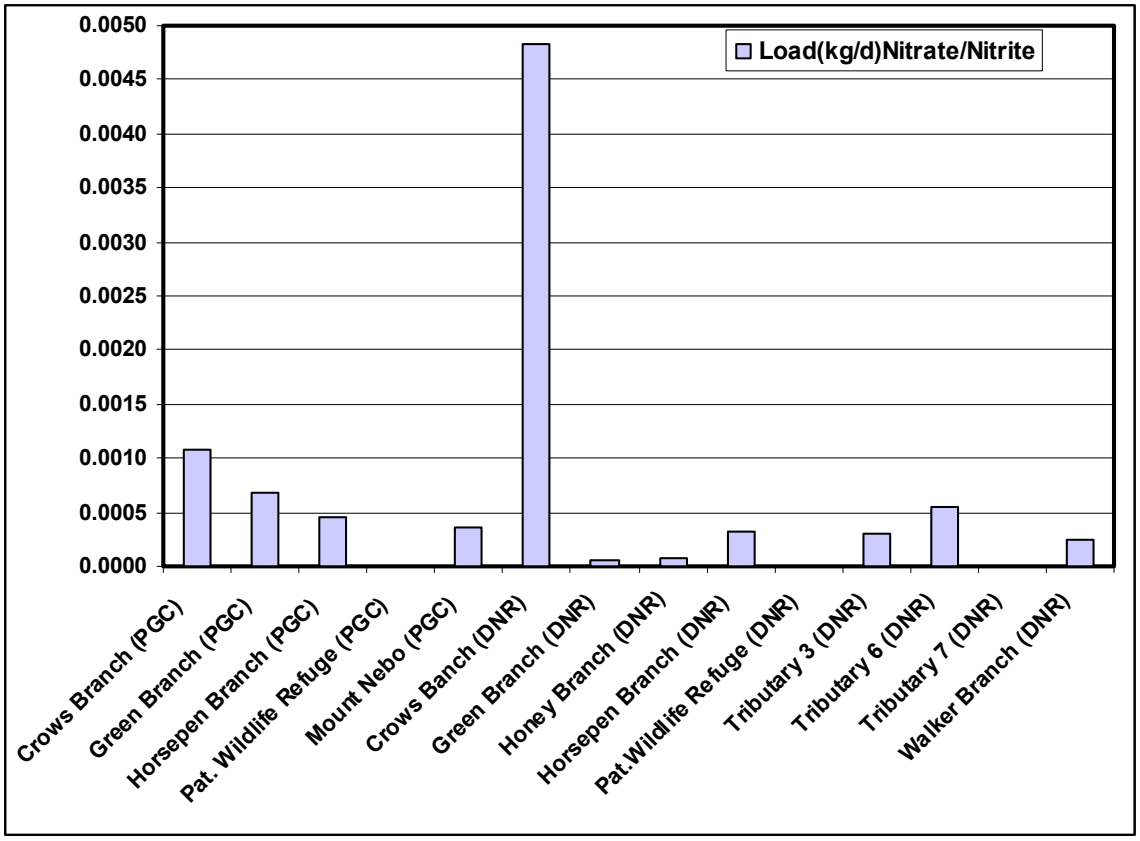


Figure III-1: Nitrate/Nitrite Levels by Subwatershed and by Sampling Agency

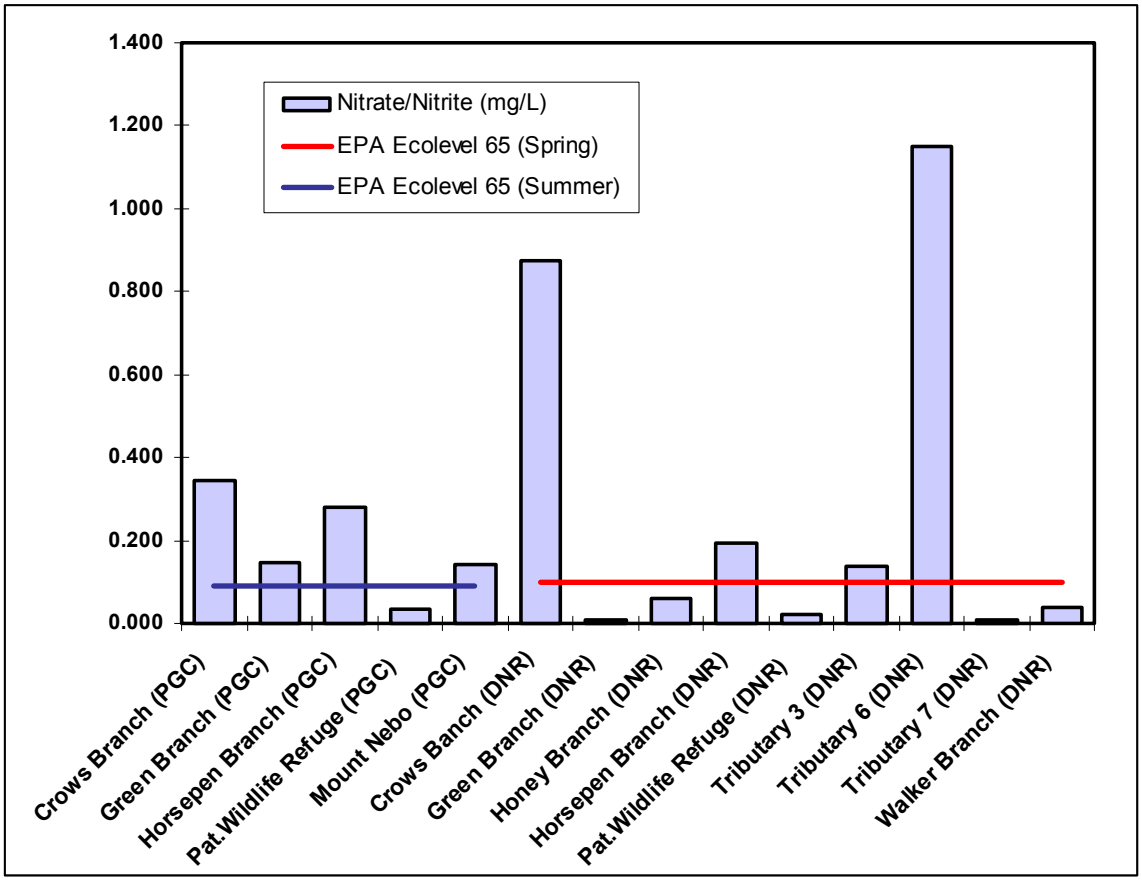


Figure III-2: Nitrate/Nitrite Daily Baseflow Loadings by Subwatershed and Sampling Agency

Phosphorus Levels

Phosphorus is an essential nutrient for living organisms and exists in water bodies in both a particulate as well as a dissolved form (Chapman, 1996). In most cases it is the limiting nutrient for algal growth and as result controls the primary productivity of a water body. The EPA's recommendations on the reference levels of total phosphorus in rivers and streams for the 25th percentile of sites within Ecolevel 65 are 0.075 mg/L in spring and 0.01 mg/L in summer (EPA, 2000). There is no recommended level for ortho-phosphorus. Total phosphorus analyses were completed for the samples taken by Prince George's County while the MDNR's samples were analyzed for ortho-phosphorus. All the subwatersheds sampled by the County, including the Patuxent Refuge Reference Subwatershed had total phosphorus levels exceeding the reference level (Figure III-3). The high level measured at the reference subwatershed, is unexplained, but may have been an artifact of the high level of organic matter in the stream water at the time of sampling. The ortho-phosphorus levels measured in subwatershed's sampled by the MDNR ranged from 0.0015 mg/L to a high of 0.0095 mg/L in Honey Branch. The value measured at Honey Branch also exceeded the EPA recommended spring level total phosphorus level of 0.0075 mg/L (Figure III-4).

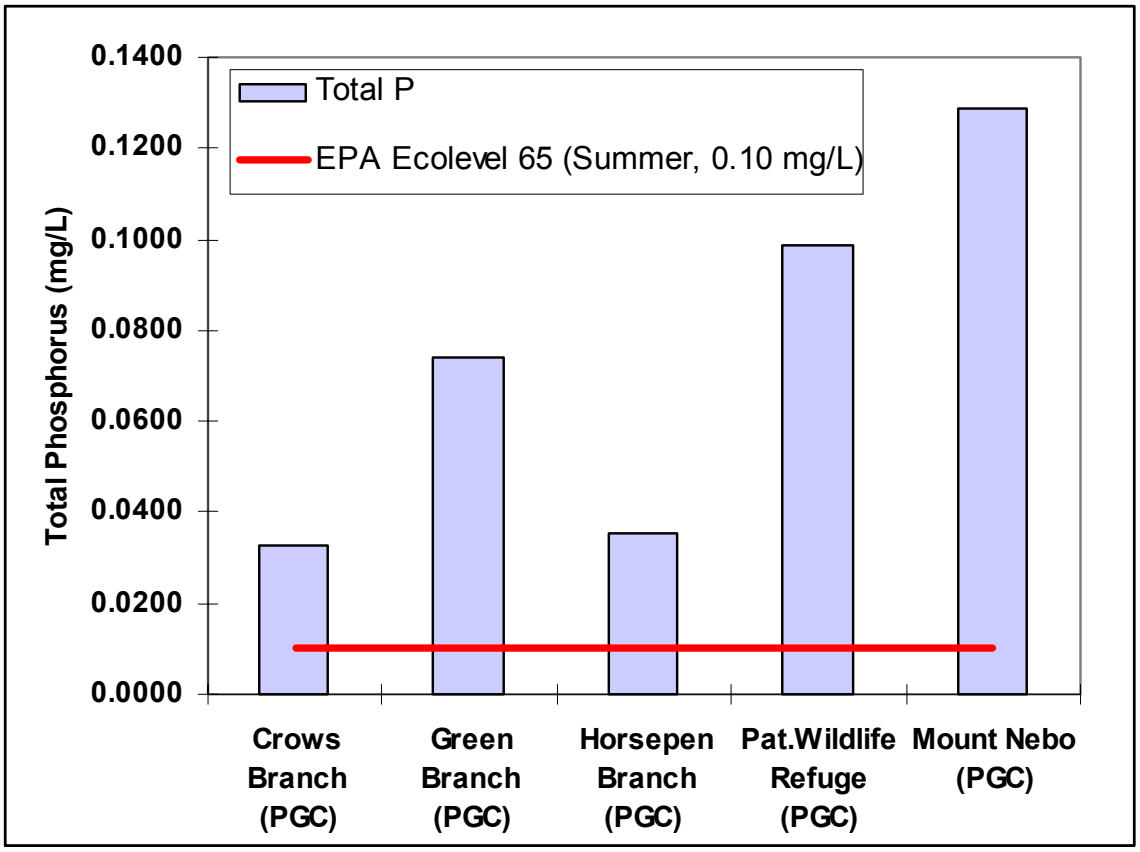


Figure III-3: Total Phosphorus Level by Subwatershed Sampled.

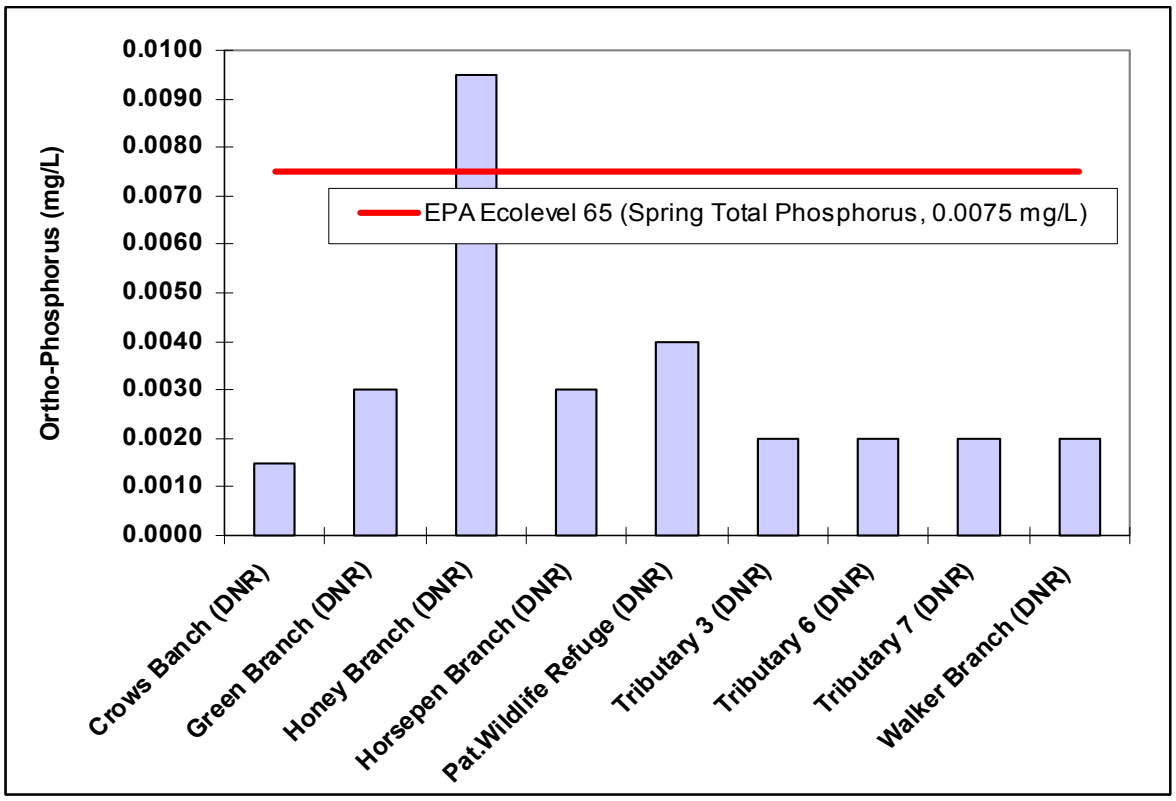


Figure III-4: Ortho-Phosphorus Levels by Subwatershed

Trace Metals

The trace metals of copper, lead, and zinc are commonly found in the storm runoff from urban areas and are toxic to aquatic life at very low concentrations. Since baseflow conditions persist in stream and rivers for most of the year elevated levels of any of these trace metals could have serious impacts on the aquatic health of a subwatershed.

For lead and zinc all the samples taken were well below EPA's chronic criteria standard (Figure III-6 and III-7). Copper levels in samples were generally much closer to the EPA's chronic criteria standard and in one case exceeded the standard (Figure III-5). The high value occurred in the Mount Nebo sample taken in September.

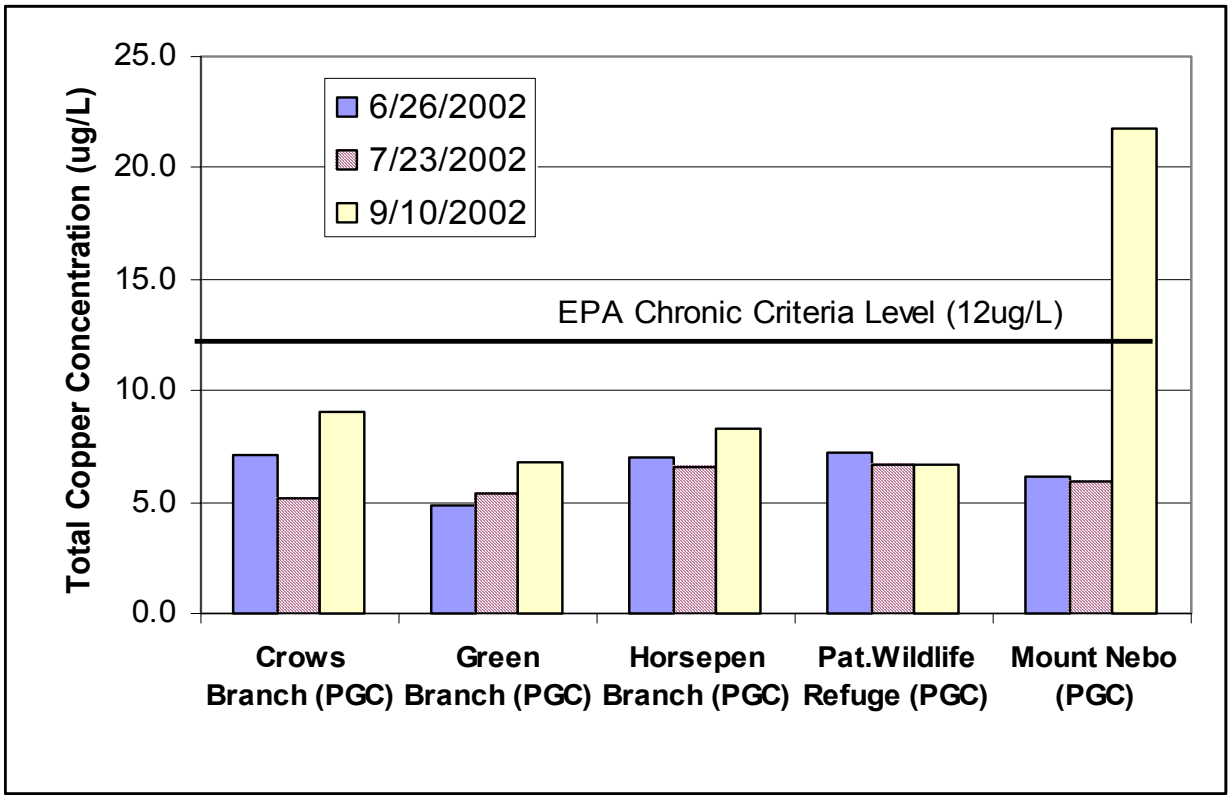


Figure III-5: Total Copper Concentration by Subwatershed Sampled.

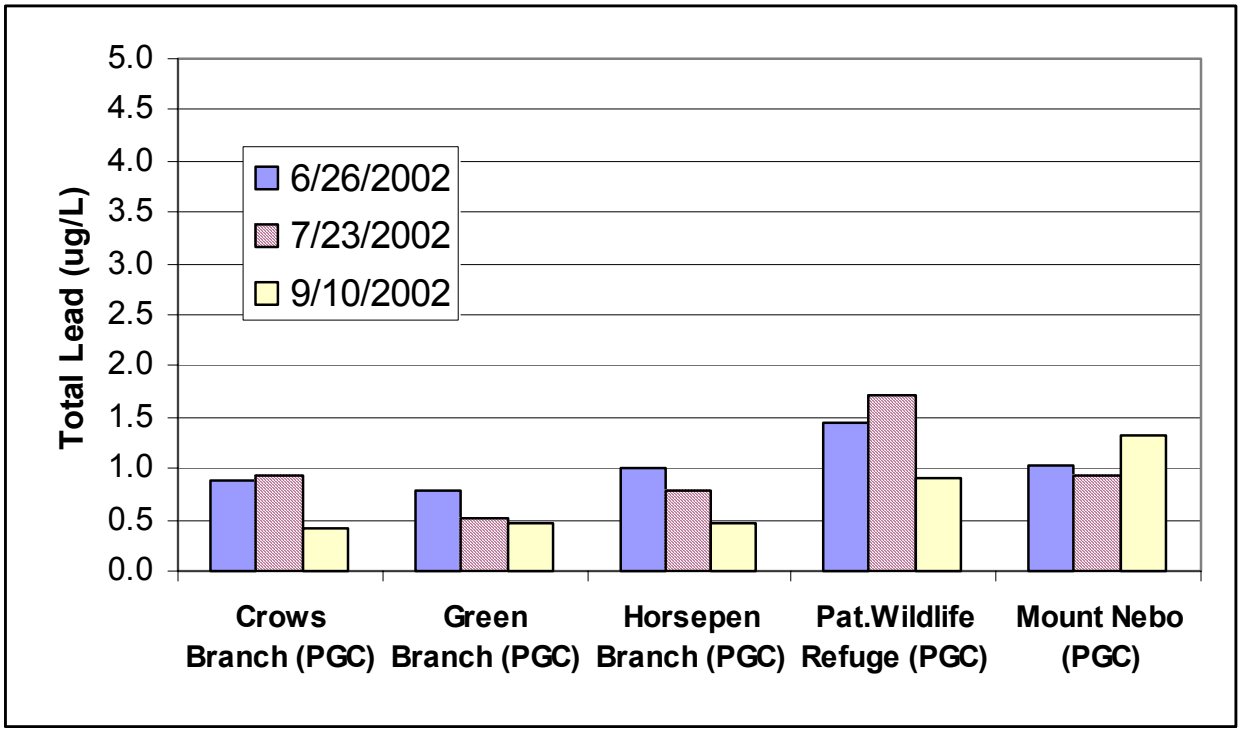


Figure III-6: Total Lead Concentration by Subwatershed Sampled (EPA Chronic Level - 32ug/L).

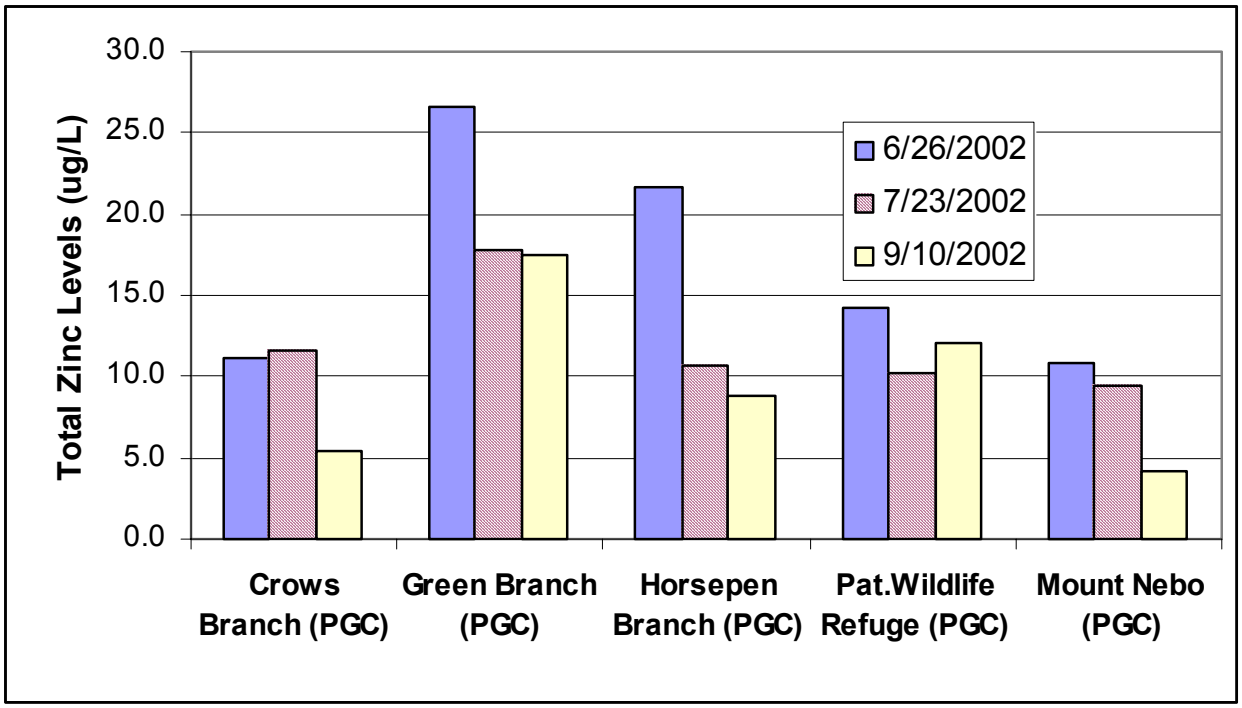


Figure III-7: Total Zinc Concentration by Subwatershed Sampled (EPA Chronic Level - 110 ug/L).

Conclusions and Recommendations

Four out of nine subwatersheds sampled by MDNR had spring baseflow nitrate/nitrite concentrations exceeding reference levels recommended by the EPA (Crows Branch, Horsepen Branch, Tributary 3, and Tributary 6). Summer baseflow concentrations of nitrate/nitrate were higher than recommended levels in four out of the five subwatersheds sampled (Crows Branch, Mount Nebo, Horsepen Branch and Green Branch). Baseflow loadings of nitrate/nitrite were highest from the most urbanized subwatersheds (Crows Branch and Horsepen Branch). Summer total phosphorus levels recommended by the EPA were exceeded in all five subwatersheds sampled. In one case the spring ortho-phosphorus levels sampled by MDNR also exceeded the EPA's recommended level. Trace level concentrations of metals were generally well below recommended levels for lead, zinc and copper. Only one sample taken for copper exceeded the chronic water quality criteria.

The management of total phosphorus levels is important to both the streams within subwatersheds of the Upper Patuxent as well as to the Upper Patuxent River. All the subwatersheds sampled had in-stream concentrations above recommended reference levels. The Cheaspeake Bay Program from 1997-1999, assessed the water quality in Upper Patuxent River downstream of the U.S. 50 bridge over the Patuxent. The total phosphorus levels were rated poor (MDNR,2002) and total nitrogen and total suspended solids were rated fair.

Total phosphorus concentrations in baseflows appear to be highest in highly urbanized (high levels of imperviousness) and agricultural watersheds. Sources of the elevated baseflow phosphorus levels in-stream were not identified, but likely represent some combination of in-stream sediment, septic and illegal storm drain connections. In-stream sediment sources of

phosphorus are likely the result of sediment deposition from stormwater runoff during wet weather. Wet weather load also likely represents the bulk of the total phosphorus loads to the Upper Patuxent River.

To assess the effectiveness of watershed wide restoration efforts in reducing both the in-stream and the wet weather loads of phosphorus, one of the assessed subwatersheds within the Upper Patuxent should be selected as a pilot for restoration work. A useful first step in the restoration effort would be to determine the extent and effectiveness of existing urban and/or agricultural stormwater facilities within the pilot subwatershed. This information in conjunction with an assessment of both in-stream concentrations, as well as the wet weather loadings of phosphorus, and their likely sources could form the basis of restoration efforts and procedures to track those efforts. Watershed restoration should target both reductions in controllable sources as well as the mitigation of uncontrolled sources.

Reductions in controllable sources can include pollution prevention/nutrient management plans for both urban and agricultural land uses, or the identification and elimination of illegal storm drain connections. Mitigation measures can include a wide range of best management practices that reduce non-point source phosphorus loads, such as low-impact development techniques, pollution prevention and modifications to existing stormwater management facilities.

Monitoring of nitrate and total suspended concentrations and loads should also be continued with efforts focused on reducing phosphorus concentrations and loads. If loads of these constituents are not reduced in conjunction with a reduction in phosphorus levels than a more detailed assessment of their source loads and mitigation options should be undertaken.

Benthic Macroinvertebrate Sampling/ Macroinvertebrate Habitat Assessment/Fish Community Assessment

HABITAT

The overall assessment for physical habitat in the Upper Patuxent in Prince George's County is rated as partially supporting (105.0 ± 14.9) (Table III-4). Although the margin of error as measured by the standard deviation for this assessment is large enough to potentially assess the area as non supporting.

Table III-4. Overall Physical Habitat Assessment Rating For The Upper Patuxent River In Prince George's County. (Only Probabilistic Sites Used).

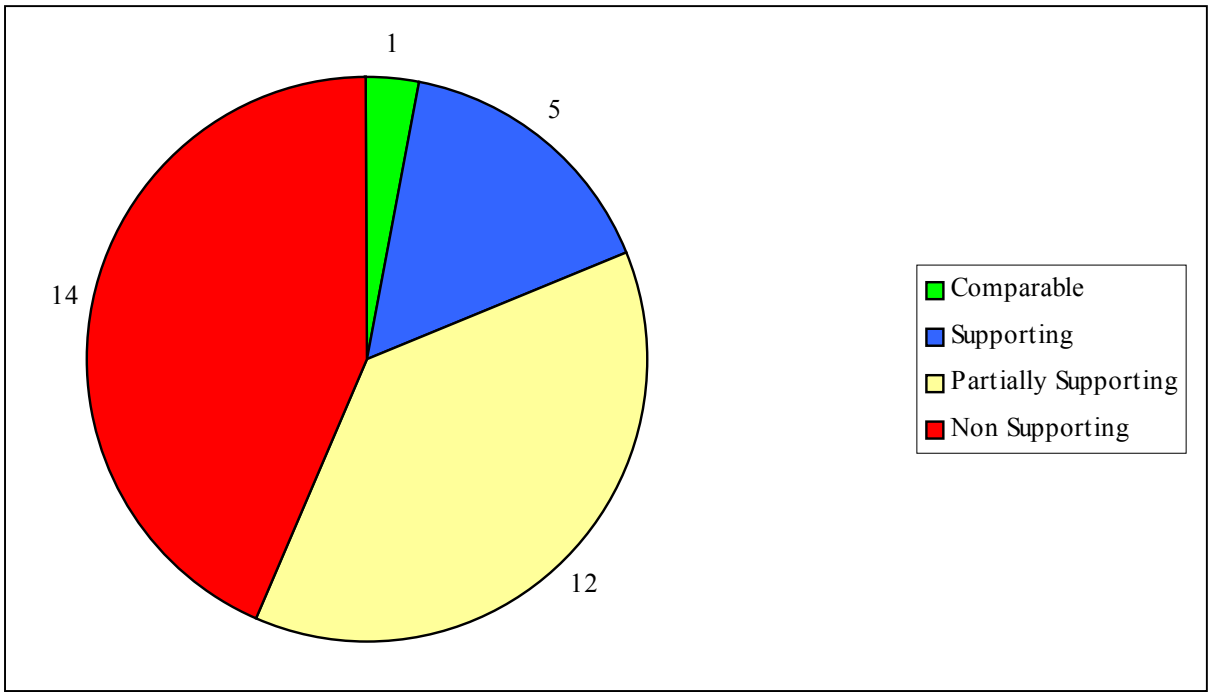
WATERSHED GROUP	Order Medians				Watershed Mean	Narrative Assessment
	1	2	3	4		
Upper Patuxent River	114.0 (N=5)	104.0 (N=1)	-	122.0 (N=1)	113.3 (N=7)	Partially Supporting
Walker Branch, Crow Branch and Bear Branch	129.00 (N=3)	114.5 (N=2)	-	-	121.8 (N=5)	Partially Supporting
Horsepen Branch	74.0 (N=4)	114.0 (N=2)	-	-	94.0 (N=6)	Non Supporting
Lower Patuxent River*	85.0 (N=8)	97.0 (N=4)	-	-	91.0 (N=12)	Non Supporting
				WRAS Mean	105.0 (N=30)	Partially Supporting

The Lower Patuxent River is a named subwatershed of Prince George's County and part of the Upper Patuxent WRAS geographical area is in the Lower Patuxent. Only part of this watershed group fell within the WRAS area. Only those sites within the WRAS area included in the assessment

Because the majority of the sites (21 of 32) were sampled in 2002, results reflect the effects of three years of drought. Four of the ten habitat parameters appear to have scored lower on average than sites sampled in 2000 and 2001. The four parameters that changed most dramatically (downward) were channel flow status, epifaunal substrate/available cover, pool substrate characterization, and sediment deposition, all of which can be affected by stream flow.

Site ratings were split almost evenly between Non Supporting (14) and Partially Supporting (12) with only one site (02-019 in 2001) rated as comparable (Figure III-8). This is likely due to the high level of urban land use in the study area.

Figure III-8. Habitat Narrative Assessment Ratings For Upper Patuxent WRAS Area. Narrative Ratings Per PG DER 2000. (All Sites)



The effect of the drought is especially evident when examining the repeat sampling of the Patuxent Wildlife Refuge reference site (02-019) from 2001 to 2002 (Table III-5). There was enough of a difference in the total scores to change the narrative assessment of this site from Comparable to Partially Supporting. The observed differences in physical habitat scores between the two years is most likely due to the effects of the drought during 2002. The noted decrease in channel flow status reflects the lower stream levels caused by a drought (the water is filling as little as 25% of the channel width for 02-019 in 2002). Less water in the channel affects the discharge and the bed load capacity of the stream. A lower discharge and stream velocity can, in turn, lead to sedimentation (less of the sediment is being carried in the water column and deposited downstream) and is a main cause for observed decreases in the other three

habitat parameters that were most dramatically different between the two sample years (epifaunal substrate/available cover, pool substrate characterization, and sediment deposition).

Table III-5. Physical Habitat Assessment Scores For Patuxent Wildlife Refuge (02-019) For 2001 And 2002.

Habitat Parameters	Sample Year		Change
	2001	2002	
Channel Alteration	19	19	0
Channel Flow Status	**18**	**6**	**-12**
Channel Sinuosity	10	9	-1
Epifaunal Substrate/Available Cover	**16**	**10**	**-6**
Pool Substrate Characterization	**15**	**10**	**-5**
Pool Variability	7	10	3
Sediment Deposition	**18**	**10**	**-8**
Bank Stability (Left Bank)	7	6	-1
Bank Stability (Right Bank)	8	6	-2
Vegetative Protection (Left Bank)	8	7	-1
Vegetative Protection (Right Bank)	8	7	-1
Riparian Vegetative Zone Width (Left Bank)	10	10	0
Riparian Vegetative Zone Width (Right Bank)	10	10	0
Total	*154*	*120*	*-34*

Benthic Macroinvertebrates

The overall condition of the Upper Patuxent River watershed and its tributaries in Prince George's County is rated according to Maryland Biological Stream Survey's Benthic IBI (Stribling et al. 1998) as very poor (1.98 ± 0.43) (Table 6). However, the standard deviation of the score is enough to possibly be scored as Poor. From the 35 samples (MDNR duplicate sampling), 188 taxa were collected, see "*Upper Patuxent River Watershed Restoration Action Strategy (WRAS) Biological Assessment, Spring 2002, Prince George's County, Maryland*." Of the 9 stations visited in 2001, two were unsampleable (one was ponded and the other was non-wadeable). Of the 21 stations visited in 2002, only one was unsampleable (non-wadeable).

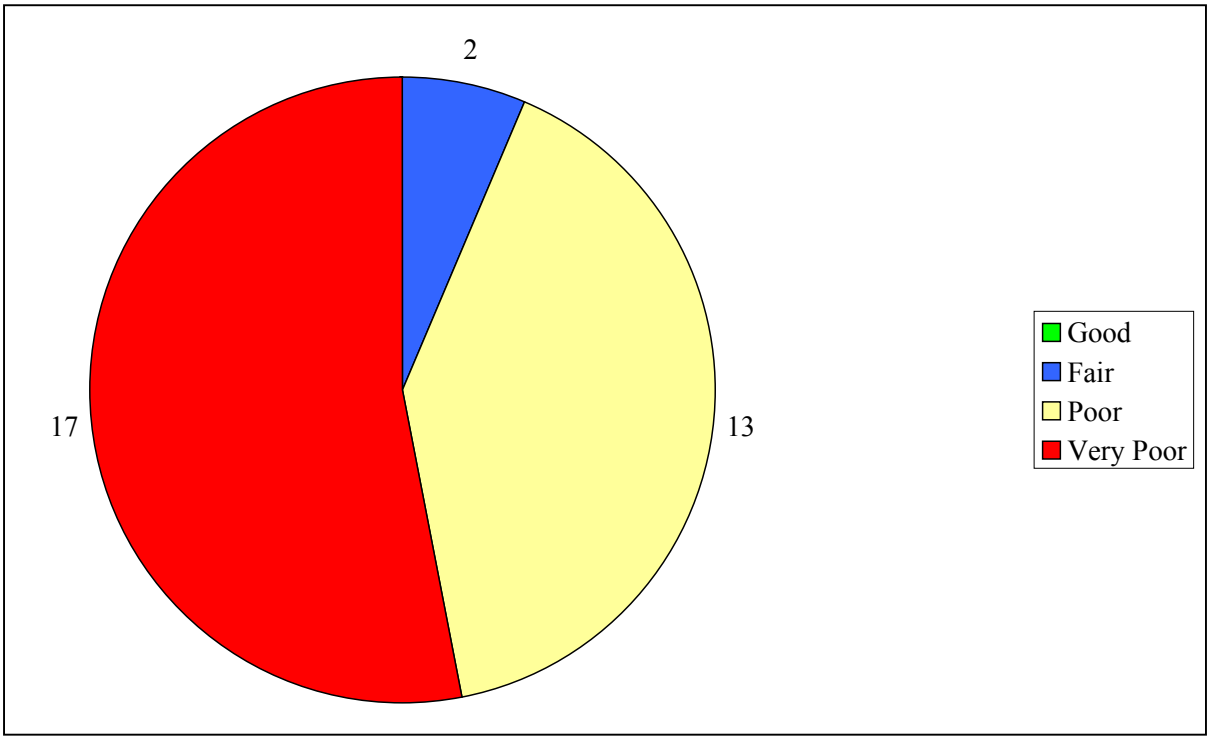
Table III-6. Overall Benthic IBI Assessment Rating For The Prince George's County Upper Patuxent River. (Only Probabilistic Sites Used).

WATERSHED GROUP	Order Medians				Watershed Mean	Narrative Assessment
	1	2	3	4		
Upper Patuxent River	1.57 (N=5)	1.86 (N=1)		2.71 (N=1)	2.05 (N=7)	Poor
Walker Branch, Crow Branch and Bear Branch	1.29 (N=3)	1.43 (N=2)			1.36 (N=5)	Very Poor
Horsepen Branch	2.14 (N=3)	2.57 (N=2)			2.36 (N=5)	Poor
Lower Patuxent River*	1.86 (N=8)	2.43 (N=4)			2.15 (N=12)	Poor
				WRAS Mean	1.98 (N=29)	Very Poor

*Only part of this watershed group fell within the WRAS area. Only those sites within the WRAS area included in the assessment. The Lower Patuxent River is a named subwatershed of

Prince George's County and part of the Upper Patuxent WRAS geographical area is in the Lower Patuxent.
Of the 32 benthic samples the majority (17) rated as very poor with only 2 sites rated as fair and the remaining 13 sites as poor (Figure III-9).

Figure III-9. Benthic IBI Narrative Assessment Ratings For Upper Patuxent WRAS Area. Narrative Ratings Per Stribling Et Al. 1998. All Sites.



Comparing the results for the Patuxent Wildlife Refuge (02-019) (sampled in both 2001 and 2002) does not yield any broad differences except for total number of taxa decreasing from 24 to 18 (Table 7). Other metrics changed only slightly but enough to drop the overall rating of this site from poor in 2001 to very poor in 2002.

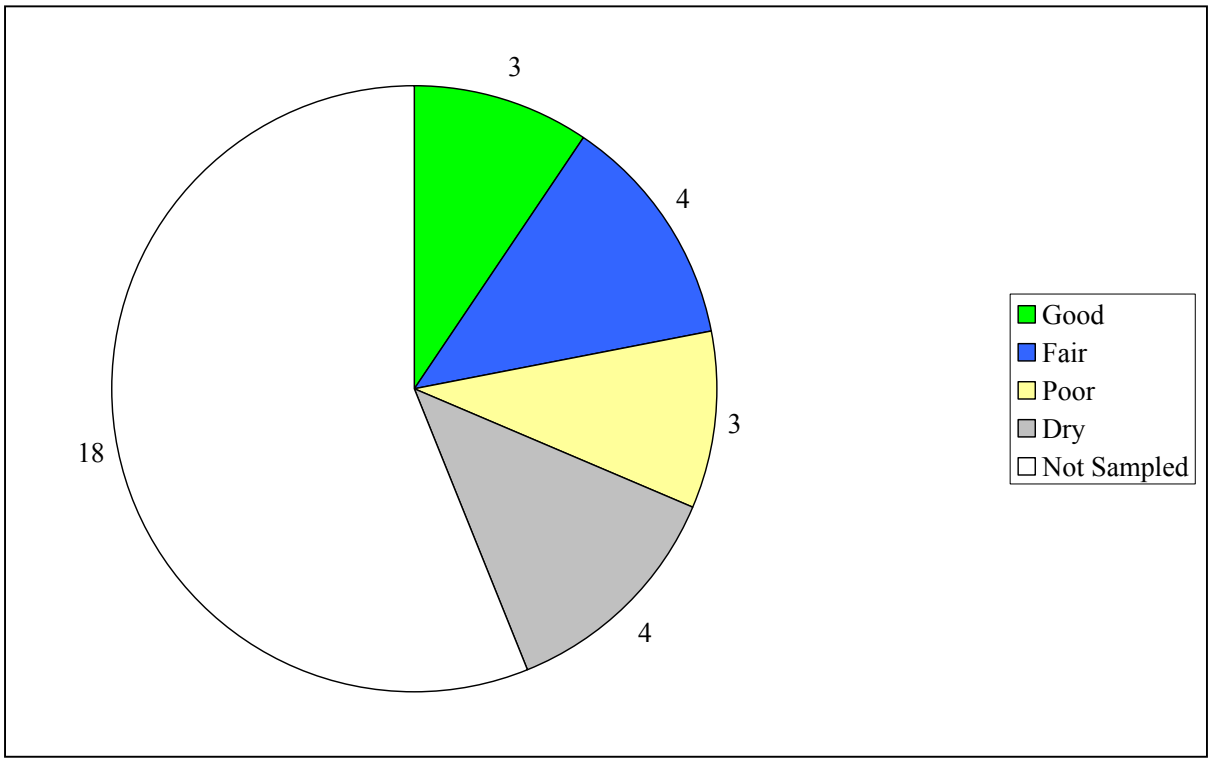
Table III-7. Benthic IBI Scores For Patuxent Wildlife Refuge (02-019) For 2001 And 2002.

Benthic IBI Metrics	Sample Year		Change
	2001	2002	
Total Taxa	24	18	-6
EPT Taxa	3	1	-2
Percent Ephemeroptera	0	0.00	0.00
Percent Tanytarsini of Chironomidae	0	1.96	1.96
Beck's Biotic Index	8	6	-2
Scraper Taxa	1	0	-1
Percent Clingers	26.92	33.61	6.69
Benthic IBI (Coastal Plain)	2.14	1.86	-0.28

Fish
Fourteen of the 32 sites were sampled for fish (two sites in 2000, 12 sites in 2002). Of the 12 sites sampled in 2002, four were found dry during the fish sampling (Figure below) but had

flowing water during the benthic macroinvertebrate sampling in the Spring. A total of 29 fish species were collected from the 14 sites. Of the remaining 10 sites, none were rated as very poor, in contrast to the benthic IBI scores (Figure III-10). Many sites (18 of 34) were too large to sample safely for fish (i.e., non-wadeable) or too small (less than 300 acre drainage area) to assign an IBI (Roth et al. 1997). Of the remaining 16 sites (12 in 2002), 4 (25%) were found to be dry in the summer of 2002. The average score for the 12 assessed sites was 3.5, a rating of fair. Sampled in 2000, Walker Branch, scored 3.75 (fair) and Crows Branch, 4.25 (good).

Figure 10. Fish IBI Assessment Ratings For Upper Patuxent WRAS Area. (Not Applicable Was Assigned To Sites That Were Dry When Visited For Sampling).



Individual Site Assessments

Of the 35 samples from 34 stations, 29 were sampled by Prince George's over a 3-year period (2000-2002) and six were collected by MDNR in 2002. The typical site in the WRAS watershed suffers from a lack of an adequate riparian zone, poor bank vegetation, and reduced bank stability. Lack of habitat complexity in the streams (both pool and riffle) is also a problem affecting colonization of the sites by benthic macroinvertebrates. Table III-8 summarizes the habitat, Benthic IBI, Fish IBI, sampling agency and type of site for each station.

Table III-8. Scores And Ratings For Upper Patuxent WRAS Sites.

StationID	Sampling Agency	SiteType	Sample Year	Total Physical Habitat		Benthic IBI		Fish IBI	
				Score	Rating	Score	Rating	Score	Rating
02-002	PG DER	Probability	2001	113	Partially Supporting	3.29	Fair		
02-019	PG DER	Probability	2001	154	Comparable	2.14	Poor		
02-019	PG DER	Probability	2002	120	Partially Supporting	1.86	Very Poor		
02-019	WRD	Duplicate	2002	118	Partially Supporting	*<80 org.*	Very Poor		
02-029	PG DER	Probability	2001	73	Non Supporting	*non-wadeable*			

StationID	Sampling Agency	SiteType	Sample Year	Total Physical Habitat		Benthic IBI		Fish IBI	
				Score	Rating	Score	Rating	Score	Rating
02-032A	PG DER	Probability	2001	114	Partially Supporting	1.29	Very Poor		
02-032B	PG DER	Probability	2001	78	Non Supporting	1.57	Very Poor		
02-034A	PG DER	Targeted	2001	132	Supporting	*non-wadeable*			
02-034B	PG DER	Probability	2001	122	Partially Supporting	2.71	Poor		
02-034B	WRD	Duplicate	2002	132	Supporting	2.14	Poor		
02-034C	PG DER	Targeted	2002	144	Supporting	*non-wadeable*			
02-036	PG DER	Probability	2001	131	Supporting	1.57	Very Poor		
03-001	PG DER	Probability	2000	131	Supporting	1.57	Very Poor	3.75	Fair
03-005	PG DER	Probability	2000	133	Supporting	1.29	Very Poor		
04-005	PG DER	Probability	2000	98	Non Supporting	1.29	Very Poor	4.25	Good
04-005B	PG DER	Probability	2001	104	Partially Supporting	1.86	Very Poor		
04-005B	PG DER	QC	2001	104	Partially Supporting	1.57	Very Poor		
04-009	PG DER	Probability	2000	55	Non Supporting	1	Very Poor		
06-008	PG DER	Probability	2000	129	Supporting	2.43	Poor		
10-001	PG DER	Targeted	2002	108	Partially Supporting	2.43	Poor	5.0	Good
10-009	PG DER	Probability	2002	112	Partially Supporting	2.43	Poor		
10-009	WRD	Duplicate	2002	113	Partially Supporting	1.57	Very Poor		
10-011	PG DER	Probability	2002	116	Partially Supporting	2.71	Poor	3.75	Fair
10-011	WRD	Probability	2002	*not sampled*		*not sampled*		4.5	Good
10-015A	PG DER	Probability	2002	69	Non Supporting	1.86	Very Poor		
10-017A	PG DER	Probability	2002	131	Supporting	2.14	Poor		
10-017A	WRD	Duplicate	2002	105	Partially Supporting	1.57	Very Poor	4.25	Good
10-017B	PG DER	Probability	2002	78	Non Supporting	2.43	Poor	3.25	Fair
10-017C	PG DER	Probability	2002	70	Non Supporting	*<80 org.*	Very Poor		
39-075	PG DER	Probability	2002	110	Partially Supporting	3.29	Fair	*dry*	
39-077A	PG DER	Probability	2002	77	Non Supporting	2.43	Poor	*dry*	
39-077A	WRD	Duplicate	2002	115	Partially Supporting	1	Very Poor		
39-077B	PG DER	Probability	2002	67	Non Supporting	1.86	Very Poor	*dry*	
39-079A	PG DER	Probability	2002	85	Non Supporting	1.86	Very Poor		
39-079B	PG DER	Probability	2002	115	Partially Supporting	1.86	Very Poor	*dry*	
39-080	PG DER	Probability	2002	91	Non Supporting	2.43	Poor	2.0	Poor
39-084	PG DER	Probability	2002	103	Partially Supporting	2.43	Poor	3.75	Fair
39-088	PG DER	Probability	2002	102	Partially Supporting	2.14	Poor	4.5	Good
39-092	PG DER	Probability	2002	78	Non Supporting	2.14	Poor	2.0	Poor
39-102A	PG DER	Probability	2002	81	Non Supporting	1.29	Very Poor		
39-102A	WRD	Duplicate	2002	72	Non Supporting	*<80 org.*	Very Poor	*dry*	
39-102B	PG DER	Probability	2002	91	Non Supporting	1.29	Very Poor	1.0	Very Poor
39-102C	PG DER	Probability	2002	85	Non Supporting	1.29	Very Poor		

Conclusions and Recommendations

There is greater potential for a healthy stream biota when the physical habitat quality is complex and relatively stable. Thus, in the absence of other stressors, sites with comparable or supporting physical habitat are expected to produce good or fair biological ratings. About half of the sites followed this expected pattern (using total habitat and benthic IBI).

Fish IBI scores were relatively good but may reflect the more mobile nature of fish and the proximity of other habitat to the mainstem of the Patuxent River. Fish IBI scores were generally higher than expected when compared with physical habitat scores.

Table III-9 outlines the priority status for protection and restoration for all 32 sites.

Table III-9– Biological Monitoring Sites, Upper Patuxent River

Protection-Restoration Priority*	Station ID	Stream Name	Habitat Narrative Assessment	Benthic IBI Narative Assessment	Fish IBI Narative Assessment****
1	06-008	Bear Branch	S	P	
1	10-017A	New Stop Branch (Horsepen)	S	P	
1	02-036	UT to Upper Patuxent	S	VP	
1	03-001	Walker Branch	S	VP	F
1	03-005	UT to Walker Branch	S	VP	
2	02-002	Upper Patuxent	PS	F	
2	39-075	Lower Patuxent (Honey Branch)	PS	F	NA
2	02-034B	Upper Patuxent River (Mainstem)	PS	P	
2	10-001	Horsepen Branch	PS	P	G
2	10-009	Horsepen Branch	PS	P	
2	10-011	Horsepen Branch	PS	P	F
2	39-084	Lower Patuxent (Mill Branch)	PS	P	F
2	39-088	Mill Branch	PS	P	G
3	02-019	Patuxent Wildlife Refuge	PS	VP	
3	02-032A	Upper Patuxent (Mainstem)	PS	VP	
3	04-005B	Crows Branch	PS	VP	
3	39-079B	Honey Branch	PS	VP	NA
3	10-017B	New Stop Branch (Horsepen)	NS	P	F
3	39-077A	Honey Branch	NS	P	NA
3	39-080	Lower Patuxent (Mt. Nebo)	NS	P	P
3	39-092	Lower Patuxent (Green Branch)	NS	P	P
4	02-032B	Tributary 6	NS	VP	
4	04-005	Crows Branch	NS	VP	G
4	04-009	Crows Branch	NS	VP	
4	10-015A	UT to Horsepen Branch	NS	VP	
4	10-017C	New Stop Branch (Horsepen)	NS	VP	
4	39-077B	Honey Branch	NS	VP	NA
4	39-079A	Honey Branch	NS	VP	
4	39-102A	UT to Lower Patuxent (Trib. 3)	NS	VP	
4	39-102B	UT to Lower Patuxent (Trib. 3)	NS	VP	NA
4	39-102C	UT to Lower Patuxent (Trib. 3)	NS	VP	
4	10-017C	New Stop Branch	NS	***	

Key to Ratings:

Habitat	Benthic IBI	Fish IBI
S = Supporting	F = Fair	G = Good
PS= Partially Supporting	P = Poor	F = Fair
NS = Non-Supporting	VP = Very Poor	P = Poor

Table III-9– Biological Monitoring Sites, Upper Patuxent River

Protection-Restoration Priority	
1	Since physical habitat is in relatively good shape (supporting or comparable), these sites are recommended to receive a combination of protection for the physical and hydrologic characteristics, and correction of other stressors impeding biological performance. They are recommended as priority because it should be easier for to deal with streams in this condition than physical reconfiguration of streams, lacking knowledge of whether biology would actually improve (since other stressors are present). Management options include LID and conservation measures.
2	Assessment results from these streams suggest substantial stressor loads are present, but biology is able to somewhat positively respond; nutrients could be a problem here. More attention needs to be given to these streams to identifiy specific stressors and stressor sources, since they may be on the edge of requiring more expensive restoration/rehabilitation techniques. Management options include LID, pollution prevention and conservation measures.
3 & 4	Major restoration/rehabilitation techniques/programs would be required here to improve conditions for improvement in overall biological condition. Recommend beginning with efforts to establish reasonable hydrology and physical habitat complexity (geomorphic reconfiguration), to control inputs of chemical stressors, and to eliminate non-native species that may be able to thrive in severely degraded systems. Will be most complex and expensive to correct. Management options include LID, pollution prevention and stream restoration.

Table III-9– Biological Monitoring Sites, Upper Patuxent River

*Sites not ranked within groups
**Three sites are not included above. Benthic samples were not collected because the site was too deep (Patuxent River - 02-034A and 02-034C) or ponded (02-029).
***Minimum number of organisms (80) not collected in sample. Given Benthic IBI rating of "very poor"
****Fish IBI - if drainage area (catchment) <300 acres then no IBI is calculated (NA).

Stream Teams volunteer monitoring stations should be established in the Upper Patuxent River watershed to complement the professional findings. This effort will increase the stream coverage monitored for benthic macroinvertebrates. The stations will also be at some of the sites chosen for protection/restoration.

Low Impact Development Retrofit Assessment

Prince George's County 's results for the ranking of the 48 sites and a discussion on the pilot sites is described in the this session. The assessments are in Appendix B.

Site Ranking

The completed forms are used to rank the 48 LID sites. The purpose of the ranking is to identify the sites that would most benefit from the retrofit of treatment applications. Forty ranking parameters were identified and include the following:

- Impairment type
- Catchment water quality volume
- Predominant land use
- Sanitary sewer type
- Catchment percent impervious
- Catchment ground water recharge volume
- Depth to ground water
- Water supply type

- Area served by storm drain system
- Percentage of channels that are not concrete
- Catchment existing storm water treatment
- Treatment provided for catchment
- Site percent impervious
- Site ground water recharge volume
- Site existing storm water treatment
- Treatment provided for site
- Pavement condition
- Roof connected directly to storm drain
- Existing drainage problems
- Existing landscaping
- Area available for above ground treatment
- Traffic islands
- Ground level of traffic island
- Trees have sufficient spacing for treatment
- Percentage of drainage system that is piped
- Location of system in catchment
- Percent of catchment that is treated
- Site ownership
- Site water quality volume
- Site storm drainage type
- Percent of site that is treated
- Pavement type
- Underdrains could be installed
- Roof drains directly onto impervious area
- Steep slopes
- Mature / specimen trees
- Existing cover for potential sties
- Curb around traffic island
- Traffic island landscaping
- Area that can be directed to treatment

Each ranking parameter was given a score ranging from zero and one. The scoring range was developed so that a high score yielded a site that would most benefit from treatment retrofits or where retrofits would be relatively easy to implement. Three examples of the ranking system used in the Upper Patuxent River WRAS follow.

1. Existing Water Quality. A site with poor existing water quality would rank higher than a site with good water quality. Water quality was determined based on the Basin Condition Scoring (BCS) methodology developed for the Upper Patuxent River Watershed (Victoria, et al, 2003).
2. Existing Storm Water Management. Although storm water treatment is desirable from a water quality perspective, a site with existing storm water treatment would rank low. An attempt was made in the ranking procedure to address the type of facility and its overall condition. However, it is very likely that existing SWM would benefit from additional upstream treatment. Fish and macroinvertebrate studies including the one conducted by Prince George's County in Spring 2000, have shown that SWM ponds alone are not enough to protect physical habitat structure (cover, substrate, sedimentation) or hydrology (baseflow, thermal fluxes or flashiness). Therefore, the implication is that SWM ponds are limited in their ability to protect streams and cannot reproduce predevelopment hydrological functions.
3. Site Constraints. A site with adequate area to construct SWM would also rank high. Areas that are covered with grass would rank higher than area covered with pavement. Conversely, a site that has a large portion that is covered with steep slopes or mature trees would rate lower. The grassed areas should still be treated with LID techniques. Several studies comparing grass/turf areas to meadow as shown significant difference in runoff and pollutant removal (meadow areas are more efficient and have less runoff).

The scoring for the ranking components developed for the Upper Patuxent River WRAS is presented in Appendix B.

The ranking parameters are not equally significant. To indicate the relative importance of each ranking parameter, weighting factors were used. The less significant parameters were given a

weight of less than one and significant parameters were given a weight greater than one. The derivation of the scores is presented in the "*Prince George's County's Watershed Restoration Assessment Strategy For The Upper Patuxent River"* in Appendix B... This sheet provides the score for each of the 40 ranking parameters for each of the 48 sites. The ranked sites are presented in Table III-10. The 48 sites were located in 13 subwatersheds. To facilitate comparison of sites within the individual subwatersheds, the sites were grouped by subwatershed. Within each subwatershed, the sites were ranked. The results are presented in Table III-11.

It is anticipated that the ranking components, scoring and weighting will be adapted and refined with use and for use for other applications, depending on the goals of the project. Typically, an area with few site constraints would rank low. However, LID techniques are quite adaptable. For example, slopes that are conditioned and planted with native vegetation would decrease the amount of runoff. Bioretention weep walls could also be used on slopes.

One of the important tenets of LID is to subdivide larger sites into smaller drainage areas. By dividing sites into smaller drainage units, you increase the use of LID practices. There are many methods that can be used to subdivide larger drainage areas into micro drainage areas and employ LID techniques. For instance, by using traffic calming devices, streets can be narrowed, divided into smaller drainage units and bioretention installed. Also, the presence of mature vegetation and/or a site that is extensively landscaped was ranked low because the vegetation would need to be removed. In many cases, the landscaping consists of invasive plants. Since invasive plants should be removed and LID practices could then be installed, a new ranking factor needs to be developed. Training for site assessors to identify invasive species will be required.

<u>Recommendations</u>

- Use GIS application/tool for prioritization and planning
- Complete LID IMP assessments for the remaining 43 sites
- Target future LID assessment sites using GIS application/tool
- Update, revise and refine the LID assessment scheme
- Continue to refine ranking system
- Target LID retrofits per subwatershed using BCS
- Train County, municipal staff on LID assessment scheme

Table III-10. Site Ranking Summary

Site Name	Site Description	Catchment	Subwatershed	Score	Rank
LSHS	Laurel Senior High School	CB01	Crows Branch	31.23	1
EMS	Eisenhower Middle School	T501	Tributary 5	29.78	2
DRES	Deerfield Run Elementary School	T603	Tributary 6	29.08	3
HDB1	Home Depot	GB01	Green Branch	27.73	4
TARG	Target	GB08	Green Branch	27.13	5
SPOR	Sports Authority	GB08	Green Branch	26.88	6
JHES	James Harrison Elementary School	T601	Tributary 6	26.88	7
BORD	Borders	GB08	Green Branch	26.73	8
HOME	Home Place	GB08	Green Branch	26.73	8
PIER	Pier 1	GB08	Green Branch	26.73	8
PETS	Petsmart	GB08	Green Branch	26.53	11
STAP	Staples	GB08	Green Branch	26.48	12
RES	Rockledge Elementary School	T104	Tributary 1	26.23	13
SOE2	Samuel Ogle Elementary School	T105	Tributary 1	26.18	14
LCH	Laurel City Hall	WB02	Walker Branch	26.08	15
WIBC	William Irwin Buck Center	T101	Tributary 1	25.98	16
GGPL	***Granville Gude Park & Lakehouse***	***BB07***	***Bear Branch***	***25.68***	***17***
LFL	Laurel Fringe Lot - Commuter Parking	T502	Tributary 5	25.38	18
LHIC	***Lowes Home Improvement Center***	***BB05***	***Bear Branch***	***25.33***	***19***
YMCA	YMCA	T301	Tributary 3	25.28	20
HDB2	Home Depot	GB02	Green Branch	25.18	21
LLEP	***Laurel Lakes Executive Park***	***BB10***	***Bear Branch***	***24.88***	***22***
BUCK	Buckingham Park	MB01	Marsh Branch	24.88	23
YTES	Yorktown Elementary School	T201	Tributary 2	24.83	24
SOE1	Samuel Ogle Elementary School	T103	Tributary 1	24.83	25
SPC	Somerset Park Condominium	MB02	Marsh Branch	23.88	26
STES	Scotchtown Hills Elementary School	WB01	Walker Branch	23.78	27
DPMK	Don Pablos Mexican Kitchen	BB12	Bear Branch	23.37	28
CCB1	Chevy Chase Bank	BB01	Bear Branch	23.30	29
LONE	Lone Star Restaurant	BB12	Bear Branch	22.87	30
HDL	Home Depot	UP02	Upper Patuxent River	22.83	31
MARY	***Marymont Apartments***	***BB11***	***Bear Branch***	***22.78***	***32***
CCB2	Chevy Chase Bank	BB01	Bear Branch	22.78	33
LVFD	Laurel Volunteer Fire Department	BB04	Bear Branch	22.73	34
CHAP	***Chapel Cove at Laurel Lakes Townhouses***	***BB09***	***Bear Branch***	***22.58***	***35***
LRH	Laurel Regional Hospital	BB02	Bear Branch	22.18	36
MPL	10th Street Cul de Sac	HB2	Horsepen Branch	22.08	37
MD3C	Robert S. Crain Highway Interchange	T406	Tributary 4	21.33	38
SFIT	Sport Fit Total Fitness Club	UP02	Upper Patuxent River	20.88	39
PVAL	Parkview at Laurel Assisted Living	T502	Tributary 5	20.83	40
MD3D	Robert S. Crain Highway Interchange	T407	Tributary 4	20.43	41
WPTC	Whitehall Pool and Tennis Club	T102	Tributary 1	20.33	42
MD3B	Robert S. Crain Highway Interchange	T405	Tributary 4	20.33	43
PWR	Patuxent Research Refuge Visitor Center	UP03	Upper Patuxent River	20.13	44
MD3A	Robert S. Crain Highway Interchange	T404	Tributary 4	19.88	45
10ST	Bowie Municipal Parking Lot	HB1	Horsepen Branch	19.78	46
ASHF	Ashford at Avondale Townhouses	BB06	Bear Branch	19.63	47
MFTH	Mayfair Townhouses	BB03	Bear Branch	18.88	48

Table III-11. Site Ranking Summarized by Subwatershed

Site Name	Site Description	Catchment	Subwatershed	Score	Rank
GGPL	***Granville Gude Park & Lakehouse***	***BB07***	***Bear Branch***	***25.68***	***17***
LHIC	***Lowes Home Improvement Center***	***BB05***	***Bear Branch***	***25.33***	***19***
LLEP	***Laurel Lakes Executive Park***	***BB10***	***Bear Branch***	***24.88***	***22***
DPMK	Don Pablos Mexican Kitchen	BB12	Bear Branch	23.37	28
CCB1	Chevy Chase Bank	BB01	Bear Branch	23.30	29
LONE	Lone Star Restaurant	BB12	Bear Branch	22.87	30
MARY	***Marymont Apartments***	***BB11***	***Bear Branch***	***22.78***	***32***
CCB2	Chevy Chase Bank	BB01	Bear Branch	22.78	32
LVFD	Laurel Volunteer Fire Department	BB04	Bear Branch	22.73	34
CHAP	***Chapel Cove at Laurel Lakes Townhouses***	***BB09***	***Bear Branch***	***22.58***	***35***
LRH	Laurel Regional Hospital	BB02	Bear Branch	22.18	36
ASHF	Ashford at Avondale Townhouses	BB06	Bear Branch	19.63	47
MFTH	Mayfair Townhouses	BB03	Bear Branch	18.88	48
LSHS	Laurel Senior High School	CB01	Crows Branch	31.23	1
HDB1	Home Depot	GB01	Green Branch	27.73	4
TARG	Target	GB08	Green Branch	27.13	5
SPOR	Sports Authority	GB08	Green Branch	26.88	6
BORD	Borders	GB08	Green Branch	26.73	8
HOME	Home Place	GB08	Green Branch	26.73	8
PIER	Pier 1	GB08	Green Branch	26.73	8
PETS	Petsmart	GB08	Green Branch	26.53	11
STAP	Staples	GB08	Green Branch	26.48	12
HDB2	Home Depot	GB02	Green Branch	25.18	21
MPL	10th Street Cul de Sac	HB2	Horsepen Branch	22.08	37
10ST	Bowie Municipal Parking Lot	HB1	Horsepen Branch	19.78	46
BUCK	Buckingham Park	MB01	Marsh Branch	24.88	22
SPC	Somerset Park Condominium	MB02	Marsh Branch	23.88	26
RES	Rockledge Elementary School	T104	Tributary 1	26.23	13
SOE2	Samuel Ogle Elementary School	T105	Tributary 1	26.18	14
WIBC	William Irwin Buck Center	T101	Tributary 1	25.98	16
SOE1	Samuel Ogle Elementary School	T103	Tributary 1	24.83	24
WPTC	Whitehall Pool and Tennis Club	T102	Tributary 1	20.33	42
YTES	Yorktown Elementary School	T201	Tributary 2	24.83	24
YMCA	YMCA	T301	Tributary 3	25.28	20
MD3C	Robert S. Crain Highway Interchange	T406	Tributary 4	21.33	38
MD3D	Robert S. Crain Highway Interchange	T407	Tributary 4	20.43	41
MD3B	Robert S. Crain Highway Interchange	T405	Tributary 4	20.33	42
MD3A	Robert S. Crain Highway Interchange	T404	Tributary 4	19.88	45
EMS	Eisenhower Middle School	T501	Tributary 5	29.78	2
LFL	Laurel Fringe Lot - Commuter Parking	T502	Tributary 5	25.38	18
PVAL	Parkview at Laurel Assisted Living	T502	Tributary 5	20.83	40
DRES	Deerfield Run Elementary School	T603	Tributary 6	29.08	3
JHES	James Harrison Elementary School	T601	Tributary 6	26.88	6
HDL	Home Depot	UP02	Upper Patuxent River	22.83	31
SFIT	Sport Fit Total Fitness Club	UP02	Upper Patuxent River	20.88	39
PWR	Patuxent Research Refuge Visitor Center	UP03	Upper Patuxent River	20.13	44
LCH	Laurel City Hall	WB02	Walker Branch	26.08	15
STES	Scotchtown Hills Elementary School	WB01	Walker Branch	23.78	27

Pilot Sites

Five sites were evaluated for opportunities and constraints related to the implementation of potential management practices. These five pilot sites would include projects that would demonstrate the retrofit potential of (LID) techniques. Because these sites would showcase LID techniques, the sites will need to be highly visible. The sites should also address water quality issues and be important to the community. To address these goals, the County made a decision to locate the five pilot sites in the Bear Branch watershed. The Bear Branch watershed was selected based on numerous problems within the watershed and within Laurel Lakes. Projects within the watershed will be highly visible, especially if they could be located adjacent to Laurel Lakes.

To demonstrate LID techniques, the County decided to have each site have a unique land use. The following land ownership and land uses were selected: (1) municipal – park, (2) commercial – retail, (3) commercial – office park, (4) residential – apartments, and (5) residential – townhouses. The corresponding site names are as follows: (1) Granville Gude Park and Lakehouse, (2) Lowes Home Improvement Center, (3) Laurel Lakes Executive Park, (4) Marymont Apartments, and (5) Chapel Cove at Laurel Lakes. These sites are included in bold italic font in Tables III-10 and III-11.

The opportunities and constraints for each site were assessed using Form 3. Focusing on the opportunities of the site, potential treatment for storm water was considered. Preferred potential treatment applications include (LID) techniques called Integrated Management Practices (IMPs). Potential treatment applications also include SWM Best Management Practices (BMPs). Descriptions of the various IMPs / BMPs, the water quality impairments that are addressed for each IMP / BMP technique and the applicability of each IMP / BMP are found in the "*Prince George's County's Watershed Restoration Assessment Strategy For The Upper Patuxent River"* in Appendix B.

Treatment was provided for as much of the site as possible, targeting impervious areas. Treatment applications that addressed water quality, quantity control and ground water recharge were given the highest priority. Treatment applications were evaluated on the basis of the benefit provided and constructability. Constructability includes constraints such as the presence of utilities, steep slopes, existing vegetation and mature trees; the suitability of soils and ground water table; and accessibility. Parking needs of the site were assessed when proposing a potential treatment application. In those areas where parking was in short supply or where vehicular access was required, parking and access were not altered.

In many situations, diverting flow could treat additional area. An inexpensive flow diversion is an asphalt "speed bump." If the site owner would not accept a "speed bump", a trench drain could be substituted.

After the site is assessed for the viability of treatment, specific practices are proposed. The approximate available footprint is noted on each site map. The drainage area to the treatment application is also drawn on the site map. Each treatment application is documented on Form 3. The documentation includes photographs of the proposed location. Proposed IMP's, their locations and photos are provided in the Appendix B.

Public Participation Process

The public participation process included discussions on environmental issues, opportunities for conservation, protection and restoration and visions for the future. The results of the public participation process and proposed potential actions to address the issues raised by the stakeholders, are described in the Tables III-12, III-13 and III-14.

Table 12 outlines general and specific environmental concerns and issues. Major issues outlined by the stakeholders are: point sources, flora and fauna, open space and forest cover, stream and water quality degradation, resource and habitat loss and government's business practices.

Table III-12: Environmental Issues

Environmental Factor	Issue	Potential Action
Point Sources		
	Quality of effluent from WWTP	Work with WSSC, City of Bowie and MDE on WWTP effluent; Research and implement alternative wastewater treatment in sewered areas
	Sludge production	Work with WSSC on techniques to minimize impacts
	Problems with Marlboro Meadows WWTP	Outside UP WRAS area; can cover in Western Branch WRAS
Flora and Fauna		
	Invasive plants	Develop invasive plant eradication program; identify pilot projects
	Deer population	Survey means to control population; research hunting restrictions; public education
	Geese management	Work with Patuxent Wildlife Refuge on management strategy; develop volunteer monitoring program
	Pet waste	Develop public outreach program; work with City Parks Departments, MNCPPC and other public areas to develop pet waste stations
	Fish blockages	Rank fish blockages; develop program to remove blockages
	Lack of anadromous fish populations	See above; develop monitoring program to assess anadromous fish populations; set up stocking program
Open Space and Forest Cover		
	Fragmentation of forested area; narrow forest buffers	Review Greenways program (state and local); develop sensitive watershed protection areas;
	Greenways loss	See above

Table III-12: Environmental Issues

Environmental Factor	Issue	Potential Action
Open Space and Forest Cover	Stream valley corridors	Identify all stream valley corridors lacking adequate protection; Coordinate with MNPPC and land conservation trusts on land acquisition; use as mitigation projects
	Lack of adequate riparian buffers	Identify and prioritize riparian areas for reforestation by coordinating with Patuxent River Commission, MDNR Forestry, MNCPPC and NCS; use State, use local and private programs for reforestation projects
Stream and Water Quality Degradation		
	Concreted streams	Investigate possible naturalization and "day lighting" of piped and concrete stream systems
	Horse stables and racetrack facilities-manure runoff	Use State and local enforcement action; Develop pollution prevention plans for these type of facilities; research alternative waste disposal options
	Inappropriate yard waste disposal	Educate public about problems with yard waste and correct disposal methods
	Trash dumping along streams	Educate public about trash problems and correct disposal methods; initiate neighborhood cleanup campaigns; develop/publicize pollution hotline; research regulations and strengthen if necessary; provide adequate resources for local enforcement programs
	Trash and contamination from storm drains; People using storm drains for inappropriate use	See above; install trash collection systems on storm drain inlets with street sweeping program

Table III-12: Environmental Issues

Environmental Factor	Issue	Potential Action
Stream and Water Quality Degradation	Pesticide and herbicide application in floodplains and streams	Research, develop and implement alternative methods for plant removal for levee systems, powerlines, etc.; educate both government, utility, businesses and the general public on the benefits of meadow plantings and naturalization; join and support the Wildlife Habitat Council
	Current development plans do not address run off problems	Review development process and incorporate LID techniques
	Sand and Gravel Operations	Coordinate with MDE-Mining Division on alternative stabilization procedures and innovative sediment controls; remove all invasive plant species from plant list; eradicate invasive plants from existing mining sites
	Erosion and denuding of landscape	Use LID for urban retrofit, redevelopment and new development; use BayScaping
	High metal levels in SWM ponds	Use LID for urban retrofit, redevelopment and new development; research mechanism for removal and disposal
	Old stormwater systems	Use LID for urban retrofit, redevelopment and new development
Resource and Habitat Loss (urban and natural areas)		
	Need to naturalize our cities	Use LID for urban retrofit, redevelopment and new development; use urban forestry practices; coordinate with MDNR and enhance existing County programs (e.g. County Releaf)
	Lack of tree cover over parking lots; parking lot trees killed by neglect	Use BayScaping and native plants; enhance existing programs (e.g. Stream Teams) to adopt urban trees
	ATV use in natural areas	Target enforcement and education efforts; provide alternative sites for ATV use

Table III-12: Environmental Issues

Environmental Factor	Issue	Potential Action
Government Business Practices		
	Lack of Intergovernmental coordination	Strengthen coordination efforts in the Upper Patuxent WRAS process in the implementation phase
	Municipality representation in WRAS process	Municipalities are represented on Upper Patuxent WRAS Steering Committee; continue Steering Committee/Stakeholder meetings and coordinate with municipalities on projects
	Poor communication of "green" issues with the general public	Develop/continue public education and outreach efforts on green issues, solicit stakeholder input; provide incentives for "green" programs to businesses and citizens

Comments on the three areas (conservation, protection and restoration) are shown in Table 13. There were two areas discussed by the stakeholders that are located in the Western Branch watershed in Prince George's County and four in the Little Patuxent watershed in Anne Arundel County. The Western Branch concerns may be addressed in the Western Branch WRAS that Prince George's is currently developing. Potential actions were added to each comment.

Table III-13: Opportunities and Areas for Conservation, Protection and Restoration

Issue	Opportunity/Area	Potential Action
Conservation		
	Work with and support land trusts to help with private conservation efforts	Identify and coordinate with land trusts, Soil Conservation Districts
	Support funding for conservation programs	Place conservation programs in the Prince George's County's Livable Communities Initiative as a priority
Protection		
	Protect stream valley protection east of Rt. 301from sewer line and Waste Water Treatment Plant	Coordinate with WSSC on identifying and repairing sewer leaks and providing adequate buffers
	Preserve Nash Woods at Rt. 301 and Rt. 50 from proposed development	Research status of development; coordinate with the developer, MNCPPC and the Bowie

Table III-13: Opportunities and Areas for Conservation, Protection and Restoration

Issue	Opportunity/Area	Potential Action
Protection	Protect and enhance green infrastructure on second order streams that connect to the Patuxent River	Coordinate with MNCPPC on zoning, greenways and Master Plans; Provide political support for greenway program and enhancement
	Acquire larger buffers for Belt Woods	Not in Upper Patuxent WRAS – may be addressed in Western Branch WRAS
Restoration		
	Restore Laurel Lakes using LID techniques in the watershed; enhance urban vegetation with LID, BayScaping and urban reforestation programs	This was selected as the demonstration project area for the USEPA grant
	Groundwater discharge on the Green Branch	Identify location of discharge; check federal, state and local actions taken to alleviate discharge; sample discharge and investigate possible sources; use enforcement action if warranted
	Sludge entrenchment site on Rt. 202 discharging nitrate into Patuxent River	Not in Upper Patuxent WRAS – may be addressed in Western Branch WRAS
	Gravel retraction recovery area between Russett and Jessup	Anne Arundel County – Little Patuxent River Watershed
	Russett Development has buffer problems (Oxbow Lake)	Anne Arundel County – Little Patuxent River Watershed
	Little Patuxent River Corridor from Patuxent Research Refuge to Annapolis Junction and points north	Anne Arundel County – Little Patuxent River Watershed
	D.C. Youth Detention Center has hazardous materials	Anne Arundel County – Little Patuxent River Watershed

There were three major themes that the Stakeholders sought for the visions; protect and restore natural resources (forests, streams, biotic communities, etc.), improve water quality using LID and provide and protect public access to the main stem of the Patuxent River (see Table III-14 for vision statements)

Table III-14: Visions for the Future

Vision
Foster community wide awareness and responsibility for water resources and better stewardship of natural resources
Restore streams throughout Bowie and educate the public about proper disposal of trash or yard waste
Remove artificial features from streams; use native plants, not invasives and protect woodlands and green infrastructure
Create a public and private protected greenway along main stem of the Patuxent River; improve water quality and provide appropriate public access to the River
Restore the Upper Patuxent watershed to be capable of sustaining viable living resources
Provide buffers along streams and river to protect water quality and habitat
The Patuxent River should be enjoyed by users (canoeing, kayaking, fishing.)
Develop low impact trails providing a way to explore the Patuxent River from top to bottom with educational opportunities on the River (history, flora, fauna, ecosystems)
Ensure the preservation of flora and fauna within the watershed
Restore spawning runs of Blueback Herring and American Shad in the Patuxent River Watershed
Permanently protect the corridor along the Patuxent River and its tributaries with natural vegetation and no invasive species
The City of Bowie should employ LID for stormwater management

As a result of the March 5 and April 23, 2003 Steering Committee meetings, Laurel Lakes was selected to demonstrate urban lake restoration using LID techniques, the City of Bowie will do up to three LID projects to illustrate "Government By Example", and Anne Arundel County will use LID for commercial retrofit in the Crofton area. Laurel Lakes is in Bear Branch watershed.

Basin Condition Score

In Prince George's County, the eighteen subwatersheds were scored using the individual metrics developed under the Basin Condition Score Methodology and summing those metrics to obtain the final overall score. Figure III-11 specifies the final score for the watersheds.

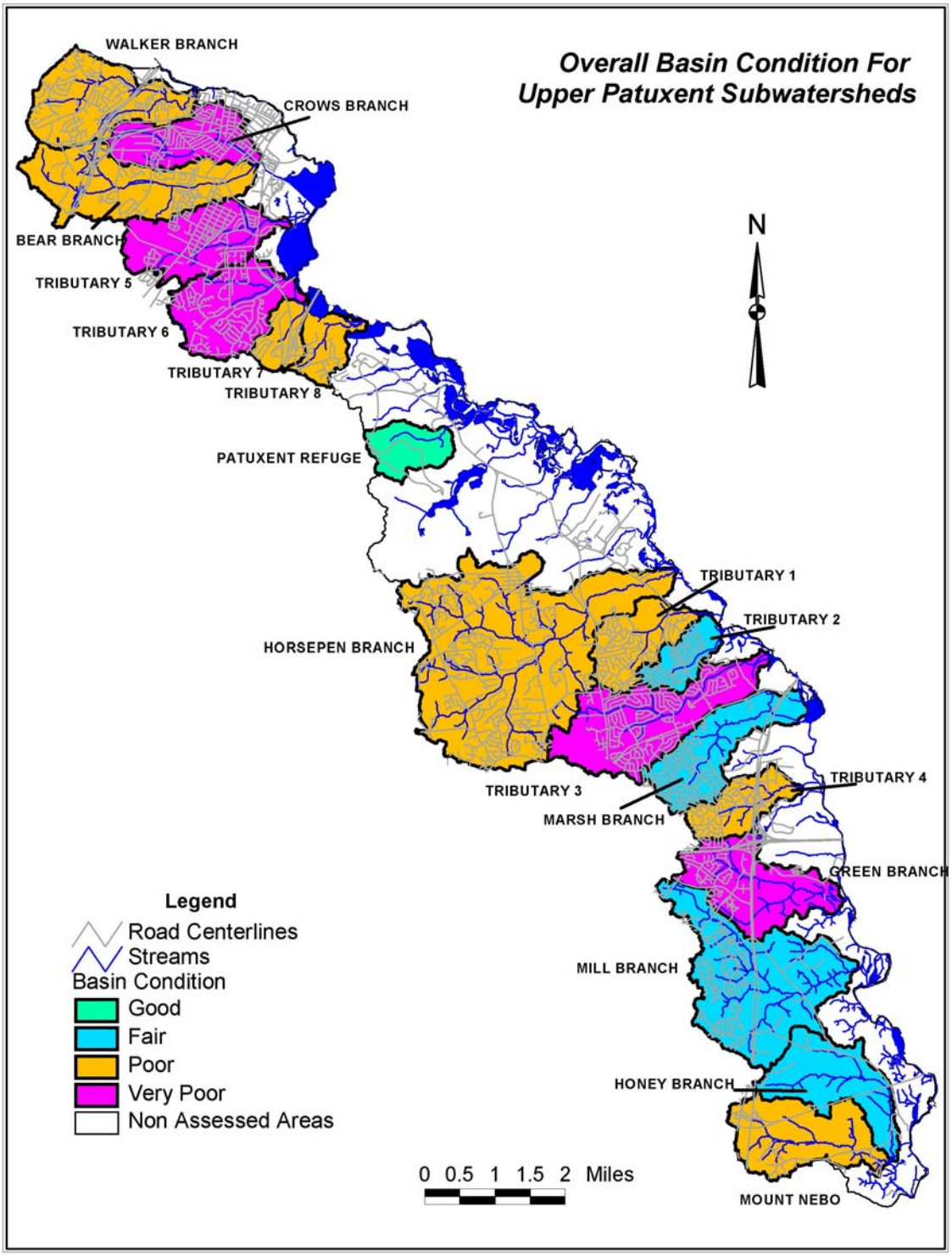


Figure III-11: Prince George's County Overall Basin Condition Score for Upper Patuxent Subwatersheds

The BCS rating has shown good discrimination in rating the eighteen subwatersheds within Prince George's County. This system has demonstrated a range of score throughout the methodology's spectrum. Table III-14 illustrates the ranking and the preliminary priority given to the each subwatershed. The priority ranking is from the lowest to the highest (very poor to good). There are five subwatersheds rated as very poor, eight rated as poor, four rated as fair (all located in the Southern Watershed and primarily under developed, agricultural, or both), and one rated as good (Patuxent Wildlife Refuge). Note: The scoring within the groups (i.e. very poor) among the subwatersheds is close. This means that any subwatershed within that group can be rated as essentially the same.

Bear Branch has been selected as the number one priority watershed for several reasons. First, the watershed does have an overall BCS rating as poor. There has been significant citizen interest and involvement through the Committee to Save Laurel Lakes in improving the health of the lake complex and in Bear Branch as well. The County focused on Bear Branch during the WRAS process (see Appendix E on the Laurel Lakes Assessment) for several reasons: high citizen concern and involvement in the public participation process, mixture of land use and zoning (e.g. sand and gravel mining, commercial office, shopping malls, restaurants, forested areas), opportunities for different restoration strategies and available funding through the National Decentralized LID and Wastewater Grant.

Mostly located in the City of Laurel, the area is a developing watershed. Therefore, there are opportunities for LID retrofit on uncontrolled sites, mitigation measures for both reclaimed and active mining sites, potential stream restoration sites and protection/conservation of forest "greenways'" along the stream corridor. This watershed and in particular, Laurel Lakes, has also been selected for the National Decentralized LID and Wastewater Demonstration Project.

Table III-15: Ranking of Eighteen Subwatersheds in Prince George's County (BCS)

Subwatershed	BCS Score	Ranking
Crows Branch	Very Poor	1
Tributary 6	Very Poor	2
Tributary 3	Very Poor	3
Green Branch	Very Poor	4
Tributary 5	Very Poor	5
Tributary 4	Poor	6
Tributary 8	Poor	7
Bear Branch	Poor	8
Mount Nebo	Poor	9
Horsepen Branch	Poor	10
Tributary 1	Poor	11
Tributary 7	Poor	12
Walker Branch	Fair	13
Honey Branch	Fair	14
Mill Branch	Fair	15
Marsh Branch	Fair	16
Tributary 2	Fair	17
Patuxent Wildlife Refuge	Good	18

Not surprisingly, the more developed the watershed, the lower the BCS score and concurrently the higher the ranking; conversely, the less dense the developed area, the better the score and ranking. The County's reference watershed, the Patuxent Wildlife Refuge rated as good. This subwatershed is an excellent candidate for protection and conservation. The unassessed watersheds are high priority for County personnel to perform SCA's and other assessments that would be applicable. The County also plans to use and refine the BCS methodology in the Western Branch WRAS.

IV. Implementation Strategy

Successful watershed restoration requires a many faceted, comprehensive and holistic approach that utilizes innovative methods combined with a committed private/public effort. Community buy in and active involvement in the development and implementation of any restoration plan, is the cornerstone to a sustainable program to improve, protect and conserve our natural resources.

New, innovative methods and thought processes are also necessary to slow down, stop and reverse the degradation of our living resources and the environment. For example, linking separate disciplines such as wastewater and stormwater and providing a forum for experts from diverse fields to experiment and develop new ways of integrating treatment options, can bring about real progress in reducing human impacts to our groundwater and surface water environments.

The partnership between Anne Arundel and Prince George's Counties has demonstrated that different jurisdictions can forge a strategy that can be implemented across political boundaries by developing watershed wide restoration programs. Both Counties are also implementing retrofit and/or restoration projects in their respective subwatersheds.

Watershed Wide Programs And Local Government Programmatic Changes

Prince George's and Anne Arundel Counties with cooperative input from their watershed partners have developed an implementation strategy that incorporates programmatic changes and provides common restoration approaches on a watershed wide basis. There are three key elements to this strategy:

- National Community Decentralized Demonstration Project
- Migratory Fish Program
- Upper Patuxent River Watershed Association

These programs will be implemented both watershed wide and on the subwatershed level. Potential projects for each of these elements have been identified in the LID, SCA, water quality and biological assessments (see section III and appendices).

Funding can be one of the major roadblocks for effective implementation of watershed restoration plans. Prince George's and Anne Arundel Counties have obtained $1 million dollars from the United States Congressional Initiative on Decentralized Stormwater and Wastewater Systems for demonstration projects in the Upper Patuxent River Watershed. This project will provide the framework for future restoration efforts in the watershed and is the mechanism for the proposed programmatic changes for the Upper Patuxent WRAS. The Counties will continue to pursue grants both as a partnership and individually, for restoration projects. Table IV-1 outlines potential grants. Other funding mechanisms include the Counties Capital programs, future Congressional initiatives for innovative technologies, USCOE programs and the State Revolving Fund.

Table IV-1. Potential Funding Sources for Restoration and LID Retrofit Projects

Federal Funding Sources
Brownfields (EPA- Environmental Protection Agency)
Environmental Education Grant Program (EPA)
Chesapeake Bay Program (EPA)
Chesapeake Bay Small Watershed Grant (USFWS-United States Fish and Wildlife Service)
Urban Park and Recreation Recovery Program (NPS-National Park Service)
State Funding Sources
Program Open Space (DNR- Department of Natural Resources)
Community Legacy Grant (DHCD)
Community Parks and Playgrounds (DNR)
Section 319 Nonpoint Source Funding (DNR)
Watershed Restoration Assessment Strategy (DNR)
Transportation Enhancement (MDSHA- Maryland State Highway Administration)
National Recreational Trail Grant (MDSHA)
Waterways Improvement Fund (MDSHA)
Private and Corporate Funding Sources
American Express Philanthropic
Baltimore Gas &Electric Foundation
Alex Brown & Sons Charitable Foundation
Morris & Gwendolyn Cafritz Foundation
Clark Charitable Foundation
Clark-Winchole Foundation
Freed Foundation
Charitable Trust u/w LaVerna Hahn
J. J. Haines Foundation
Sidney L. Hechinger Foundation
Hitachi Foundation
Grayce B. Kerr Fund
Knapp Foundation
Kresge Foundation
Lockheed Martin Corp. Foundation
MARPAT Foundation
Merck Family Fund
Eugene & Agnes Meyer Foundation
Middendorf Foundation
Moriah Fund
T. Rowe Price Associates Foundation
Rouse Company Foundation
Summit Foundation

National Community Decentralized Demonstration Project

Prince George's and Anne Arundel Counties and its watershed partners are proposing to demonstrate a comprehensive stormwater management plan using Low Impact Development (LID) for urban retrofit and developing a decentralized wastewater demonstration project in the Upper Patuxent River Watershed. This demonstration project also begins the implementation for the Upper Patuxent Watershed Restoration Action Strategy (WRAS) developed by Prince George's and Anne Arundel Counties. The Counties' partners include:

- City of Laurel
- City of Bowie
- Committee to Save Laurel Lakes (CSLL)
- Laurel High School
- United States Fish and Wildlife Service (USFWS)
- Patuxent Wildlife Research Center
- Maryland Department of Natural Resources (MDNR)
- Washington Suburban Sanitary Commission (WSSC)
- Maryland State Highway Administration (MSHA)
- The Local Business Community

The goal of the project is to institutionalize urban stormwater retrofit technologies and strategies, and decentralized wastewater options and maintenance. The objectives are:

- Provide a cost effective, innovative approach to urban stormwater management retrofit and redevelopment;
- Develop a mechanism for long term operation and maintenance of septic systems;
- Develop a multifunctional, dual septic system and stormwater management scheme;
- Institute a public outreach and education program for both professionals and the general public on wastewater and stormwater issues; and
- Demonstrate measurable success of the project components.

There are five major elements for this project. The first three projects will show how LID techniques can be used to retrofit different land use and development types. The last two concentrate on decentralized wastewater issues.

LID Project Components:

1. Laurel Lakes: Prince George's County with the City of Laurel, CSLL and the USFWS will develop and implement an integrated stormwater management approach using LID techniques to retrofit a mixed use, high-density residential area. This approach should also provide methods to restore and protect urban lakes. The project area is located in the City of Laurel and is shown in the Figure.IV-1. The development types include townhouses, apartments, condominiums, commercial offices, urban parks, public and private road systems, schools and commercial shopping and eateries. Project components include:

- Assessment of 10 to 15 additional development areas for retrofit opportunities and determination of the appropriate LID techniques. Some of the LID techniques that may

be appropriate include bioretention, amended soils, strategic grading, green roofs, rain barrels/cisterns, pavers, rooftop detention, Bayscaping and street narrowing/sidewalk storage. The County has completed feasibility assessments for five projects: Laurel Lakes Executive Office Park, City of Laurel's Gude Park at Laurel Lakes, Chapel Cove Townhouse Development, Marymont Apartment Complex and Lowe's Home Improvement Store.

- Installation of LID Integrated Management Practices (IMP). This includes design, permitting and construction.
- Develop and implement a comprehensive environmental public outreach program for residential and commercial applications. Some of the outreach elements include pollution prevention, stormwater management, wastewater alternatives, water conservation, waterfowl management, pet waste, environmental sensitive landscaping (BayScapes), invasive plants and protection and restoration of natural resources. From Rainbows to Rain Gardens (a train the trainers program) and Stream Teams (an Adopt-A-Stream program) will be the main mechanisms for implementation projects and workshops. The USFWS has agreed to do workshops on Bayscaping. Educational signs and kiosks for the LID facilities will be developed as well as an overall project website (includes PG, AA, City of Bowie and wastewater components).
- Develop a partnership program with garden center(s) within the watershed for LID/bioretention. This may include LID demonstration retrofits particularly in the parking lot areas, information centers for Rain Gardens/LID, workshops on Rain Gardens sponsored by the garden center(s) and special displays of Rain Garden plants.
- Livable Communities Liaison and cooperative projects with Laurel High School, City of Laurel and businesses in the Laurel Lakes area. This would include stakeholder identification, property owner contacts, stakeholder input and participation on LID retrofit projects, Stream Teams volunteer activities and community involvement in Laurel Lakes. Also, other interested partners and stakeholders from the Upper Patuxent WRAS may be brought into the process. For example, there are opportunities to install LID/bioretention facilities at the Patuxent Wildlife Refuge Visitor Center and partner with the Center on public outreach and monitoring activities.
- Complaints, Investigation and Enforcement program. Laurel Lakes and the Upper Patuxent River is one of the targeted areas for this program. Components include complaints (water quality, pollution and drainage), commercial pollution prevention, storm drain outfall sampling, stream corridor assessments, stormwater management preventive maintenance inspections and watershed surveys. This is another means to monitor the success of the project by using qualitative and visual assessments.

2. City of Bowie: With a total land area of 17.24 square miles, and more than 2,950 people per square mile, Bowie is the largest municipality within Prince George's County, and the fourth largest incorporated jurisdiction in the state of Maryland.

The City of Bowie will be embarking on several highly visible Low Impact Development (LID) demonstration projects. These proposed projects will illustrate responsible land use, habitat protection, and resource conservation through Pollution Prevention (P_2) techniques such as LID and BayScapes conservation landscaping that will prevent non-point pollution and improve water quality in the Upper Patuxent River watershed. The City intends to serve as a "Government by Example" by employing LID techniques on City property and establish a method of incorporating LID into its Community Development Block Grant program for Old Town Bowie. Project components include:

- Build internal capacity for conducting and managing Green Building /LID construction projects, and for reviewing development plans that may also incorporate Green Building /LID into their site plans. By conducting a series of demonstration projects, staff from various departments will learn more about LID techniques, as well as the benefits and the necessity to implement them, and the methods by which to manage them. Staff from the Planning Department, Department of Community Services, as well as the Public Works Department will gain a clearer understanding through active involvement with the projects of what LID is and does, and will be better equipped to implement and recommend future LID projects.
- Assess up to three City properties for LID retrofit opportunities. The City has identified three potential project areas. These include retrofitting a city owned parking lot used as Bowie's Farmers Market and Skateboard Park, the Main Street Green on Bowie's Main Street (Rt. 450) and in Old Town Bowie, retrofitting a residential street that has drainage problems. The City may use this last project to demonstrate the incorporation of LID retrofits into their revitalization efforts and Community Block Grant Program. LID techniques that may be used are grass pavers, Bayscaping and reforestation, bioretention, and tree cells.
- Provide public outreach on each project including signage and placement on the City's website under their Green Page. There will also be public education and outreach through a series of LID workshops and presentations. The intention is to teach and implement community wide change by demonstrating the benefits of LID for residential applications. It is expected that by bringing the demonstrations into communities such as this one that residents will also begin to retrofit their yards and rooftops.
- Installation of LID Integrated Management Practices (IMP). This includes design, permitting and construction.

3. Anne Arundel County: Anne Arundel County will focus on implementing LID techniques as stormwater retrofits in areas with commercial development. Two primary goals will be accomplished. First, by installing these projects as retrofits, Anne Arundel County will demonstrate the feasibility of adding innovative, environmentally sensitive stormwater management to older areas that are untreated or treated in a way that provides little protection to receiving streams. Second, work in this area will directly benefit the water quality and habitat of the main stem Patuxent River and one of it's tributaries, a tributary that was assessed as part of the Upper Patuxent River Watershed Restoration Action Strategy.

The project area consists of a collection of approximately 35 large to medium sized office buildings concentrated within a large industrial park located near Crofton, Maryland. Most of this development took place without stormwater management or using stormwater management techniques that provide little protection to stream channels. Project components include:

- The evaluation of approximately 20 properties within the project area to determine the feasibility of LID retrofits. Possible techniques may include, green roofs, bioretention facilities, rooftop storage, permeable pavement, and the conversion of old stormwater management facilities to meet the objectives of LID.
- The design and installation of LID projects on at least two of these properties, depending upon cost based upon the evaluation described above.

- Perform outreach and education to property owners within this industrial park in order to improve water quality within the Patuxent River and the tributary that partially drains the area. Outreach activities may include information on pollution prevention, stormwater management, wastewater alternatives, environmentally beneficial landscaping techniques (BayScapes, etc.) and water conservation.

Decentralized Wastewater Projects:

4. Prince George's County will work with WSSC to develop a countywide public sector inspection, enforcement and maintenance program for septic systems. WSSC has agreed in principle to be the agency responsible for this long-term operation and maintenance program. The strategy will include development of regulations to allow oversight by WSSC of private septic systems, development of a utility rate to fund the program, identification of operation and maintenance needs, development of public outreach and education program for wastewater, septic system issues including proper operation and maintenance and research into providing State authority to WSSC for possible expansion to other counties.

5. Prince George's County's Department of Environmental Resources, the Prince George's County Health Department and WSSC will develop a multifunctional, dual septic system and stormwater management project in the Upper Patuxent River Watershed. Site level water and waste water management provides the opportunity to assess all water entering and leaving a specific site, and identify all opportunities for water use reductions, re-use and infiltration at the site level. This project will examine the potential linkage between LID techniques and other systems use and disposal of water on the site. By taking a more holistic approach to site level assessment and water resource management, the in-home, wastewater treatment, and site water management practices can be considered. Through this process, the potential for linkages between the various water systems, options for water reuse, and alternatives for increasing and optimizing water use on-site will be explored. The demonstration project will identify a process to examine in detail an existing site, evaluate the total water balance for the site, and identify options for retrofitting the site to meet site level environmental objectives for both the site and region (e.g. subwatershed, aquifer recharge zone). By incorporating expertise from an interdisciplinary team, the approach will consider aesthetic, environmental, human health, and hydrologic impacts. This project combines input from experts in multiple disciplines in order to provide a holistic view of the site level water cycle. Steps needed for the project are:

- Research appropriate stormwater (LID) and septic system technologies and select appropriate alternatives for the selected site.
- Consider local and state regulations that are barriers to this type of design and work with the appropriate regulatory agencies for approval of design.
- Identify potential septic system retrofit sites, prioritize sites and obtain property owner permission for project.
- Perform site assessment, characterization and water level balance
- Design dual stormwater management and septic system scheme and obtain all necessary permits and approvals.
- Install recommended dual system.
- Develop monitoring plan for dual system.
- Initiate monitoring program.

Monitoring: Prince George's and Anne Arundel Counties, the City of Bowie and MDNR will develop a comprehensive monitoring strategy to measure the success of the project components. The strategy should include both monitoring the effectiveness of the LID IMPs and the dual stormwater management septic system scheme, groundwater, and the condition of the receiving stream(s). Chemical, biological and physical monitoring are components of the plan. MDNR has offered to assist with monitoring efforts as part of the Upper Patuxent WRAS. Volunteer monitoring under the Stream Teams program will be part of the monitoring plan. Monitoring protocols will be compatible with the USEPA QA/QC procedures. USEPA's Environmental Technology Verification (ETV) Program will be used when applicable. ETV develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment. The American Society of Engineers database will also be used.

To measure the success of the public outreach components, the County will develop an evaluation plan that should include:

- Pre and post surveys on targeted residents and commercial operations;
- Workshop evaluations with tabulations and report; and
- Report on number of workshop participants, number and type of volunteer activities and projects and the number of volunteers participating in the activities and projects.

In addition, the County will work with the Patuxent Wildlife Refuge on developing and implementing a waterfowl monitoring program for Laurel Lakes. The City of Laurel and CSLL will assist with the implementation of this monitoring effort. Finally, the County will develop a monitoring protocol under its Stream Teams program to measure turbidity in the Laurel Lakes and CSLL will provide and/or recruit volunteers.

Total Cost: The total federal funding is $1,000,000 and Prince George's County will contribute an additional $250,000. The total in-kind match is $150,000 (Prince George's County, Anne Arundel County and other partners) and in-kind and cash funding is $1,400,000.

Timeframe: The grant's scope of work has been approved by the USEPA and the official grant application will be submitted by July 30, 2003. Both Counties have started work on the components of the project. Several coordination meetings have been held with the Cities of Laurel and Bowie, the Prince George's County Health Department and WSSC; and outreach to the potentially affected property owners has been initiated. A kickoff meeting for County staff has been held to discuss the project and develop a timeline for each component. The anticipated date of completion is Fall 2004.

Upper Patuxent WRAS Programmatic Change: Because the County is serious about providing a comprehensive and holistic watershed restoration strategy, there are three major proposed programmatic changes for the Upper Patuxent WRAS; two pertain to Low Impact Development and one is for decentralized wastewater treatment. A description of the proposed changes and implementation strategy follows:

- For Prince George's County, a policy change using LID for retrofit and redevelopment. The approach is to require that LID be used for retrofit and redevelopment projects. The changes would be incorporated into each jurisdiction's normal business practices. This

would require policy changes for Prince George's County, the Cities of Bowie and Laurel, MNCPPC and the private sector. A committee will be formed to implement the change. The charge to the committee will include:

- Research policies pertaining to retrofit and redevelopment
- Propose recommendations to incorporate and remove barriers to LID
- Identify the processes needed for the changes
- Develop implementation strategy and timeline.

Committee members at a minimum would include representatives from the municipalities, County, MNCPPC, the development community and property owners. The policy committee would also address legislative and regulatory changes that may be needed. For example, some potential policy change for the Cities of Laurel and Bowie are:

- Incorporate LID into their City facilities by retrofitting existing facilities.
- Incorporate LID into their street repair program and Community Development Block Grants (CDGB).
- Change municipal codes that may inhibit use of LID techniques (e.g. spacing requirements on landscaping; restrictions on street size)

- Policy, legislative and regulatory changes for the operation and maintenance of septic systems in Prince George's County. Currently, there is no agency responsible for the operation and maintenance for septic systems. The maintenance is the responsibility of the homeowner. Under the National Community Decentralized Demonstration Project, WSSC would be the agency responsible for the long term operation and maintenance program. The strategy to implement this policy change is outlined above under the Decentralized Wastewater Projects.

- The research project on the dual stormwater and septic system scheme should provide opportunities for further policy, legislative and regulatory changes. Examples may be changes in local and State Health regulations, changes in local and State stormwater management regulations and building codes to allow such innovative systems.

More detailed steps are outlined below for each proposed programmatic change:

1. Require that LID be used for retrofit and redevelopment projects. This will focus on countywide projects and include both public and private endeavors.
2. Specific to the Upper Patuxent, identify and revise municipal codes in the City of Laurel that may inhibit the use of LID techniques (e.g. spacing requirements on landscaping, restrictions on street size").
3. To provide a strategy for the Washington Suburban Sanitary Commission (WSSC) to have oversight for the operations and maintenance of private septic systems and integration of LID and wastewater management programs.

Specific strategies to achieve each programmatic change are described in the following paragraphs.

To realize the requirement of using LID in retrofit and redevelopment projects, several steps will be completed. These are:

- Revise the stormwater management code and manual to require LID for retrofit and redevelopment projects.
- Provide successful LID demonstration projects for each land use type (residential, commercial, industrial and transportation) that will grant impetus for the proposed changes.
- Increase internal capacity in County and municipal governments to provide a better understanding of the LID approach, and a more comprehensive review and design of innovative LID projects.
- Provide training for local government staff and policy makers on the LID approach, techniques and design criteria.
- In the two other WRASs that the County has received, identify and propose changes to codes and regulations in other County agencies (e.g. Department of Public Works and Transportation), State agencies (e.g. Maryland State Highway Administration) and municipalities (e.g. the City of Bowie) to require LID.
- Obtain approval for the stormwater management code and manual changes from the appropriate state and federal agencies.
- Achieve buy-in on LID from communities, the general public and the local political establishment.
- Codify these changes through both the County and Municipal Councils as appropriate.

It is anticipated that the timeline for the stormwater management code and manual changes will take a minimum of one year. Some steps are dependent on other WRASs and still others are long term and are on going activities that will evolve over time.

Specific changes to the County's stormwater management code and manual are outlined below:

- Revise the" *Prince George's County Stormwater Management Design Manual*" to require LID techniques for retrofit and redevelopment projects and for the Transportation District Overlay Zones. The proposed draft language is: "All retrofit and redevelopment projects must use Low Impact Development techniques and conform with the County's LID methodology. "The LID approach includes the reduction of impervious surface area (e.g. use of living roofs, removal of parking areas for bioretention, conservation landscaping, narrowing of streets and paved areas, etc.) as well as water quality measures. The 20% reduction of impervious surface area can be met by using the LID methods. Should there be any increase in impervious surface area, LID techniques must used to provide water quality (WQv, REV, and Cpv). Transportation District Overlay Zones (TDOZs)) must meet the specific stormwater management and water quality requirements as described in the TDOZ. These projects must use the County's LID methodology."
- Revise Prince George's County's Stormwater Management code with the following draft language: " The County's LID approach and methodology is the required process for all retrofit and redevelopment projects. LID methodology for all retrofits and redevelopments shall reduce existing site impervious areas by at least 20 percent, or, LID practices shall be implemented to provide qualitative control for at least 20 percent of the

site's impervious area, or a combination of LID impervious area reduction and LID water quality IMPs may be used so that the combined area shall equal or exceed 20 percent of the site."

For the City of Laurel, any changes to the City codes will be promulgated in the implementation phase of the Upper Patuxent WRAS and any necessary funding is provided by the "*Demonstration Project for LID Urban Retrofit and Septic Systems in the Upper Patuxent River Watershed, Maryland*". The process will involves these steps:

- Development of stakeholder committee that will address the municipal codes for LID compliance. At a minimum, the committee members will include City and County staff, interested citizens and groups (e.g. Citizens to Conserve and Save Laurel Lakes), interested Laurel businesses and the development community.
- Review of all City codes and identification of municipal codes in the City of Laurel that may inhibit the use of LID techniques (e.g. spacing requirements on landscaping, restrictions on street size").
- Utilize public hearing and comment processes necessary for both the City and the County.
- Codify all code changes through the Laurel City Council.

Timeframe is within the grant period of one year.

Finally, the County will also pursue the strategy for the W SSC to have oversight for the operations and maintenance of private septic systems ***"Demonstration Project for LID Urban Retrofit and Septic Systems in the Upper Patuxent River Watershed, Maryland".*** This strategy entails the following steps:

- Review of all State, federal, WSSC and County codes and regulations that pertain to decentralized wastewater treatment and those specific to septic system operation and maintenance.
- Develop policy and technical review committees. Committee members at a minimum will include WSSC, Health Department, County, State and federal agencies, interested businesses, citizens and organizations and possibly, industry representatives.
- Produce reports on findings and recommendations from the committees.
- Prepare any necessary legislation and code changes.
- Develop a multifunctional, dual septic system and stormwater management project in the Upper Patuxent River Watershed. A site has been selected and a technical review committee is being developed. This will also highlight alternative wastewater treatment options, and the integration of wastewater and stormwater treatment to provide minimal discharge for surface and groundwater.
- Promulgation of any rule, code and regulation change through the appropriate administrative and political processes (local, State, federal).
- Develop internal capacity and training for WSSC staff to implement the operation and maintenance of septic systems.
- Develop any necessary funding mechanisms for WSSC to provide the oversight.
- Provide a public outreach program for septic systems and alternative wastewater systems for homeowners and the general public.

- Investigate the extension of this oversight authority, and the integration of LID and wastewater systems to other Counties in Maryland.

Oversight options for WSSC include permitting, maintenance and development of easements. These options and possibly others will be reviewed by the committees and recommendations made in the committee reports. The timeframe is within the grant period of one year. This project fits well within the Nonpoint Pollution Control programs with the use of LID techniques, water reuse and capture, septic system maintenance. This program change will also address the integration of LID and wastewater systems.

Migratory Fish

The seven migratory species of greatest historical importance in the area were American shad, hickory shad, alewife, blueback herring, yellow perch, white perch, and striped bass. These seven remain the most important, today. They've dramatically declined in abundance in the Patuxent River (and the Chesapeake Bay, overall) throughout the 20th century. Declines were primarily due to the combined effects of over harvesting, pollutants, and stream blockages. In 2002, the entire Patuxent River watershed contained 108 blockages (primarily dams and culverts), which is a relatively high number for a relatively small system. The Maryland DNR Fish Passage Program has identified 29 blockages in the Upper Patuxent River Watershed (see Upper Patuxent River Watershed Characterization, December 2002). The Stream Corridor Assessments performed for this WRAS, identified 16 blockages in Anne Arundel County and 178 in Prince George's.

Maryland DNR has documented the historic presence of migratory fish species in their report: "*1983 Surveys and Inventory of Anadromous Fish Spawning and Nursery Areas"* (Mowrer, J. and J. O'Dell). The report details numbers of migratory fish found in specific Patuxent tributaries, and provides maps to show where the species were collected. In Prince George's County, historical presence of migratory fish were indicated in Horsepen Branch and Mill Branch Several Anne Arundel County subwatersheds are thought to have had historical anadromous fish populations including Stocketts Run, Davidsonville branch and Kings Branch. Up to the time of the Chesapeake 2000 Bay Agreement, migratory fish restoration program success was primarily based on stream "miles reopened," that is, the number of miles of stream upstream of a blockage that removed. Using "miles reopened" as the only indicator of passage success is an over-simplified measure, and ignores the importance of habitat quality above the blockage.

The Chesapeake 2000 Bay Agreement recognized the importance of "miles reopened," but also identified the need to quantify and standardize cost, habitat benefits for fish populations, and geographic location. In 2002, the Gemstone Fish Sustainability Team (a part of the Gemstone Program at the University of Maryland, College Park) designed a model to meet the goals of the Chesapeake Bay 2000 Agreement. Their model consists of four factors: historical presence of migratory fish populations; stream miles reopened; indices of the condition of individual Patuxent watersheds compiled by the Chesapeake Bay Program; and recently collected habitat data associated with each blockage. The conceptual design of their model may be a suitable tool for use by Prince George's and Anne Arundel Counties in partnership with Maryland DNR for future anadromous fish monitoring, assessment and restoration programs. The model centralizes a decision-making process that typically involves fisheries managers, biologists, engineers,

economists, managers and landowners. Use of the model provides a preliminary prioritization, i.e., establishes a passage (or restoration) priority for a given watershed, which informs decision-makers as to which blockages should be studied further by fisheries managers for actual passage implementation.

An interesting aspect in considering the use of the conceptual design of this model is that Counties and Maryland DNR could use their existing network of biological contractors and volunteers to gather the input information with State monitoring. It's also possible that (in some cases) existing data that's been gathered to date by the contractors and volunteers may by used as model input. The SCA data would also be good input data for the model. An important aspect of this model approach is that it would result in a "benefit rating," or measure of the probability that removing (or bypassing) a blockage will increase migratory fish populations (based on a weighted sum of benefit components -- stream miles upstream of the blockage, historic presence of migratory fish, and the quality of the habitat above the blockage. By collecting some simple habitat parameter data at known blockages, combining it with some desk-top stream mile measurement and historical fish presence homework, and applying it all to the model framework, it would be a method to prioritize locations/watersheds for potential future migratory fish restoration efforts (e.g., blockage removal, fish passage technology installation and/or habitat improvement).

Maryland has had extensive hatchery and stocking programs for migratory species and Maryland DNR Fisheries Service has been conducting a project to restore populations of American shad and hickory shad in the Patuxent River. It's important to realize that removal of a migration blockage or installation of a passage technology doesn't guarantee that fish will return even if habitat is suitable upstream of the blockage. Stocking in upstream habitats with migratory species to encourage spawning in that area (and increase the likelihood that fish will return to the area in subsequent years) is the goal of the project. This is where post-restoration monitoring would come into the picture, e.g., to determine whether fish are naturally returning to the area or whether there's a need for a reintroduction/stocking program.

Both Counties and the Patuxent Wildlife Refuge are interested in coordinating with MDNR on the restocking project. Cooperative efforts may be expanded to include the development of a network of volunteer programs. This network could include incorporating existing educational hatching, stocking and monitoring programs (e.g. Chesapeake Bay Foundation) as well as "filling the gaps" by creating new projects. Cooperative partnerships could be formed with schools, universities, fishing and environmental groups, and community organizations. This effort will dovetail well with both state and national migratory fish initiatives. Prince George's County has identified the two potential pilot schools (Laurel High School and Scotchtown Elementary) for the National Decentralized Demonstration Project.

River Monitoring Methods- Proposed Pilot Study

There are no accepted non-wadeable monitoring methods for large rivers for both fish and benthos. The States of Michigan and Mississippi, and the USEPA Environmental Monitoring and Assessment Program (EMAP), are testing methods to monitor large rivers. EMAP is working predominantly in western rivers. Though testing hasn't been completed, it seems that the methods are heading towards sampling along the shores for both fish and benthos. The sampling reach includes both sides of the river channel over very long distances (around 30-40x the wetted width). Boats would be used for both benthos and fish and the sampling method

would be electroshocking for fish, D-frame net for benthos in snags, vegetation, root mats and other appropriate habitats.

A pilot study to test this monitoring method in the Patuxent River is an objective for both Counties, in partnership with Maryland DNR, Maryland Monitoring Council and the U.S.EPA The study may be used to determine the status of the biotic community and gauge the effectiveness of management practices on larger river systems, such as the Patuxent. Grants, congressional initiatives and cooperative partnerships are some ways to fund this type of project. Anne Arundel and Prince George's will coordinate with the appropriate State and Federal agencies to determine the scope and interest in this type of monitoring effort.

In addition to the fish blockage removal projects identified in Section III and Appendix D, the implementation strategy for restoring historic migratory fish populations will include the following actions:

- Development of prioritization approach such as the Gemstone Fish Sustainability Team model using SCA and County data
- Coordination with Maryland DNR programs and others for fish stocking and monitoring
- Development of a volunteer network to support restoration of those fisheries
- Implementation of a pilot project for large river monitoring in the Patuxent River

Stream Restoration Mitigation Bank

Prince George's County is investigating the establishment of a stream restoration bank modeled after wetland mitigation banking programs. The first step for this, is to set up an in-house list of potential mitigation projects that may be of interest to other government agencies and developers. This could be done both watershed wide and for individual subwatersheds. Potential stream restoration mitigation sites have been identified in the SCA. Further "culling" of the list by selected field investigations would be performed. These field investigations may collect more data and determine the stream mileage to be restored. This mitigation bank would be continually updated with new projects. This potential program should increase the number of stream restoration projects.

Upper Patuxent River Watershed Association

Building on the work begun in the development of the WRAS, an Upper Patuxent River Watershed Association will be developed to address WRAS implementation in both Prince George's and Anne Arundel Counties. The core group of members will consist of interested Steering Committee members and stakeholders identified in the WRAS process. The purpose of the watershed association will include being an advocate for sound land use practices in the watershed; assisting with the WRAS implementation; and working with the local jurisdictions to ensure that the WRAS is, indeed, a living document that will be revisited, updated, and continually implemented. Both Prince George's and Anne Arundel Counties have noted that membership in local environmental organizations grows and remains strong only for those organizations whose members are interested and actively participate in activities with tangible results. To that end, the WRAS Partners will propose implementing many of the volunteer-oriented projects, as identified in Table 39, through the watershed association. Concomitantly,

volunteer-oriented project implementation should serve to increase the membership of the watershed association.

One of the primary communication methods for the watershed association will be via the Internet, using list serves. Prince George's County has investigated the list serve process. A "list serve" is basically a subscription-based e-mail mailing list. It is an excellent method of distributing information within groups. From a public / community outreach standpoint, it is an efficient means of distributing all kinds of information - announcements, meeting notices, newsletters, press releases, etc. For less than the cost of a large direct mailing, a "list serve" can effectively reach a computer-literate audience and solicit an interactive response if desired.

Once set up, the "list serve" is easy to administer; adding and deleting names is easy, requiring no assistance from the hosting organization. Then, whenever there is an announcement to be made, one e-mail is created, and with the push of a button, it is sent to all the subscribers. Prince George's County's DER can use a "list serve" to disseminate information about its contributions to the Upper Patuxent River Watershed Restoration Action Strategy (WRAS). Subscribers would be stakeholders, the Workgroup (representatives of MDNR and Anne Arundel County), the Steering Committee, volunteers and others interested in the project.

"List Serve" Options:
There are two types of list serves: ***announce*** and ***discussion.*** An ***announce*** list serve is a subscription based e-mail mailing list. One e-mail message is sent to a list of subscribers with one push of the send button. Also, because it is a subscription based program, recipients can unsubscribe at any time. In terms of applicability for the project, project updates and meeting announcements can be easily disseminated to everyone for whom we currently have an e-mail address. Also, using an interactive form on the web site to invite visitors to subscribe to the lists may be a good vehicle for increasing the list of project volunteers. A ***discussion*** list serve is subscription based as well and all subscribers can post messages to all other subscribers. Whenever one list member sends an e-mail message to the list address, it is sent to all of the list members. These discussion lists can also be monitored where all messages go through a list moderator and are posted as are deemed appropriate for the list. An example of how a list serve may be used is for discussions of Stream Teams activities among volunteers as well as stakeholders for the Upper Patuxent WRAS.
As with the ***announce*** list serve, members may unsubscribe at any time.

Archiving Options

Posted messages from discussion or announce lists can be archived for future reference. Archiving in a searchable database or in a database that is searchable from a web page. These options entail additional charges.

Subscription Options

All subscribers have the ability to unsubscribe from the "list serve" that they belong to at any time. Both ***announce*** and ***discussion*** lists can be either **open**, that is, anyone can subscribe; or **private**, where new subscribers must be approved by the list administrator.

Discussion list subscribers have the option of receiving posts one at a time, or they can receive messages posted in digest form. Digest form is where all the day's messages are combined and sent at one time.

Set Up

A "list serve" can either be hosted by a specific company, or Prince George's County can purchase the software itself and host it through the County website. The County is investigating cost and set up information for this service

Stakeholder involvement and input to develop the Watershed Association is key to a successful organization. Both Prince George's and Anne Arundel Counties have successful stakeholder-based volunteer watershed organizations. These organizations will be used as models for the Upper Patuxent River Watershed Association. As the Watershed Association takes form, its members will determine the structure, goals, objectives, by-laws, projects, and other necessary components. The Watershed Association will become the vehicle for sustainable restoration and public education/outreach efforts in the Upper Patuxent River watershed.

In conclusion, Anne Arundel and Prince George's Counties will continue their partnership in the implementation phase of the Upper Patuxent River WRAS.

Prince George's County Subwatershed Approach

Prince George's County will implement the recommendations outlined in Section III and Appendix D for each type of assessment (LID, SCA, Biological and Water Quality). The County will use volunteer efforts and County resources in the projects identified.

To measure the success of these projects, various methods will be employed, appropriate to the type of project. These include both quantitative and qualitative assessments including professional and volunteer biological monitoring, BMP/IMP monitoring, physical stream assessments and surrogates such as amount and type of trash collected, the miles of stream restored, and other qualitative measures.