

**Stormwater Management and Regional Ponds Public Meeting
November 19, 2002
Summary of Comments from Breakout Sessions
And Those Submitted Later**

Introduction

The purpose of the public meeting was to bring together a broad array of perspectives, knowledge, experiences and visions in our community to thoughtfully consider the *Findings* and *Ideal* documents prepared by the committee and to offer suggestions and make recommendations.

The numbered notes below are a compilation of the comments that were recorded during the breakout sessions, as well as those submitted later by individuals. They are grouped under the four questions addressed during the breakout sessions:

- A. What is missing in the Findings?
- B. Do you agree with the Ideal program? What would you change?
- C. What other suggestions and recommendations do you have?
- D. How and when do you want to be involved if there is a regional pond or other stormwater management structure planned in your neighborhood?

“Other Comments” are included E.

The Regional Pond sub-committee deems all of these comments important and will consider them, along with its on-going research, findings, and discussions, as it develops recommendations to improve Fairfax County’s stormwater management program and to clarify the role of regional ponds in that program.

Main Themes

While it is impossible to capture the many diverse and detailed comments in a few summary phrases, the following main themes emerged from the comments recorded at the public meeting and received later from individuals:

1. A goal of stormwater management must be to protect streams and the ecological integrity of stream valleys.
2. Eliminate one size fits all solutions. Consider stormwater management as it applies specifically in each watershed.
3. Be realistic. Deal with what is on the ground now, including the waivers already granted.

4. Be flexible and creative; consider the full suite of available technology, including innovative techniques and retrofitting in existing development; include infiltration as much as possible.
5. Consider all regional ponds on a site-by-site basis. Go back and re-assess need and design specifications in light of reality in the watershed. Then, consider all alternatives, including innovative techniques, retrofits, detention elsewhere in the watershed.
6. When regional ponds are built, make them part of the landscape; also make them aesthetically pleasing and ecologically balanced.
7. Deal with mosquito issue.
8. Remove policy, regulatory and funding barriers so as to allow and encourage the best solutions.
9. Influence the stormwater planning process in the earliest stages of any development or redevelopment.
10. Engage the public fully and early on.

A. What is missing in the findings?

1. Report needs a good, clear statement of this study's objective; a statement defining the problem is needed.
2. Need to discuss a "unified position."
3. Given the Comprehensive Plan amendment in October 2000 to protect and restore ecological integrity of streams and to encourage better site design and low-impact practices, and since the regional pond program has caused environmental degradation, the regional pond program is inconsistent with the 2000 Policy Plan. Discuss this in the findings.
4. Findings need to state more strongly that regional vs. on-site isn't an "either-or" matter; however, this is recognized in the Ideal program.
5. County has placed undue emphasis on regional pond best management practices (BMPs) to the exclusion of other potentially beneficial techniques.
6. Report is too pro-regional ponds; it needs more balance.
7. General tone of document has bias towards regional ponds with minimal consideration for alternatives such as bioretention, constructed wetlands, and infiltration ditches/trenches.
8. Need more details about Low Impact Development (LID) techniques; need more emphasis on LIDs.
9. Point out that LID techniques control stormwater close to the source.
10. Need more specifics; create a list of alternatives, rather than pros.
11. What is the availability of advanced techniques?
12. A more accurate analysis for alternative stormwater management (SWM) methods is needed.
13. All possible alternatives that have been tried and proven should be included in the report (regional ponds are not the only alternative).
14. Need a matrix of alternative solutions and a way to compare these alternatives.

15. Need to tailor solutions to problems; use the toolbox approach.
16. Need to discuss other alternatives to regional ponds, e.g., the full suite of SWM measures in the toolbox.
17. Regional Pond program is flawed because regional ponds work as a network. If some are not built, the system will fail.
18. Findings should recognize regional pond program would never work effectively because entire system will never be built.
19. Regional Pond Policy is flawed because land ownership and right-of-way are, most of time, an issue; this affects the timely building of these ponds.
20. Regional Pond Program does not provide environmental protection: abandons upstream to erosion and pollution, construction of pond destroys natural area, and no proof that they succeed in collecting pollutants.
21. Regional Pond Program is neither efficient nor fair. Costs of creating impervious surfaces are not borne by those benefiting from them. Upstream homeowners enjoy benefits of impervious surfaces while the costs of runoff are borne by stream ecosystem and those living near regional ponds, and taxpayers who are denied enjoyment of what was once parkland.
22. In light of near build-out in the County, we need to consider stream restoration in lieu of regional ponds
23. Hydrology section should reflect actual soil conditions in Fairfax County (infiltration).
24. Regional ponds do not provide for ground water recharge (infiltration).
25. Most soils in Fairfax County not amenable to infiltration practices.
26. Groundwater is lifeblood of streams and recharge is critical. When streams dry up, effect on downstream biota is devastating. Recharge can only be obtained through infiltration techniques, which is discouraged by reliance on regional ponds.
27. Ecologically, infiltration methods are an ideal way to deal with stormwater because they mimic pre-development hydrology without destruction and fragmentation associated with in-stream pond building.
28. Need to verify performance standards for measuring effectiveness of ponds in removing pollutants (nutrients and sediments); how well are existing ponds doing?
29. Need more accurate statistics.
30. Does quality of water leaving regional ponds meet Chesapeake Bay standards?
31. Regarding reference to “extending the detention time” (p. 11), insert: “of the BMP storm event volume.” The way it currently reads implies that additional 48 hr detention applies to 2 and 10 yr storms, which is not correct.
32. Regarding fluctuations in water surface elevation (p. 13), the “bounce” should be less than 2-3 feet (not 8 to 20 ft) in order for vegetation (trees) to survive; also, elevation is determined by topography; and, many small ponds attain sufficient depths.
33. Does not address how SWM program is related to, or will address, future regulatory water quality requirements, e.g., water quality standards necessary to meet TMDL requirements.
34. Does not give enough values to other methodologies.
35. Regional Ponds do not address total flow.
36. Need to consider the impact of poor design.
37. Use measurables.
38. Need a good cost analysis; need costs of various solutions.
39. Need to give more information on maintenance cost comparisons for different measures.

40. Maintenance issues regarding regional ponds have been mostly ignored in the Findings.
41. Look at issue of dredging costs.
42. Wet ponds will naturally fill with sediment; is this happening? Is this desirable?
43. Not all regional ponds are located far away from residential properties, which would reduce safety problems.
44. Research done by the committee needs to be made available
45. List research in a bibliography and citations
46. Thermal impacts not sufficiently addressed.
47. Address increase in temperatures downstream.
48. Thermal impact from typical regional ponds should be minimal due to wind driven mixing in shallow impoundments.
49. Surface pond water is greatly heated in warm weather, and since most regional ponds discharge from the surface, there is negative thermal impact on aquatic organisms. Bottom, cooler water, could be discharged, but it could be anoxic and have accumulated metals and toxins.
50. The problem of release of higher concentration of pollutants from deep-water ponds not relevant because typical county ponds are shallow.
51. Regional Ponds do not protect the streams located above these ponds; this area can be substantial—100 to 300 acres, or a mile of stream length
52. Need to address impacts to streams between regional ponds and upstream development
53. Address stream impact between development site and regional pond because of waivers.
54. Disruption of stream ecology not sufficiently addressed.
55. Statement (p.6) that “stream valley habitat may be destroyed” is an understatement; hydrologic changes kill trees, and without a riparian buffer, habitat changes cause the loss of aquatic life and wildlife.
56. Regional ponds dramatically impact ecology of stream and riparian ecosystem: organisms in pond are totally different than those in natural stream valley; regional pond blocks flow or organisms along riparian corridor; inhibit recolonization of upstream areas; block flow of leaf-derived fine particulate organic matter downstream, which is food for many macroinvertebrates.
57. No protection now for areas that will be protected when regional ponds are built.
58. Regional ponds do not restore water quality or habitat integrity to downstream areas.
59. Does not adequately address impacts to forested wetland and stream habitat.
60. Best nutrient filter system for stormwater runoff is mature forest buffer floodplain; regional ponds destroy these and do not provide near the same stormwater control benefits.
61. Address impact of these ponds on the area in which they are located.
62. Include potential plantings around regional ponds
63. Acreage information given for various SWM facilities is inaccurate because actual area of inundation is not included for regional ponds.
64. Only passing reference is given to the fact that most regional ponds will be constructed in stream valleys on County park land and in Resource Protection Areas.
65. Resource damage to parkland at pond site during construction and future impacts outweigh any downstream benefits.
66. County and Regional Park interests are not well described and discussed.
67. Perennial streams were not considered in developing Regional Pond Program.

68. Given the many documented ‘demerits’ of regional ponds, the Findings should state that regional ponds have an overall negative impact on the environment (see p. 7).
 69. Many regional pond locations are in intermittent streams where fish migration is not an important consideration.
 70. Address the mosquito issue.
 71. Inadequate response to West Nile problem from inadequately maintained dry ponds; this is a potential liability problem for the County.
 72. Evaluate pond contribution to mosquitoes (West Nile Virus mitigation).
 73. Dry ponds are not good wildlife habitat (for natural controls of mosquitoes).
 74. Address funding sources; look at funding through stormwater utility fee; what has happened to the stormwater utility fee?
 75. Need more disclosure on negotiated financial commitments between County and developers.
 76. Don’t overlook that in many instances Park Authority land may have been donated by developers. At the same time, need to acknowledge they received private gain in approval process.
 77. Developers put money in the pot, but there is not enough accumulated to construct the regional pond until many years later, if at all.
 78. Need an explanation of the disincentives for why developers do not use alternative methods.
 79. Need analysis of funding and economic benefits to developers.
 80. Only beneficiaries of program are developers (higher density because of stormwater waivers) and county, not citizens.
 81. Need data to support assessed value of homes next to ponds.
 82. Financial benefit to homeowners next to wet ponds is overstated; they are considered unsightly (muddy, lifeless, oversized trash racks, large outfall structures, paved access nearby).
 83. Impact of waivers already granted.
 84. Automatic waivers granted because of planned regional ponds.
 85. Explain process for granting detention waivers (how have 800 been granted?)
 86. Small sites use regional ponds for stormwater control, rather than constructing detention on site.
 87. Under ecology (p.5), stormwater control waivers granted in conjunction with adequate outfall is flawed because adequate outfall is not determined correctly (should use bankfull). The statement should read: uncontrolled volumes of stormwater will (not may) cause channel scouring.
 88. Statements (p. 9 and p. 21) that on-site stormwater management is not required outside Occoquan is incorrect (e.g. temporary ponds have been required for a development in the Difficult Run Watershed).
 89. Need summary of requirements under current laws and regulations.
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- B. Do you agree with the Ideal program? What would you change?** (Many of these comments are also appropriate for the next section “C. Other Suggestions and Recommendations”)

1. Ideal is too idealistic.

2. No ideas given about how to get to the Ideal; how to get to the best of all possible worlds?
3. Should be ready before impact.
4. Discuss Ideal program in view of 85% build-out and current controls in place; consider realistic alternatives.
5. Does not address the “hole” caused by waivers granted for on-site controls.
6. Don’t come up with an Ideal program and then apply it county-wide; has to be more site specific; look at watersheds individually.
7. Move toward a holistic approach through watershed planning -- Current approach is like putting all eggs in one basket.
8. Add more detail to plan for managing stormwater.
9. Allow cluster development By Right.
10. “As natural as possible” design (replicate natural systems).
11. Ideal should minimize thermal impacts.
12. Stress need for better communication and public education.
13. Importance of gaining public support.
14. Rank alternatives based on potential success.
15. Add measurable evaluation criteria so solutions can be compared.
16. If pollutants come from a road, filter them near the source.
17. Address maintenance issues.
18. Include better drains to avoid clogging.
19. Identify barriers / impediments to reaching the Idea.
20. Use different criteria for drinking water watersheds, e.g., Occoquan.
21. Hydrology section should reflect actual soil conditions in Fairfax County.
22. Quantitative measurement needed in watershed to meet stormwater management goals.
23. Consideration should be given to riparian rights (access to water) of downstream property owners, particularly during low flow that occurs during dry periods.
24. Regarding maintaining integrity of stream valley ecosystems: acknowledge that water quality functions of natural buffer areas (flood control, infiltration, mitigate thermal, nutrient uptake) are displaced when stormwater management facilities are located in stream valleys; hence, stormwater management best management practices (BMPs) ideally, should be located outside these areas.
25. Regional ponds should be retrofitted to integrate other alternatives.
26. Multiple BMPs are the solution.
27. Well-designed and maintained Low Impact Development (LID) features can enhance property values.
28. Ideal would have a funding source to support it, particularly in areas that are already developed.
29. Need to identify sources for reliable funding.
30. SWM costs should be shared among users.

C. What other suggestions and recommendations do you have?

1. Consider more SMART growth and LID measures.
2. Need incentives for developers to use LID.
3. Better technologies, such as LID techniques might be a better replacement for regional ponds.

4. LID works, but must be implemented on a wide scale to be effective.
5. In the earliest stages of review and development process, suggest stormwater measures, taking into consideration the watershed and cost-effectiveness.
6. Need tools and flexibility to change regional pond program.
7. Multiple BMPs are the solution.
8. Consider street sweeping.
9. Stream restoration is part of the solution.
10. There should be a list of practical features that must be considered in every pond design to make it aesthetically pleasing, as well as protect ecological integrity, stabilize stream channels, etc.
11. Consider including a matrix of alternatives and a decision tree.
12. Stormwater management goals: economically reduce runoff and pollutants as close to the source as possible; mimic natural ecosystems (e.g., created wetlands will naturally control mosquitoes).
13. Recognize validity of developer viewpoint, but not to extent of allowing negative vetoes of practical solutions.
14. Remove barriers to get to the Ideal (financial, aesthetic, regulatory, etc.).
15. Need for enabling legislation to implement the plan.
16. Since pro-rata funds are limited in their use, county may need enabling legislation to allow a “fee in lieu” system to collect funds where waivers are granted (used by MD and DC). Developers should strongly support this.
17. Ordinance changes are needed to encourage alternatives to ponds.
18. County should consider mechanisms to encourage alternatives.
19. Building process and building codes need to be modified to allow alternatives.
20. Need inter-agency cooperation on design standards for roads.
21. Stimulate Park Authority to initiate stormwater management in stream valleys, or revert lands to County ownership.
22. In-stream regional ponds are counter to any stream preservation and ecology; infrastructure built in last natural resource areas in county (stream valleys) is disservice to quality of life and sense of place for citizens.
23. Recommendations should be for discontinuation of regional pond program; or, at the very least confine regional ponds to highly industrialized areas with pre-existing environmental damage; they should never be built in residential areas.
24. Increase fees to developers to provide stormwater management.
25. Consider land-use and zoning restrictions.
26. Water from point sources must be reduced.
27. Credit should be given for tree preservation.
28. Need to consider tree preservation and other measures that will help to mitigate thermal impacts.
29. Minimize risk associated with mosquitoes (West Nile Virus) when developing stormwater management options.
30. Mosquito-eating fish should be part of regional ponds.
31. Dry weather and evaporation; need faster infiltration into pond.
32. Need stormwater management alternatives that increase infiltration.

33. Since there is little contribution to aquifer recharge (because of impervious surfaces), need to consider alternatives.
34. Extended detention should be included on all on-site and regional ponds -- at least .5 in. of runoff, and preferably more, should be adopted as extended detention design standard (this would control the small storms that cause channel erosion).
35. Land-use planning and watershed management should be promoted everywhere.
36. Study the relationship of existing conditions to future development. What programmatic changes are needed?
37. Retrofit existing development as it redevelops; change the code for redevelopment to address existing problems rather than just addressing the impact of the redevelopment.
38. Citizens need information on proposed pond retrofits. Is there a master list of dry ponds to be converted to wetland-type ponds?
39. Transition from wet to dry ponds: There should be a way citizens can petition the County to change wet ponds to dry ponds.
40. Existing old farm ponds should be considered in the development of stormwater management programs.
41. Public is more accepting of wet ponds than dry ones. County should support them where others will build and maintain them.
42. Need prioritization of construction of regional ponds.
43. Timing of construction over the years.
44. Regarding phasing of construction: If current method is the only practical approach, then admit it, describe it, and try to improve it.
45. Institute a moratorium on stormwater management waivers.
46. Evaluate the criteria for granting waivers.
47. Current stormwater waivers are not working.
48. Decrease the number of SW waivers.
49. EQAC has strongly recommended that waivers be sharply curtailed.
50. Look at retracting some waivers already granted.
51. Retrofits are necessary to make up for past decisions (waivers, delays of on-site retention, funding).
52. Make a full analysis of adequate outfall for stormwater discharges before on-site detention waivers are granted; the key is not whether or not waivers should be granted, but whether or not outfall is adequate.
53. Problem of operating low-level release valves during storm events (p. 18) can be resolved with a simple design modification.
54. Analyze existing pond's existing and designed capacity to help get information needed to minimize the footprint of future ponds.
55. Over excavate wet ponds, making them more effective BMPs (look at PL-566 and FCPA lakes).
56. Most regional dry ponds require a Corps of Engineers permit. Insist that individual developers get their own permits.
57. Concern with applying averages countywide; analysis has to be more specific (watershed and sub-watershed specific).
58. A reasonable approach is on page 25 of the report, under Ideal: "Through a systematic consideration of specific watershed and subwatershed conditions . . . optimize effectiveness of regional and/or on-site controls." (On-site controls should be considered along with each

regional pond proposal; require on-site controls if they are needed between development site and regional pond).

59. Have regional ponds failed, or have we had successes with regional ponds? Statistical support is needed.
60. Review regional pond sites to determine continuing appropriateness.
61. Implement regional pond system, except for any ponds that are no longer practical.
62. Will existing regional ponds be revisited?
63. Are there quantitative measures the County must meet in managing stormwater?
64. Funding is needed for implementing this report's findings.
65. What has happened to the Stormwater Utility Fee?
66. Propose something practical for the Board of Supervisors to consider, e.g., 3 or 4 projects annually, up to \$1million added to pro-rata share money.
67. Pass ordinances that encourage low capital cost solutions since developers are not liable for stormwater management maintenance costs.
68. Evaluate total cost of ownership, including maintenance costs.
69. Adopt the following policies: a) regional ponds are good for high density watersheds (provide some protection for reaches below pond in highly impervious areas where streams are already degraded) and bad for low density watersheds; b) smaller, properly designed on-site ponds throughout a low-density watershed provide more protection and don't sacrifice stream reaches above ponds.
70. Regional ponds should be built for recreational use.
71. Regional ponds can be built to be aesthetically pleasing and provide quality wildlife habitat.
72. Make a detailed analysis on a case-by-case basis to determine if regional pond is best solution (hydrologic and hydraulic models, topography, existing facilities, planned land-uses; evaluate retrofits and innovative practices).
73. Look at retrofitting in areas of existing development.
74. Implement Low Impact Development measures in low-density areas and implement regional ponds in high-density areas.
75. Adopt a pilot program in one or two watersheds to test the effectiveness of Low Impact Development techniques.
76. Implement pilot project using D-40 project; evaluate and seek mix of alternatives.
77. Adopt all measures to restore permeability of ground in both new and existing developed areas (expand tree save, rain gardens in right-of-ways, porous pavement, curb removal, swales).
78. Don't make any changes until the study is completed and submitted to the Board of Supervisors.
79. Note that Loudoun, Prince Georges and Montgomery Counties don't have regional pond programs. Because Montgomery County's development is similar to Fairfax County's, study Montgomery County's stormwater management program.

D. How and when do you want to be involved if there is a regional pond or other stormwater management structure planned in your neighborhood?

1. At the very beginning.
2. Continuous and on-going; often.

3. Web updates and monthly meetings.
4. DPWES does need to communicate more.
5. Send out maps and planners as soon as plan is initiated.
6. Notify public of existing plans.
7. Posting of sites where ponds are proposed.
8. Educate public on what is being designed.
9. HOA and others should be informed during the conceptual planning process.
10. Advertise meetings on signs placed in medians and at major intersections.
11. Come up with a better method of informing the citizens about meetings, e.g., use property records to contact homeowners and residents, not just the homeowner's association.
12. Notify the public before waivers are granted; notify the minute a waiver is requested; notify landowners downstream at a distance where the stormwater discharge becomes 1% of drainage area; notify within 30 days of submission for review process.
13. At time property is purchased, landowner should be notified of plans for regional pond structures.
14. Public outreach should be done when pond construction is expected in next 3 or 4 years (it is not practical to inform the whole county).
15. Develop a step-by-step public information program to be used for each pond project.
16. In effort to gain public acceptance, focus not only on those living near a proposed facility, but emphasize watershed benefits.
17. Shift to watershed management plans, involving citizens stakeholders: a) Develop citizen stakeholder, Homeowner Association (HOA) District Council Task Force; b) Use HOA as central point of contact and for notifying residents; c) Use the Public Hearing process for stormwater planning notification and approval; d) HOAs and others should be informed during the watershed planning process.
18. The public should be involved in the problem assessment/issue identification phase of the watershed planning process.
19. Individuals want to coordinate and promote pilot projects within communities.
20. Individuals want to help combat bad state laws and policies and help county develop laws that reduce tree clearing.
21. Individuals want to help county devise system for funding stormwater management according to the amount of impervious cover, and with a system for stormwater credits.
22. The onus is on the County to present alternatives and recommended solutions to stakeholders.
23. The County should ensure the public understands why particular SWM alternatives are being considered.
24. The public needs basic stormwater management education.

E. Other Comments

1. How does this report relate to the County's watershed planning?
2. Timeline for the completion of the report is too optimistic.
3. Need an on-going website of the decision making process (for developing this report).
4. More similar public meetings are required.
5. Would like to see recommendations of this committee.

6. Report needs to be completed for public to provide thoughtful, productive comments. Complete last 3 sections and disseminate for public review.
7. Extend timetable for study and report -- draft has no recommendations or legal analysis; allow for two more public meetings and one more round of comments on a final draft of the report.
8. What is the interim status of the regional pond program? There should be no changes until study completed and submitted to the Board of Supervisors.
9. Use South Fork and proposed D-40 area to do a pilot project (measure runoff; look at design criteria in light of development; modify existing facilities upstream; engage community to implement simple LID and non-structural BMPs, e.g., plant trees, curb cuts, rain gardens).
10. Ask the County Executive to review this entire situation and provide an opinion based on sound engineering, legal principles and administrative acumen.
11. With considerable internal work, a new popular and workable program may be developed; don't hustle to a quick fix that may confound the problem.
12. Study is a disappointment. It is too biased with lack of research documentation; incomplete citations are especially frustrating. Have outside party, such as the Center for Watershed Protection, Northern Virginia Regional Commission, and/or consulting firms) review information and present the reality in Fairfax County.
13. Involve national experts in promising new LID BMPs to help define County policy.

A Primer on Watersheds and Streams

The water resources of Fairfax County include its streams, groundwater, ponds and lakes. These serve as sources of drinking water, recreation, and habitat for a myriad of organisms. One-third of the land in the Fairfax County Park system, around 5,000 acres, is stream valley parkland. These stream valleys are significant corridors for the County trails system and wildlife.

Fairfax County is criss-crossed by a variety of natural streams, often called runs or creeks. These streams are considered flowing water habitats. Rainfall soaks into the earth and drains to low points within the surrounding land, then emerges from the ground as seeps, springs and trickling headwaters. These tiny threads of running water join with others in the same drainage area to create a stream system. By definition a stream is a system of fresh water moving over the earth's surface. There is a natural progression in size from the smallest tributaries to the largest rivers into which they eventually flow. Perennial streams flow throughout the year and intermittent streams flow only part of the year. There are over 900 miles of perennial streams within Fairfax County fed by smaller intermittent headwater streams.

Most of the water on earth, almost 98%, is in liquid form, in the oceans, lakes, ponds, rivers, and streams. Of the remaining 2%, some water is frozen in the polar ice and glaciers, some in the soil and some in the atmosphere in the form of vapor and some in the bodies of living organisms.

Water is evaporated from the oceans, and in much smaller amounts, from moist soil surfaces, from the leaves of plants and from the bodies of other organisms. This water, now water vapor, is carried up in the atmosphere by air currents. Eventually these water molecules fall to the Earth's surface as rain or snow. Much of the water that falls onto the land runs off into streams, then rivers and eventually reaches the ocean.

Some of the water that falls on the land percolates down through the soil until it reaches a zone of saturation. In the zone of saturation, all pores and cracks in the rocks and soils are filled with water (groundwater). The upper surface of the zone of saturation is called the water table. This groundwater provides the base flow in streams and is the reason that streams and rivers have flow when it is not raining. It is this groundwater that is the source of water in wells and provides water for plants through their roots. Eventually all groundwater reaches the oceans, thereby completing the water cycle.

A watershed is an area from which the water above and below ground drains into a particular stream, river system or larger body of water. Everyone in Fairfax County lives in a watershed with a name and drainage boundaries. The larger stream watersheds usually have sub-basins. There are 30 separate drainage basins or watersheds within the County. For example, the largest watershed in Fairfax County, Difficult Run (58 square miles), has ten streams, which drain into the main stream channel, Difficult Run itself. It, in turn drains into the Potomac River. The Potomac River watershed is a sub-basin of the even larger watershed, the Chesapeake Bay watershed, which is 64,000 square miles and extends from New York through Pennsylvania, Delaware, West Virginia, Maryland, Virginia, and the District of Columbia. All Fairfax County streams are in the Potomac River Watershed and subsequently the Chesapeake Bay Watershed.

Within a stream are shallow areas called riffles where the velocity is rapid and the bottom consists of boulders, stones, gravel and/or sand. Dissolved oxygen levels are high because water is flowing over rocks, mixing air into the tumbling water. Alternating with riffles are deeper

pools and runs where water speed slows and small particles of mineral and organic matter fall to the bottom and oxygen levels are reduced. Each of these stream regions has a diverse community of plants and animals, which spend all, or part of their life cycles in the water.

The aquatic food chain begins with leaves and other decaying plant and animal material called detritus. These are carried into the stream from the surrounding forests and fields by wind and water runoff. Food sources also include aquatic vegetation such as algae. Bottom-dwelling (benthic) Macro (large) invertebrates (back-boneless) animals eat this organic matter. These include snails, clams, aquatic worms and crustaceans such as crayfish, but the most ecologically important are the aquatic insects such as stoneflies, mayflies, caddisflies, and true flies. In turn, fish, birds, and other streamside wildlife, such as frogs, salamanders and small mammals eat these macroinvertebrates.

Oxygen is vital to organisms that live in a stream just as it is to terrestrial animals. Submerged animals use oxygen dissolved in the water. Most aquatic insect larvae, such as mayflies and stoneflies, absorb oxygen through their body walls, but many are aided by the use of structural gills. Fish absorb oxygen by drawing water in through the mouth where it passes over internal gills. High levels of dissolved oxygen in the water are essential to the life functions of a healthy stream community.

A buffer of trees lining the banks of streams is another essential part of a healthy stream system. The temperature in a stream greatly affects how much oxygen it can hold. Since warmer water holds less oxygen, trees are vital along the bank or edge of stream or river. Shade from the tree canopy maintains cool water temperatures so the water will hold more oxygen.

Tree cover also provides food and floating detritus for shelter when leaves and branches fall into a stream. Streamside forests offer food, nesting sites, and protection to a great diversity of streamside wildlife including birds, turtles, beaver and snakes. Tree roots stabilize fragile stream banks and give cover to fish, crayfish and aquatic insects. Forested buffers absorb high percentages of excess nutrient runoff.

Wetland areas adjacent to streams can be forested or open wetlands. These wetlands serve as transitions to stream channels and help to attenuate the effect of stormwater and remove pollutants.

Nitrogen and phosphorus are nutrients essential to the growth and development of all plants. But an overabundance of either can damage stream ecosystems dramatically. Forested buffers can retain and utilize as much as 89% of the nitrogen and 80% of the phosphorus runoff associated with land use or development practices. In excess, these nutrients become major pollutants causing the rapid growth of algae in streams, rivers, lakes and estuaries. When the algae dies and begins to decay, the bacteria breaking down the algae uses up the dissolved oxygen necessary for other aquatic life.

Water-polluting substances originate from either non-point or point sources. Non-point sources (NPS) include surface runoff, atmospheric deposition, and groundwater flow. Because of their diffuse and intermittent nature, NPS are difficult to control. NPS pollutant loads are greatest following rainfall events. A significant part of the NPS load consists of nutrients, including nitrogen and phosphorus (organic matter, fertilizer), that are substances that stimulate algal growth. Other NPS pollutants are sediment (from eroding lands, construction sites, and stream banks during high-flow, high-velocity conditions), toxics (oil, paint, chemicals and metals), pathogens, fecal coliform bacteria (animal waste, failing septic and leaking sewer systems), and

trash.

Point sources are specific locations that discharge pollutants. They are relatively constant and provide a steady flow of pollutants. In the Potomac Basin, most point sources are either wastewater treatment plants (WWTPs) or industrial discharges. Point sources contribute relatively small portions of the nutrient loads during high flows and the majority during low flows.

As development occurs, impervious surface increases as driveways and buildings are placed on land that once had trees and other vegetative cover that absorbed water and its contents. With the increase in impervious surface and loss of vegetative cover, there is a concurrent increase in the amount and speed of stormwater running off the land carrying sediment to nearby streams. Sediment is a major non-point source pollutant reaching streams and rivers that drain to the Chesapeake Bay. Silt and sand scour stream channels, which erodes the banks and causes even greater loss of tree cover. This in turn allows water temperature increases. This silt and sediment also gets deposited on the bottom covering the habitat of macroinvertebrates, cutting off their oxygen supply. This change in bottom substrate usually results in a change in the diversity of organisms--a loss in the numbers and kinds of animals and plants in stream. There is usually a concurrent increase in the numbers of floods that occur where water spills over the banks of streams and onto adjacent lowlands. Over time, this increased flooding and sediment depositions leads to channel widening, loss of pools and riffles and increased pollutant levels. In urban and suburban watersheds, rain flows off impervious surfaces like parking lots and highways, carrying oil and other automobile wastes into streams. During summer storms, these heated surfaces contribute to raising the temperature of water runoff into streams. High water temperatures often kill stream organisms. The combined effects serve to badly degrade streams and rivers.

Good stormwater management practices attempt to mitigate the impact of development on streams and to protect the integrity of the streams as a living resource for all citizens of Fairfax County to enjoy.

