Memorandum

8390 Main Street, 2nd Floor
Ellicott City, MD 21043
410.461.8323
FAX 410.461.8324
www.cwp.org
www.stormwatercenter.net

Date: March 20, 2007

To: Gem Bingol
Piedmont Environmental Council

From: Center for Watershed Protection

Re: Protecting Human Health and Water Quality in the Town of Leesburg and its Watersheds

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1. Introduction

Project Summary

The Goose Creek watershed and its tributaries drain 385 square miles in Loudoun and Fauquier Counties of Virginia. In 2002, the Center for Watershed Protection (CWP) conducted an evaluation of subwatersheds in the Goose Creek watershed to assess their vulnerability to current and future land development. The resulting *Goose Creek Vulnerability Analysis* (CWP, 2002) indicates that the Town of Leesburg's (TOL) subwatersheds currently have levels of imperviousness that negatively impact water quality, and that anticipated growth in the area will not allow water quality to be sustained under a build-out scenario.

As recommended by the *Goose Creek Vulnerability Analysis*, a study was undertaken in 2006 to conduct watershed planning and assessments in the two primary subwatersheds that are contained within the TOL's limits: Upper Tuscarora Direct Drainage (Upper DD) and Lower Tuscarora Direct Drainage (Lower DD). The location of the study area can be found on Map 1 in Appendix A. This collectively represents an area of about 10 square miles and 18 stream miles. As a subcontractor to the Piedmont Environmental Council (PEC) under a National Fish and Wildlife Foundation grant, CWP conducted these assessments, the results of which are summarized within this technical memorandum. Additional funding from Columbia Gas of Virginia (a NiSource Company) and Dominion Foundation was used to supplement this effort. All landowners within the confines of this report were notified of this study prior to the commencement of this study to ensure legal trespass over the study area.

The scope of work for CWP under this project consisted of the following three major tasks:

- Task 1: Performing a Baseline Watershed Assessment
- Task 2: Identifying Stormwater Retrofits, Upland Pollution Prevention, Conservation Areas, and Stream Corridor Restoration Opportunities
- Task 3: Technical Memorandum

This technical memorandum summarizes the conditions and opportunities in the two target subwatersheds, based on the results of Tasks 1 and 2. It also identifies priority opportunities for watershed protection and restoration for PEC, TOL and other stakeholders to consider.

Description of Study Area

The Tuscarora Upper and Lower DD subwatersheds drain approximately 9.7 square miles of land in TOL and Loudoun County. Tuscarora Creek empties into Goose Creek not far from its confluence with the Potomac River. The majority of land in these subwatersheds (83%) falls within TOL's jurisdiction; therefore, land use is dominated by urban and suburban uses, such as residential, commercial, and industrial areas. The Tuscarora headwaters are located in Loudoun County and are outside of the study area (this subwatershed has been given the unique identifier: Tuscarora 101). The Tuscarora 101 subwatershed is largely rural, with agriculture and forest being the predominant land use types.

Development has increased dramatically in the Leesburg area, doubling between 1990 and 2000 (Schwalm, 2005). The growth is expected to continue with TOL's current population estimated at nearly 37,500 and projected to be 45,000 by 2010 (TOL, 2007). As a result, imperviousness and subsequent stream degradation are expected to increase substantially in the Tuscarora Creek subwatershed (Schwalm, 2005).

The current levels of impervious cover led to classification of the Tuscarora Upper and Lower DD subwatersheds as Urban Impacted in the *Goose Creek Vulnerability Analysis*. With the continued residential and commercial development predicted during the next decade, the management classification of the target subwatersheds will change to Non-Supporting. Characteristics of the Tuscarora subwatersheds are provided in Table 1 below.

Table 1. Characteristics of the Tuscarora Subwatersheds (Source: CWP, 2002)*

Subwatershed	Area (ac)	Mapped Perennial Stream Mi.	Current Impervious %	Future Impervious %	Current Management Category	Future Management Category
Tuscarora 101	3013	7.6	5	8	High Quality	High Quality
Tuscarora Upper DD	3187	9.5	22	34	Urban Impacted	Non-Supporting
Tuscarora Lower DD	3024	8.5	15	36	Urban Impacted	Non-Supporting

* Calculations based on Loudon County GIS. For additional information regarding data sources and methodology, see CWP, 2002.
** Tuscarora 101 subwatershed is outside of this memo's study area.

Opportunities for watershed protection and restoration are identified in this technical memorandum for Tuscarora Upper and Lower DD subwatersheds in light of impending urban growth. The memo structure is described below.

Memo Structure

This technical memorandum is organized into the following sections:

- Section 2. Baseline Assessment – describes subwatershed in-stream conditions, sensitive areas, and conservation lands.

- Section 3. Review of Stormwater Regulations – describes recommended changes to TOL's stormwater code.

- Section 4. Unified Stream Assessment – describes the protocols used, results, and recommendations from the Unified Stream Assessment in the Tuscarora Upper and Lower DD subwatersheds.

- Section 5. Unified Subwatershed and Site Reconnaissance - describes the protocols used, results, and recommendations from the Unified Subwatershed and Site Reconnaissance in the Tuscarora Upper and Lower DD subwatersheds.

- Section 6. Sensitive Areas Inventory - describes the protocols used, results, and recommendations from the Sensitive Areas Inventory in the Tuscarora Upper and Lower DD subwatersheds.

- Section 7. Stormwater Retrofit Inventory - describes the protocols used, results, and recommendations from the Stormwater Retrofit Inventory in the Tuscarora Upper and Lower DD subwatersheds.

- Section 8. Summary of Recommendations – summarizes recommendations from all field assessments in the Tuscarora Upper and Lower DD subwatersheds.

- Section 9. References

- Appendices:
    A. Subwatershed Maps
    B. Unified Stream Assessment Field Sheets
    C. Unified Subwatershed and Site Reconnaissance Field Sheets
    D. Sensitive Areas Inventory Field Sheets
    E. Stormwater Retrofit Inventory Field Sheets
    F. CD of Field Photos
    G. Vehicle Maintenance Facilities and Operations Fact Sheets
    H. Street Sweeping Practices in the Bay Region
    I. Proper Outdoor Storage of Materials

2. Baseline Assessment

The section summarizes information on the Tuscarora Upper DD and Lower DD subwatersheds acquired from reports and Geographic Information System (GIS) data. Reports were obtained from the Loudoun Watershed Watch, Loudoun Wildlife Conservancy (LWC), United States Department of Agriculture, Natural Resource Conservation Service, Wetland Science Institute, Virginia Department of Environmental Quality (DEQ), Department of Conservation and Recreation (DCR), and CWP. GIS data were obtained from the Virginia Office of Mapping and Geographic Information, United States Fish and Wildlife Service (USFWS) and PEC.

In-Stream Conditions

Bacteria

The Tuscarora Creek subwatershed contains two impaired stream segments, as listed within the 2006 Draft 305(b)/303(d) Water Quality Assessment Integrated Report (www.deq.viriginia.gov/wqa/ir2006irdoc/Appendices/2006AppendixA_Cat_5_Factsheets_all.pdf). Both stream segments were listed as impaired by the Commonwealth of Virginia in 2004 due to fecal coliform. Water quality in the stream segments does not support the stream's intended use for recreation, including swimming, wading, and fishing. Approximately 66% of fecal coliform in the Tuscarora Creek subwatershed originates from runoff sources of pasture and livestock land, 25% comes from cattle in the stream, and the remaining 8% is from runoff sources of forest wildlife, cropland, and developed areas (Schwalm, 2005). There has been no further field testing to verify whether or not conditions have improved or worsened since the time of original data collection.

The 1.05 mile impaired upstream segment of Tuscarora Creek begins at the convergence of Town Branch and continues downstream to the boundary for the public water supply (PWS) designation area, approximately 0.1 river miles downstream from the Route 15 crossing. The second impacted stream segment begins at the boundary of the PWS area and continues downstream to the confluence with Goose Creek, for a total of 2.5 miles. The projected Total Maximum Daily Load (TMDL) development date is 2016 (DEQ and DCR, 2006).

Aquatic Insects

DEQ has monitored aquatic insects at stations in the Goose Creek watershed for several years. Figure 1 shows dramatic fluctuations in the condition of the aquatic insect community in Tuscarora

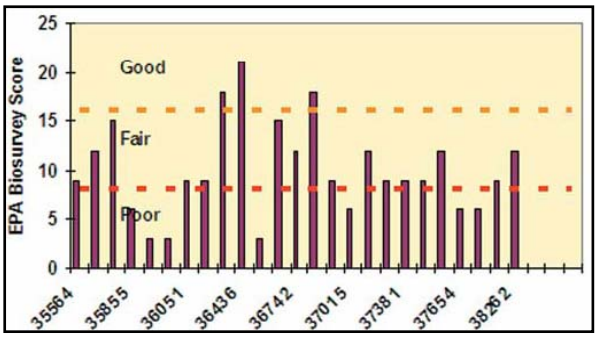

Figure 1. Aquatic Insect Conditions in Tuscarora Creek (source: Schwalm, 2005)

Creek, with scores ranging from three to 21. In 2004, DEQ identified Tuscarora Creek as having a threatened benthic macroinvertebrate community. Low scores are indicative of low species diversity and high numbers of insects tolerant to pollution. They are most likely caused by urban runoff impacts. High scores are indicative of an aquatic insect community with minimal human impact and stabilized stream corridors (Schwalm, 2005).

Fish

A survey of the fish community was conducted by USDA and Environmental Protection Agency (EPA) from 1997-1999 at three sites on Tuscarora Creek. Results are reported in Teels and Danielson (2001) using an index of biotic integrity (IBI). The IBI combines multiple metrics with appropriate sampling design and statistical analyses to evaluate a stream's ability to support undisturbed living systems. Scores for the sampling sites were 32 and 28 (out of 54), which indicate poor integrity classification for fish assemblage sampling locations. This classification indicates that the stream is dominated by omnivores, tolerant species, and habitat generalists. It also has few top carnivores, depressed reproductive and condition factors, and diseased fish. These low IBI scores are attributed to suburban sprawl around TOL (Teels and Danielson, 2001).

Physical Habitat

LWC has monitored physical in-stream habitat at one station on Tuscarora Creek since 1997 using EPA's Rapid Bioassessment Protocol II. Figure 2 illustrates the habitat conditions of Tuscarora Creek from 1997 through 2002. In the *State of the Streams, Loudoun County: 2005 Report*, physical habitat conditions are characterized as fair. Habitat stressors include increased sediment deposits that reduce living spaces for aquatic life, reduced canopy cover, and stream channel alteration (Schwalm, 2005).

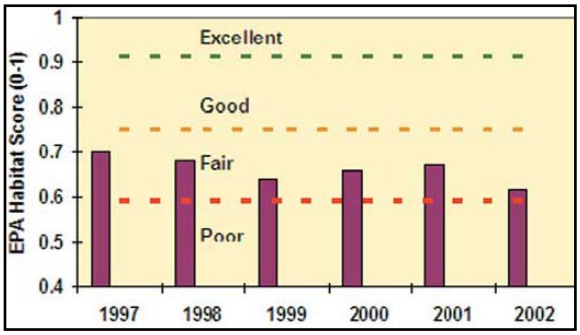

Figure 2. Habitat Conditions in Tuscarora Creek, 1997-2002 (source: Schwalm, 2005)

Sensitive Areas

Wetlands

A wetland area is regularly saturated by surface water or groundwater and has a prevalence of vegetation adapted for life in saturated soil conditions. Wetlands remove pollutants, store floodwaters, control erosion, recharge aquifers, and provide wildlife habitat (CWP, 2006). Wetlands within the Tuscarora subwatershed consist of freshwater ponds, freshwater forested/shrub wetlands, and freshwater emergent wetlands. Based on the National Wetland Inventory (NWI), the Tuscarora Upper DD subwatershed has approximately 35 acres of wetlands (1% of subwatershed area) and the Tuscarora Lower

DD subwatershed has approximately 75 acres of wetlands (2% of subwatershed area) (USFWS, 2006). The dominant wetland type in each subwatershed is the freshwater forested/shrub wetland.

Forest Cover

Forests provide many watershed benefits, including runoff reduction, improved air and water quality, and wildlife habitat. The percent forest cover in a watershed has been directly linked to stream health, with thresholds of 65% identified as correlating with excellent stream health ratings (Booth, 2000; Goetz *et al*., 2003). The Tuscarora Upper DD has approximately 1140 acres of forest (36% of the subwatershed), while the Tuscarora Lower DD has approximately 1205 acres of forest (40% of the subwatershed) (Loudoun County, 2001).

Conservation Lands

Two tracts of land protected by conservation easement are present in the Tuscarora subwatersheds. One is in the Tuscarora Upper DD and is known as the Rust Sanctuary. The Audubon Naturalist Society owns this land, which consists of 69 acres of wildlife habitat gardens, meadows, hedgerows, mixed hardwood forest, pine plantation, and a pond. The second conservation land is in the Lower DD subwatershed and is the Douglass Community Center, owned by the Loudoun County School Board. These 10 acres are designated as a local park.

3. Review of Stormwater Regulations

TOL is currently undergoing revisions to portions of the town stormwater code. CWP reviewed the revisions made to the Design and Construction Standards Manual (DCSM), Article 5 Section 5-600 (Stormwater Runoff Quality Control Criteria) and The Town Code Ordinance, Chapter 21. Recommendations for TOL's consideration are bulleted below.

Overarching Issues

- Utilize the same terms and definitions throughout the code and DSCM. Terms and definitions should also be consistent with terms found in the Virginia Stormwater Management Handbook (VA Handbook).
- TOL should revisit the stormwater ordinance as a whole in the near future to improve organization, flow and ensure consistency across sections.
- The code and DCSM should refer to the VA Handbook whenever possible. Details provided in the VA Handbook should not be provided within the ordinance (e.g., take out Table 5-630-1 and refer to the VA Handbook instead). This will allow TOL to keep up with changes made at the State level without having to change the ordinance.

Town Code Ordinance: *Chapter 21*

- Provide definitions for structural and nonstructural Best Management Practices (BMPs).

- Utilize the same definitions as provided in the VA Handbook.
- Add sewage and pet waste as illicit discharges to Section 21-5(a): Illicit Discharge Detection and Elimination.
- Rephrase Section 21-5(b)(1): "Any proposed land disturbing activity greater than 500 square feet shall comply with Section 6-100 *et seq* of the DCSM." This rewording will allow all land disturbing activities to be captured under the ordinance – current wording may be construed such that road construction may be considered exempt.
- Section 21-5(d)(Maintenance) should clarify the following:
    1. Who is the owner – developer?
    2. Is the Home Owners Association (HOA) expected to enter performance bond? When?
    3. Is the performance bond to ensure long-term maintenance of the BMP or does it just cover construction?
    4. Is access to facility provided in the form of a drainage easement?
- The TOL should make a standard maintenance agreement available for use.
- Revise section 21-7 (Violations) so that there is a clear progression and scale of punishment (i.e., punishment should fit the crime).
- Consolidate the discussion of the Watershed Improvement Fund into one section and reference the other. The Watershed Improvement Fund is currently covered in both DCSM Article 5 and The Town Code Ordinance Chapter 21.

DCSM: *Article 5*

- Revise the performance criteria so that it is based on site-by-site conditions. Eliminate reference and use of average land cover condition.
- Revise section 5-610(9d) so that the stormwater easement applies to entire stormwater treatment facility, not just the vegetated area.
- Revise 5-630 (1iii) so that feasibility is considered for all BMP types, not just infiltration.
- Revise 5-630(4) so that low impact development (LID) techniques go through same review process as any other stormwater treatment practice. Review of LID on a case-by-case basis will discourage its use. Additionally, TOL should utilize and provide existing resources such as checklists made available through the State.
- Revise 5-640 (Watershed Improvement Fund) – this section should state that payment to the fund is the last preference and that burden of proof is on developer to show why he/she were unable to meet performance requirements onsite. This section should also specify that funds will be used within same watershed.
- Eliminate Table 5-630-1 and reference the VA Handbook.
- Provide a definition for onsite control and nonstructural BMPs.

4. Unified Stream Assessment

CWP, PEC, TOL and other project partners conducted a physical stream corridor assessment along 11 stream miles in the Tuscarora Upper DD and Lower DD subwatersheds during the week of August 7-9, 2006. The assessment was used to identify restoration and maintenance opportunities and impacts within the stream corridor.

Assessment Protocol

The primary assessment protocol used was the Unified Stream Assessment (USA), which is a comprehensive stream walk protocol developed by CWP for evaluating the physical riparian and floodplain conditions in small urban watersheds. The USA integrates qualitative and quantitative components of various stream survey and habitat assessment methods and is used to identify locations of suspected illicit connections, impacted buffers, severe stream bank erosion, excessive trash accumulation and dumping, and impacted stream crossings. Restoration opportunities for discharge prevention, stream restoration, stormwater retrofits, and riparian reforestation are also identified.

The USA contains eight individual impact assessment forms for evaluating restoration potential for common urban stream impairments. The USA also provides an overall reach assessment to document average in-stream and riparian conditions for an individual reach. More detail on conducting the USA protocol can be obtained directly from Kitchell and Schueler (2004).

Summary of Reaches Assessed

Twenty-seven stream reaches were evaluated in the Tuscarora Upper DD and Lower DD subwatersheds using the USA. An overall quantitative score for each reach was assigned based on average physical condition as measured by various in-stream and riparian parameters (diversity of in-stream habitat, floodplain connectivity, vegetative buffer width, etc). These scores were used to classify stream reaches into condition categories ranging from *excellent* to *very poor*. The resulting reach scores for Tuscarora Creek ranged from *good* to *very poor* due to its suburban character.

Reach categories are defined based on a reference condition, which is considered to be the least impaired, best attainable condition for a stream in a given region. For this assessment, the reference condition was limited to the least disturbed stream reach observed in the Tuscarora DD subwatersheds. Therefore, the highest rated reach (RCH 1002) was considered to be equivalent to the reference condition. The highest reach score in the study area was 121 out of 160 points. Based on natural breaks in the total scores, a score greater than 85% of this number (>102) represents *good* stream conditions for Tuscarora. A score less than or equal to 50% (<61) of the reference score is considered *very poor*. Between these two extremes, 70% of the reference score (85 points) represents the divide between *fair* and *poor* stream conditions. The scoring criteria are shown in Table 2.

Table 2. Stream Reach Scoring Criteria

Category	Percentile	Point Threshold
Good	85%	>102
Fair	70%	>85
Poor	50%	>61
Very Poor	--	≤61

While these criteria serve to place the assessed reaches in context, they are somewhat subjective. A reach scoring a few points higher than another may be placed in a higher category, but the qualitative aspects of the method make differences of a few points insignificant. It should also be noted that these classifications are based on the limited sampling of impacted conditions in the Upper and Lower DD portions of Tuscarora Creek and are likely not comparable to conditions in other parts of the Goose Creek watershed.

Table 3 summarizes the reaches by classification category. The location and condition of these reaches is illustrated in Map 2 of Appendix A. Good reaches often had better quality riparian buffer and floodplain connectivity than streams scoring in the fair or poor range. Figure 3 illustrates some of the common stream conditions found in the Tuscarora Creek DD subwatersheds. Photo documentation can be found in Appendix F.

Table 3. Stream Reach Classifications

Reach	In-stream Condition 80 possible pts	Buffer/Floodplain Condition 80 possible pts	Total Score 160 possible pts	Classification
RCH-103	52	51	103	Good
RCH-201	50	55	105	
RCH-501	65	41	106	
RCH-601	68	51	119	
RCH-705	62	52	114	
RCH-801	54	51	105	
RCH-1001	60	55	115	
RCH-1002	66	55	121	
RCH-104	54	31	85	Fair
RCH-701	48	52	100	
RCH-702	57	30	87	
RCH-703	62	28	90	
RCH-704	62	28	90	
RCH-902	56	32	88	
RCH-101	45	24	69	Poor
RCH-102	38	35	73	
RCH-203	44	39	83	
RCH-301	41	42	83	
RCH-302	39	42	81	
RCH-401	53	17	70	
RCH-402	50	32	82	
RCH-502	56	15	71	
RCH-105	30	25	55	Very Poor
RCH-202	39	20	59	
RCH-204	35	15	50	
RCH-802	45	9	54	
RCH-901	41	19	60	

Figure 3. Representative photos of reach conditions found in the Tuscarora Creek Direct Drainage subwatersheds. A) Stream crossings act as barriers to fish migration; B) Good stream conditions found in Reach 201; C) Eroding stream bank; and D) Inadequate buffer.

Field crews completed more than 100 individual site impact evaluations. Locations of these sites can be found in Maps 3 and 4 of Appendix A. Field sheets for each site are available in Appendix B. Restoration recommendations at these sites include infrastructure repair, discharge investigations, stream restoration, and trash clean up, and buffer reforestation. A summary of notable restoration opportunities are presented in the subsection below.

Recommendations

Recommendations directed towards the Tuscarora Upper and Lower DD stream corridor are presented below and are organized by broad and specific recommendations.

Broad:

- Establish and Enforce River and Stream Crossing Standards. Some of the stream crossings observed in TOL alter natural hydrology and potentially act as fish barriers (see Figure 4A). Where stream crossings cannot be avoided, culverts and bridges should be designed to avoid or mitigate environmental damage to the stream corridor, disturbance of the aquatic environment, downstream migration of sediment, damage to

bank stability, and damage to stream or river bank and riparian area vegetation. TOL, in coordination with Loudoun County, Virginia DCR, and the Army Corps of Engineers, should take the lead on this recommendation with regard to proposed design for new developments and maintenance projects and should continue to promote improvements that minimize impact to environmentally sensitive areas. Resources for additional guidance include:

- Massachusetts River and Stream Crossing Standards: Technical Guidelines; available at: http://www.streamcontinuity.org/pdf_files/MA_Crossing_Stds_3-1-06.pdf
- Etowah Habitat Conservation Plan: Stream Crossing and Culvert Design Policy; available at: http://www.etowahhcp.org/research/documents/road_crossings_tech_rpt_2006_08_18.pdf

- Implement a Residential Stewardship Program. This recommendation should be pursued by PEC and TOL. TOL should build upon recent outreach efforts related to National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) requirements. The purpose of this outreach program would be to minimize nonpoint source pollution in residential areas by increasing watershed awareness and active stewardship primarily among residents in the Tuscarora Upper and Lower DD subwatersheds. Since stream assessment field crews observed undesirable behaviors such as disposal of lawn clippings in the stream and poor stream buffer management (see Figure 4B and 4C), the education campaign should target appropriate stream buffer awareness, appropriate yard waste disposal/composting and native plantings. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Conduct Outreach to Westpark Golf Course. Inadequate buffers and water quality problems relating to excessive nutrients were observed in streams located at the Westpark Golf Course (see Figure 4D). Information about the benefits of buffers and environmentally-friendly golf course management techniques can be incorporated into outreach efforts to Westgate Golf Course in an effort to mitigate these impacts. Some examples of behaviors to promote include reducing fertilization, proper disposal/composting of grass clippings, adding low ground cover buffers along stream banks, and utilizing integrated pest management practices. PEC should take the lead on this task with assistance from TOL.

Figure 4. USA broad recommendation photos. A) Stream crossing altering natural hydrology; B) Lawn clipping dumping; C) Residential lot mowed to edge of stream; and D) Inadequate buffer at the Westgate Golf Course.

Specific:

PEC, TOL and other civic groups should work with specific landowners to pursue all of the restoration opportunities noted in Table 4. The top four recommendations from this table are described in more detail below.

Table 4. Summary of Notable Restoration Opportunities

Type	Site Description
Discharge Investigation	• Investigate Suspicious Discharges at Multiple Locations: o OT-202: strong odor of chlorine; should investigate swimming pool discharge o OT-706: dry weather discharge; conduct Illicit Discharge Detection and Elimination (IDDE) investigation o OT-707: dry weather discharge; conduct IDDE investigation • Ensure Repair of UT-901: leaking pipe reported at time of field investigation
Buffer Reforestation	• Create Community Amenity Along W&OD Trail at IB-101: discontinue active removal of vegetation and allow natural regeneration • Pursue Tree Planting Opportunity at IB-102: land under conservation easement • Establish Treed Stream Buffer at IB-202: work with private landowners • Establish Treed Stream Buffer at IB-401 and IB-901: work with golf course

Table 4. Summary of Notable Restoration Opportunities	
Stream Restoration	• Conduct Stream Restoration at ER-401: golf course; active erosion and good access to site • Conduct Streambank at ER-901: golf course is losing some ground due to active erosion; investigate ability to combine stabilization with upland retrofit • Implement Natural Channel Design at CM-104: armoring on right bank; could implement natural channel design; low priority though since benefit would probably not outweigh cost • Make Improvements to Existing In-Line Pond at CM-401: high priority project on golf course; replace failing in-line pond with a series of drop pools • Replace Stream Crossing at SC-602: current culvert impedes flow and promotes roadway flooding; replace with bottomless arch culvert • Replace Stream Crossing at SC-901: current culvert (for golf cart crossing) is corroding and is altering hydrology; replace with bottomless arch culvert • Replace Stream Crossing at SC-903: current culvert in poor condition and is altering hydrology; replace with bottomless arch culvert
Infrastructure repairs	• Perform Maintenance at OT-801: outfall is approximately 2/3 full of sediment; should be cleaned out and source of sediment investigated • Perform Maintenance at OT-802: outfall is approximately ½ full of sediment; should be cleaned out and sources of sediment investigated • Conduct Repairs for OT-902: concrete open channel could use reinforcement where it abruptly ends • Perform Maintenance at MI-901: concrete channel needs sediment cleanout • Conduct Repair for MI-902: foundation for concrete channel undermined by erosion; conduct repair

- Make Improvements to Existing In-Line Pond at CM-401. Westpark Golf Course should make improvements to this failing in-line pond. The in-line pond has resulted in severe erosion and alteration of the natural hydrology (see Figure 6A). Westpark Golf Course should consider implementing a series of drop pools in its place. The reconstruction of this in-line pond would be an additional benefit to the golf course and water quality of the stream.

- Create Community Amenity Along W&OD Trail at IB-101. PEC, Northern Virginia Regional Park Authority (NVRPA) and the Friends of the Washington and Old Dominion (W&OD) Trail should work in partnership with the TOL to make this portion of the Tuscarora Creek a community amenity. The W&OD trail runs parallel to the stream here, so this location presents a good opportunity to reconnect the surrounding community with Tuscarora Creek through recreation and signage. Currently these straightened stream sections are lined with rip-rap and are periodically defoliated using herbicide and mechanical means (See Figures 5, 6B). The recommended strategy includes:

    - Plant trees in the riparian corridor, where not constrained by underground or overhead utilities.
    - Use a native seed mix and infrequent mowing to create as much of a riparian buffer as possible if trees are not a viable option.
    - Cease vegetation removal and herbicide application in rip-rap areas.
    - Cease mowing to the top of bank in grassed areas.
    - Add educational signage.

Some steps to proceed with these strategies include:

- Designate a lead agency or group for the project.
- Review TOL and NVRPA master plans for synergy with this project.
- TOL to compare with plans submitted for upcoming adjacent development.
- Contact and work with property owners to gain permission and cooperation in planting and changed landscaping maintenance.
- Locate utilities and determine the associated tree-planting constraints.
- Seek grant funding and volunteers for implementation.
- TOL to internally determine an alternative strategy for streambank maintenance that does not involve herbicide. If flooding concerns remain, TOL should take the lead on modeling the stream channels and their contributing drainage area to determine water surface elevations downstream. The hydraulic analysis of the channel should compare existing conditions to natural vegetation in the channel and buffer while considering upstream volume control retrofits.

Figure 5. Defoliated stream with rip-rap (left). Stream with no buffer and eroding banks (right).

- Replace Stream Crossing at SC-602. Future improvements are planned for this area once the vehicular travel way is closed. TOL should replace the current stream crossing at Sycolin Road (see Figure 6C) with a bottomless arch culvert. The current crossing impedes flow and promotes roadway flooding.

- Investigate Suspicious Discharges at Multiple Locations (OT-202, OT-706, and OT-707). TOL should investigate suspicious discharges at outfall locations OT-202, OT-706, and OT-707 (See Figure 6D). Implementation of this recommendation may help TOL to comply with MS4 requirements.

Figure 6. USA specific recommendation photos. A) Malfunctioning in-line pond; B) Rip-rap application and excessive removal of vegetation; C) Stream crossing that impedes flow and promotes roadway flooding; and D) Suspicious discharge.

5. Unified Subwatershed and Site Reconnaissance

Subwatershed restoration has traditionally focused on the stream corridor, with less attention paid to upland areas where neighborhoods and businesses are located. These upland areas, however, are important in subwatershed restoration, since they contribute stormwater pollutants to the stream corridor. With this in mind, field crews conducted the Unified Subwatershed and Site Reconnaissance (USSR) - a field survey to evaluate potential pollution sources and restoration opportunities within upland portions of urban subwatersheds (Wright *et al.*, 2004). CWP, PEC and volunteers from Leesburg conducted the USSR in the Tuscarora Upper and Lower DD subwatersheds on August 7 and 8, 2006.

Assessment Protocol

The USSR is a “windshield survey” where field crews drive every road in the subwatershed to identify specific pollution sources and pollution prevention opportunities. The USSR can be a powerful tool in shaping the initial subwatershed restoration strategy, and in locating upland restoration projects that deserve further investigation. The concept behind the USSR is to provide watershed groups, municipal staff, and consultants a quick but thorough characterization of all upland areas to identify

major sources of pollutants and restoration opportunities for source controls, pervious area management, and improved municipal maintenance (i.e., education, retrofits, and referral for immediate enforcement). The Tuscarora Creek USSR focused on two assessment components:

- Neighborhood Source Assessment (NSA*)* - profiles stormwater pollution source areas, stewardship behaviors, and restoration opportunities within individual neighborhoods. Looks specifically at yards and lawns, rooftops, driveways and sidewalks, curbs, and common areas.
- Hotspot Site Investigation (HSI) - evaluates sites where the risk of stormwater contamination is higher than normal (i.e., gas stations, large parking lots, municipal maintenance yards, etc.) and provides recommendations for pollution prevention. Looks specifically at vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure.

Prior to going out in the field, potential NSA and HSI locations were identified in the office. Distinct neighborhood units were delineated using GIS data layers and digital orthophotos. The USSR field teams focused on identifying hotspots, municipal operations, and residential pollution-producing behaviors that contribute to nutrient loading, as well as areas with significant reforestation opportunities.

Neighborhood Source Assessment (NSA)

Neighborhoods were assessed in terms of age, lot size, tree cover, drainage, lawn size, general upkeep, and evidence of resident stewardship (i.e., storm drain stenciling, pet waste management signage, etc.). Each site was assigned a pollution severity of “severe,” “high,” “moderate,” or “low,” using a set of benchmarks set forth in Wright *et al.* (2004). Pollution severity is an index of how much nonpoint source pollution a neighborhood is likely generating based on easily observable features (lawn care practices, drainage patterns, oil stains, etc.). Each neighborhood was also assigned a restoration potential of “high,” “moderate,” or “low.” Restoration potential is a measure of how feasible onsite retrofits or behavior changes would be based on available space, number of opportunities, presence of a strong HOA, and other factors. Opportunities for the following types of restoration activities were evaluated for each site:

- On-site retrofits – such as rain gardens, rain barrels, or other rooftop disconnection practices.
- Better lawn and landscaping practices – including improved buffer protection, native plants, turf reduction, proper fertilization and pesticide application, and mowing practices.
- Dumping and trash—proper disposal of car maintenance fluids, trash and debris.
- Better open-space management – management of neighborhood common areas or courtyards (landscaping, pet waste, etc.).

Hotspot Site Investigation (HSI)

At hotspot sites, field crews evaluated the potential for stormwater pollution from source areas such as vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and existing stormwater infrastructure. Based on observations at the site, the field crew may recommend enforcement measures, follow-up inspections, illicit discharge investigations, retrofits, or pollution prevention planning and education.

The overall pollution potential for each hotspot site was determined based on observed sources of pollution and the potential of the site to generate pollutants that would likely enter the storm drain network. The hotspot designation criteria set forth in Wright *et al*. (2004) was used to assign a status to each site based on field crew observations. Sites were classified into four initial hotspot status categories:

- Not a hotspot – no observed pollutant; few to no potential sources.
- Potential hotspot – no observed pollution; some potential sources present.
- Confirmed hotspot – pollution observed; many potential sources.
- Severe hotspot – multiple polluting activities directly observed.

Summary of Sites Investigated

A summary of the neighborhoods and hotspots investigated and general findings for each are provided below. Field sheets for each site are available in Appendix C. Photo documentation for hotspots and neighborhood conditions can be found in Appendix F.

Neighborhoods

Twenty-one residential neighborhoods were assessed using the NSA. The assessment was used to evaluate prevalent residential behaviors that contribute to stormwater pollution (excessive lawn fertilization, vehicle maintenance, etc.), and to help target future educational campaigns to the most appropriate locations and behaviors of concern. The neighborhood sites are shown in Map 5 of Appendix A. None of the neighborhoods in the study area met the definition of a high pollution generator; one was considered to have little to no pollution severity, and the rest were classified as moderate pollution generators. All but one site were identified as having moderate restoration potential. The top priorities for all of the neighborhoods include tree planting, landscaping with native vegetation, and downspout disconnection.

Table 5 summarizes the pollution and restoration classifications assigned to each of the neighborhoods evaluated.

Table 5. Tuscarora Watershed Neighborhoods and USSR Classifications			
ID	**Location**	**Pollution Severity**	**Restoration Potential**
NSA-1	Woodlea Manor	Moderate	Moderate
NSA-2	Greenway Farms	Moderate	Moderate
NSA-3	Greenway Farms	Moderate	Moderate
NSA-4	Country Club	Moderate	Moderate
NSA-5	Linden Hill	Moderate	Moderate
NSA-6	Evergreen Meadow	Moderate	Moderate
NSA-7	Country Club Green /Tuscarora Arms	Low	Low
NSA-8	King's Chase	Moderate	Moderate
NSA-9	Prospect Hill	Moderate	Moderate
NSA-10	Rock Spring	Moderate	Moderate
NSA-11	Fox Ridge	Moderate	Moderate
NSA-12	Catoctin Chase	Moderate	Moderate
NSA-13	Normandy Village	Moderate	Moderate
NSA-14	Stratford	Moderate	Moderate
NSA-15	Stratford	Moderate	Moderate
NSA-16	Stratford	Moderate	Moderate
NSA-17	Tavistock Farms	Moderate	Moderate
NSA-18	Beauregard Estates	Moderate	Moderate
NSA-19	Kincaid Forest	Moderate	Moderate
NSA-20	Potomac Station	Moderate	Moderate
NSA-21	Sycamore Hills	Moderate	Moderate

General observations during the NSA include the following:

- The majority of neighborhoods had low to moderate lawn care intensity and minimal landscaping and forest canopy. A tree planting program is recommended throughout the subwatersheds. Trees could be planted in the right-of-way or lawns.
- Many of the neighborhoods have sufficient room for rain gardens, and would be ideal for targeting restoration projects. Areas upstream of highly eroded streams should receive increased attention for downspout disconnection (i.e., rain barrels, rain gardens).
- Buffer encroachment and yard waste dumping were common in residential areas along stream corridors.

Educational signage observed included pet waste pickup signs and storm marker decals. TOL should increase the number of pet waste pickup signs and storm marker decals around the neighborhood and replace storm marker decals that have been removed by vandals.

Stormwater Hotspots

Field crews assessed over 20 stormwater hotspot candidates, including ten auto-related sites (i.e., gas station, car repair), eight municipal sites (i.e., schools, fire department, maintenance yard), and six shopping centers. No sites were confirmed hotspots, but six were potential hotspots and two others had practices that represented a possible pollution source. Table 6 lists the potential hotspots identified and the source of pollution for each site. Map 5 in Appendix A shows the location of the hotspots assessed.

General observations during the HSI include the following:

- Auto-related facilities were represented the most as potential hotspots. Better pollution prevention practices, storage of materials, dumpster management and education were commonly recommended. Consider developing a business outreach program targeted towards specific issues of these small business owners.
- Several restaurant sites contained outdoor grease storage containers, often not located to prevent exposure to stormwater and in some cases not even covered with a lid (Figure 6).

Table 6. Tuscarora Watershed Hotspots and USSR Classification

SITE_ID	Name	Operation	Field Observations	Status
HSI-2	Don's Automotive	Auto Repair	Barrels stored outdoors uncovered; vehicles stored with no preventative SW measures	Potential
HSI-3	Bloom	Grocery	Materials stored outdoors uncovered	Potential
HSI-4	CS Monroe Technology Center	School	Materials stored outdoors uncovered; vehicles stored with no preventative SW measures	Potential
HSI-6	Catoctin Automotive	Auto Repair	Barrels stored outdoors uncovered; vehicles stored with no preventative SW measures	Potential
HSI-7	Auto Recyclers of Leesburg	Scrap Yard	Access Limited – Unable to completely assess	?*
HSI-10	Unnamed Storage Area	Unknown	Materials stored outdoors uncovered	Potential
HSI-11	Numerous Restaurants	Eating Establishments	Grease stored in barrels outdoors uncovered or in traps with open lids	Potential

*Additional information about the site's storm drainage system is needed to determine status

Recommendations

Recommendations to reduce upland pollution sources in the Tuscarora Upper and Lower DD subwatersheds are presented below and are organized by broad and specific recommendations.

Broad:

- Develop a Rain Barrel Program. Residential areas appear to contribute rooftop runoff to the storm drain system. TOL should explore opportunities to install rain barrels in residential neighborhoods and rain gardens in open spaces at schools and commercial sites to accept rooftop drainage. A rain barrel program should target older sections of TOL where flooding problems exist, and educate residents on the link between rooftop runoff and stream conditions, and quantity control of stormwater runoff.

- Educate Auto Care Shops. Several auto care businesses had potential pollution issues related to outdoor storage of tires and barrels that are exposed to stormwater runoff (Figure 7). An education effort regarding pollution prevention should be performed for these types of businesses. Appendix G has fact sheets related to vehicle maintenance facilities and operations. In addition, TOL should continue to explore the requirement of certain business types to submit a stormwater pollution prevention plan as part of compliance with their MS4 requirements. These business types are considered hotspots where routine operations and activities may generate higher levels of pollutants or present a higher risk for spills or illicit discharges. PEC can lobby/support the adoption of an ordinance that requires submittal of a pollution prevention plan to the Town engineer responsible for stormwater permit compliance.

- Coordinate Public Involvement Activities. TOL should continue to engage environmental clubs and community groups in public involvement activities such as storm drain stenciling, tree plantings, and low tech residential retrofits such as rain gardens/rain barrels. PEC has tried to coordinate efforts such as these in the past, and continues to be interested in working with Leesburg area schools to incorporate these ideas into the environmental curriculum. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Educate the Public on Stream Buffers. Stream buffer encroachment and invasive plant species appear to be significant problems throughout the two subwatersheds. An education campaign regarding the benefits of buffers and proper disposal of yard waste might be in order, and could be implemented by PEC. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Increase Watershed Related Signage. There is an opportunity for additional watershed-related signage such as buffer awareness signs and storm drain stenciling, as well as signage making residents aware of the function of the

stormwater ponds in their neighborhoods. PEC could take the lead on this recommendation. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Review Scheduling of Yard Waste Pickup. Municipal curbside leaf and yard waste pickup schedules should be examined by TOL to determine if an increase in frequency or additional homeowner education is required. This is a beneficial community service already provided; however, if municipal pickup lags or yard waste is incorrectly disposed of in the street, there is a window of opportunity for nutrients and sediment to enter into the storm drain system during storm events. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Increase Street Sweeping. TOL should examine street sweeping schedules and consider revisions to the current schedule to maximize water quality benefits. Appendix H includes information on current street sweeping practices in the Chesapeake Bay region and suggestions to improve the potential of street sweeping to provide pollutant removal benefits. Implementation of this recommendation may help TOL to comply with MS4 requirements.

Specific:

- Lawn Fertilization Education in Three Neighborhoods (NSA-17, NSA-18 and NSA-20). Three neighborhoods (Beauregard Estates, Potomac Station, and Tavistock Farms) appear to have some homeowners with high-input lawns (e.g., excessive fertilizer application), as evidenced by monoculture lawns and brighter green color. A targeted education campaign on fertilizer application needs might reduce fertilizer use. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Educate Restaurants on Storage Practices (HSI-11). An education campaign for restaurants on proper outdoor storage practices for grease and restaurant waste is needed. Figure 7 maps the location of specific sites where this education should be focused, based on the field investigation (Andy's, China King, Roma Pizza, Xuan Saigon, and Bella Luna). Appendix I has tips on the proper storage of restaurant materials such as grease. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Develop Pollution Prevention Plan for Technology Center (HIS-4). The CS Monroe Technology Center has several pollution prevention issues that were identified during field investigations (Figure 8). The biggest issue from a stormwater pollution standpoint is the lack of containment or protection for materials stored outdoors. Barrels and other materials are exposed to rainfall, and may be washed offsite during storm events. Simple measures could be employed to reduce the risk of possible pollutants leaving the site (Appendix I).

Figure 7. Select Restaurants with Grease Storage Issues

Figure 8. USSR Observations. A) Pollution prevention issues at the CS Monroe Technology Center; B) Example of improper grease storage; C) Outdoor storage practices at a vehicle service facility; and D) Outdoor storage of construction materials.

6. Sensitive Areas Inventory

A Sensitive Areas Inventory includes several field protocols that are designed to evaluate remaining natural areas in the watershed, such as forests, wetlands, and turf, in order to identify conservation and/or restoration opportunities. Three assessment protocols were selected for the Tuscarora subwatersheds and were implemented during the field reconnaissance on August 7-8, 2006. The assessment protocols used, sites evaluated, and resulting recommendations for sensitive areas are described below.

Assessment Protocol

The three assessment protocols selected to evaluate sensitive areas in the Tuscarora Subwatersheds were the Pervious Area Assessment (PAA), the Urban Reforestation Site Assessment (URSA), and the Contiguous Forest Assessment. Each protocol is summarized below.

Pervious Area Assessment (PAA)

The PAA evaluates the potential to reforest turf areas or restore natural area remnants at all open parcels within a subwatershed. The PAA evaluates factors that influence the feasibility of upland restoration projects, and is conducted on parcels that are identified during a preliminary desktop analysis. Most often, this includes selecting all publicly-owned pervious areas larger than two acres. The PAA is one of the four components of the USSR. In addition to recording general information about the site, Part I of the PAA is used to evaluate natural area remnants, such as forest parcels and wetland fragments, while Part II is designed to assess open pervious areas, such as turf, vacant land and meadows. Part III is used to sketch the parcel. Each part of the PAA asks a series of questions about vegetative characteristics and current impacts on the parcel. Additional information about the protocol can be found in Wright *et al*. (2004).

Urban Reforestation Site Assessment (URSA)

The URSA is a follow-up survey to the PAA that is completed for turf or other open pervious areas that have reforestation potential, and is used to collect detailed information about planting site conditions. The URSA provides a tool to help organize important data that determines where and what to plant, and what special methods are needed to prepare the site or reduce tree/infrastructure conflicts. Information collected with the URSA is used to develop detailed planting plans. The goal is to have all the available information about an individual planting area contained in a single form. Nine major elements are evaluated at each potential reforestation site to develop an effective planting strategy:

1. *General Site Information* – information about the location, property owner, and current land use at the site.
2. *Climate* – climate data, to help select tree and shrub species.
3. *Topography* – local topographic features that may present planting difficulty.

4. *Vegetation* – data on current vegetative cover, to determine if removal of vegetation is necessary and to select tree and shrub species.
5. *Soils* – soil characteristics, to determine if soil amendments are needed, and to select appropriate tree and shrub species.
6. *Hydrology* – site drainage, to determine if the site has capacity to provide water quality treatment of storm water runoff, and to select tree and shrub species most tolerant of the prevailing soil moisture regime.
7. *Potential Planting Conflicts* – available space for planting and other limiting factors, to define specific planting locations, select tree and shrub species, or identify special methods to improve the growing environment.
8. *Planting and Maintenance Logistics* – logistical factors that may influence tree survival and future maintenance needs.
9. *Site Sketch* – detailed sketch of the planting site.

The URSA can be customized based on the needs and interest of the field crew. Not all elements will apply to every planting scenario, and each section of the field sheet may be adapted for the site. Additional information about this protocol is provided in Cappiella *et al*. (2006a).

Contiguous Forest Assessment

The Contiguous Forest Assessment is a method for evaluating upland contiguous forest tracts to identify special habitats in the watershed, document conditions in the forest tracts, and help to prioritize these tracts for conservation. The assessment protocol includes identifying large contiguous tracts of forest (a minimum of 20 acres) using mapping prior to going out in the field. Representative points in each tract are also identified through the desktop analysis. Enough points should be chosen to provide a good representative characterization of the land under consideration for protection (e.g., at least two points for tracts less than 100 acres and at least four points for tracts up to 1,000 acres). The contiguous forest assessment evaluates:

- Ecoregion/ Forest Classification
- Number of mature trees and DBH using prism and Biltmore stick
- Dominant tree species present
- Specimen or rare species present
- Canopy coverage using a densiometer
- Wetland presence
- Understory characterization
- Habitat complexity
- Forbs
- Evidence and extent of disruption
- Invasive species
- Size of tract
- Surrounding watershed features

Summary of Sites Inventoried

CWP, PEC, and volunteers conducted the Sensitive Areas Inventory in the Tuscarora Upper and Lower DD subwatersheds. The PAA was used to evaluate sites for reforestation potential and the URSA was used to collect detailed information to develop planting plans. Potential reforestation sites were pre-identified from the mapping, and included large publicly-owned pervious areas, such as schools, parks, and community open space. The survey was limited to public lands because these areas have greater potential for reforestation.

In total, seven potential reforestation sites were evaluated (see Map 6 in Appendix A). Most of the sites evaluated were mowed turf (Figure 9) and it was unclear whether they had a specific use (such as recreation) that might conflict with reforestation. The soils testing portion of the URSA was not utilized since landowners had not yet been contacted about their willingness to reforest. Further investigation is needed before pursuing restoration at individual sites. A summary of the findings is provided in Table 7. Appendix D contains the completed PAA and URSA field forms, while Appendix F provides photo documentation of the Sensitive Areas Inventory sites.

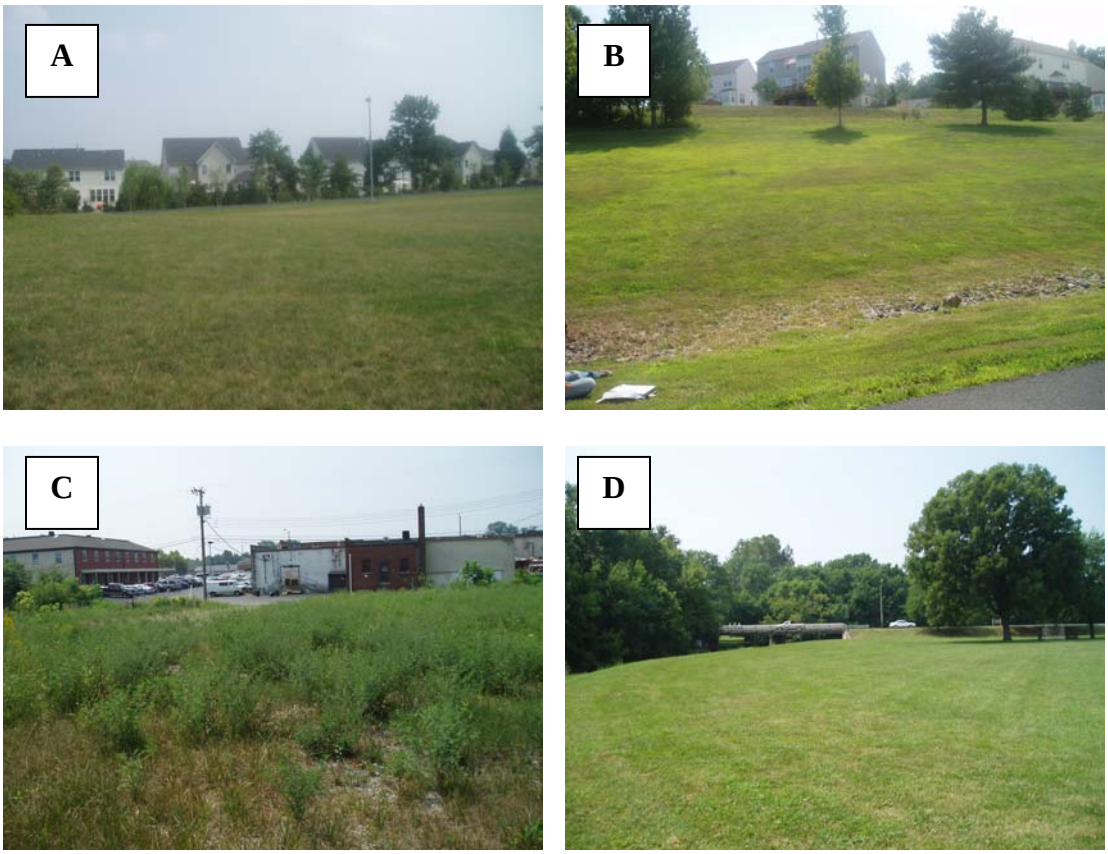

Figure 9. Representative photos of potential planting sites in TOL. A) Large turf area at Harper Park MS; B) Steep slope with mostly turf at Cool Spring ES; C) Potential natural regeneration site behind Madison Court; and D) Open turf area at Brandon Park with no streamside buffer.

Table 7. Potential Planting Sites Evaluated in Goose Creek using the PAA and URSA		
Site ID	**Site Name**	**Ownership**
URSA 1	Fox Ridge Park	Public – TOL
URSA 2	Fox Ridge Neighborhood	Public - TOL
URSA 3	Brandon Park	Public - TOL, possibility to expand onto Virginia Knolls Community Association land
URSA 4	Madison Court vacant lot	Private - Eloise Ours
URSA 5	John Tolbert ES	Public - Loudoun County School Board
URSA 6	Harper Park MS	Public - Loudoun County School Board
URSA 7	Cool Spring ES	Public - Loudoun County School Board, possibility to expand to Tavistock Farms Community Association land

The Contiguous Forest Assessment was used to evaluate forested sites for conservation potential. Mapping was used to initially identify potential sites using 20 acres as the minimum threshold for contiguity. Four contiguous forest sites were initially identified; however, three of these sites were determined to be primarily cedar forests with numerous gaps that did not qualify as either contiguous or high quality forest. Therefore, only one contiguous forest parcel was investigated within the TOL (Olde Izaac Walton Park). Additional contiguous forest parcels were identified outside the Town boundaries; one of these sites was evaluated in the field (Hunter-Dowdy Tract). Map 7 of Appendix A shows the locations of the two contiguous forest sites evaluated in the Leesburg area, while Appendix D contains the completed field forms. Figures 10 and 11 provide representative photos of each site. Table 8 provides a summary of conditions at each site.

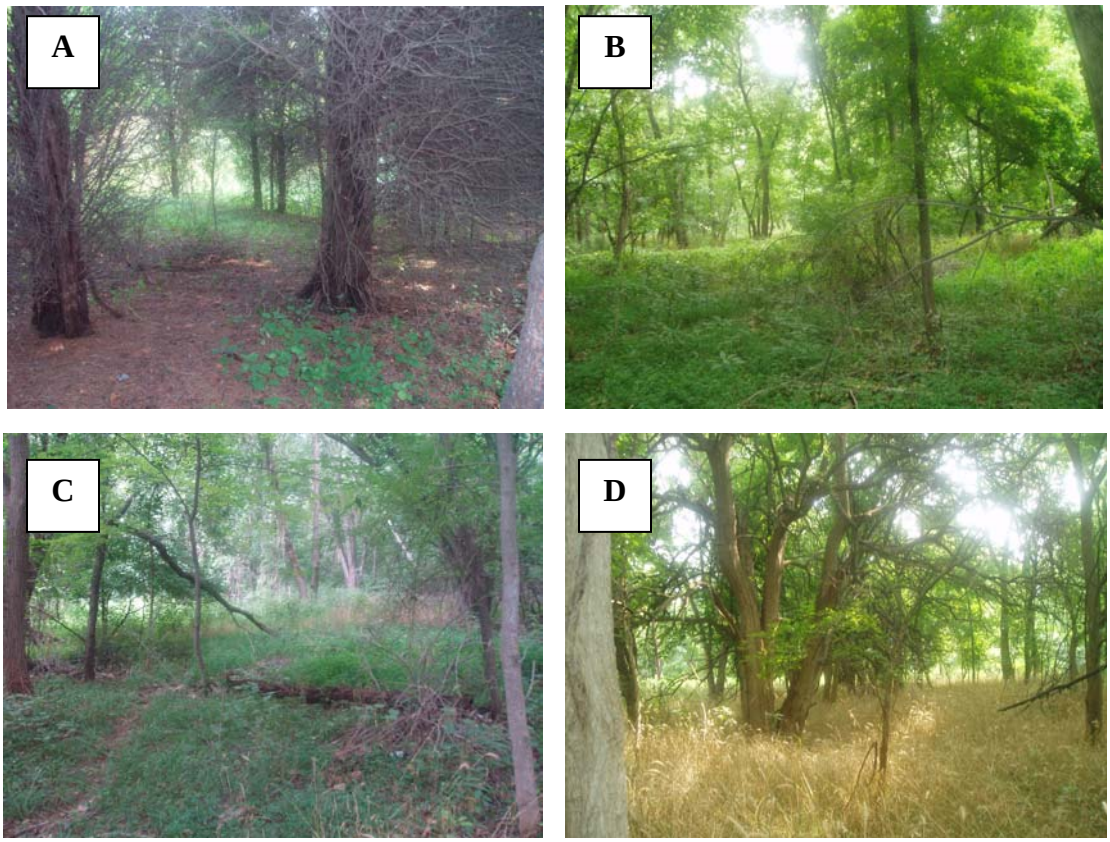

Figure 10. Representative photos of Olde Izaac Walton Park tract. A) Early successional species such as cedar are present; B) Carpet of invasive Japanese stiltgrass, C) More invasive species and frequent canopy gaps; D) Remnant grove of mature Osage orange trees.

Figure 11. Representative photos of Hunter Dowdy tract. A) Typical oak hardwood forest; B) Steep slopes in some portions of forest; C) Few invasive species and lots of leaf litter; and D) Occasional canopy gaps and minimal disturbance near gravel road.

Table 8. Potential Forest Conservation Sites in Tuscarora Upper and Lower DD Subwatersheds Evaluated Using the Contiguous Forest Assessment

Site Name	Acres	Site Description	Ownership	Description of Condition
Olde Izaak Walton Park	47	Includes Olde Izaak-Walton Park and forested area east and north of the park	Private - small portion is part of Olde Izaak Walton Park (leased to TOL by Failmezger investments). Remainder has multiple owners.	Mix of upland and floodplain forest, 1 to 2 vertical layers of habitat present, 11 to 19% canopy coverage, lots of early successional species such as cedar, extensive coverage by multiple invasive species, significant disturbance from trails or other canopy gaps, lots of trash (appears to be used as local beer drinking hangout). One nice section has a grove of mature Osage Orange trees and minimal invasives.
Hunter Dowdy Tract	155	Forest area east of Kincaid Forest neighborhood and south of WWTP (outside Town limits)	Private - majority of site is owned by Hunter-Dowdy. A small portion is located on the WWTP property.	Oak-hickory dominated upland forest; some areas have fairly steep slopes. Site appears to have been old pasture and upper portion of site is a mix of meadow and cedar. Minimal invasives and disturbance in forest. Two to three vertical layers of habitat present, 18 to 21% canopy coverage. Property is outside of Town boundary but included in Town's future growth area as community office.

Recommendations

Recommendations for managing sensitive areas in the Tuscarora Upper and Lower DD subwatersheds are presented below and are organized by broad and specific recommendations.

Broad:

- Work Towards Implementation of the Urban Forestry Management Plan. TOL's 2006 Urban Forestry Management Plan states that in 2001, TOL had eight percent tree canopy cover. In November 2006, TOL became an official partner in reaching the Chesapeake Bay Program's urban tree canopy goals by setting a preliminary goal of 40% canopy cover within 25 years. TOL plans to conduct a more detailed and accurate tree canopy assessment and identify potential planting areas. An overall approach for meeting the canopy goal is outlined in TOL's recently adopted Urban Forestry Management Plan. Specific recommendations include creating and implementing a Master Tree Planting Plan, revising and/or creating new regulations to conserve trees during development, creating incentives for planting trees on private land, and developing a longer-term funding source for implementing the Urban Forestry Management Plan. TOL should work towards implementation of this plan.

- Identify Additional Opportunities for Forest Conservation and Reforestation in the Tuscarora Subwatersheds. TOL, working with PEC, should identify additional opportunities for forest conservation and reforestation to connect/expand existing forest fragments within the Tuscarora subwatersheds. There are currently few contiguous forest (a minimum of 20 acres of unbroken forest) tracts in TOL. PEC should evaluate planting potential at the schools and parks that were not assessed during the 2006 field work. Additional opportunities and options include:

    - TOL's Urban Forestry Management Plan indicates that 102 public right-of-way (ROW) planting sites have been identified. These could be pursued for tree planting.
    - Fill in gaps and enhance the quality of some of the remaining forest areas, such as Olde Izaak Walton Park and surrounding forest tracts, as well as the forest tracts south of Route 7 by Shenandoah College, the TOL waste water treatment plant (WWTP) and vicinity. These are large forest tracts with a lot of canopy gaps and appear to consist mostly of cedar trees. Enhancement could result in a more contiguous and diverse habitat area. The ownership and future status of these tracts should be investigated.
    - The National Children's Rehab Center is a large, privately owned site that has potential for both conservation and reforestation (about half of this site is located in the watershed). The site appears to be a mix of forest and open space, with little impervious cover. PEC should work with this landowner to perhaps reforest and/or conserve a portion of the site.

- Develop Incentive Programs for Tree Planting on Private Property. TOL, working with local environmental groups, such as the Potomac Conservancy and PEC, should develop an incentive program for tree planting on private property. Private lands, particularly residential lawns, often include the majority of turf cover in a watershed. Encouraging replanting in these areas may have a significant impact on overall tree cover. Tree planting incentive programs can include providing native trees to residents at a reduced cost or no cost, distributing coupons to residents to put toward purchase of trees at local nurseries, and educating residents about the benefits of trees and proper tree planting and care techniques. Baltimore County's Growing Home campaign is a good example of an incentive program. Information is available at: www.baltimorecountymd.gov/Agencies/environment/growinghome/index.html. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Explore the Potential for Establishing a Greenbelt that Connects Existing Sensitive Area Fragments in the Town. TOL should explore the potential for establishing a greenbelt that connects existing forest fragments, wetlands, and parks in TOL, as well as the W&OD trail. Since TOL is under development pressure, identifying specific forest tracts that could become part of a greenbelt is important to do now before more development occurs. TOL should work with Loudoun County and PEC to identify and acquire potential sites.

- Develop an Education Campaign Targeted to Schools in Leesburg that Focuses on Increasing Tree Cover. TOL should develop an education campaign targeted to schools in Leesburg. Most of the schools evaluated by CWP had few trees or forest cover. The campaign could target school designers and developers about the benefits of trees and how to make some simple design changes to conserve trees at new school sites. Existing schools could be targeted as priorities for tree planting and serve an educational purpose as demonstration sites. Since safety is always a concern when planting trees at schools and urban parks, the concept of Crime Prevention Through Environmental Design (CPTED) may be appropriate to use in this targeted campaign. The program should also address proper planting methods and long-term maintenance of trees, as high tree mortality has been identified as an issue for TOL. Implementation of this recommendation may help TOL to comply with MS4 requirements.

- Develop a Program to Manage Invasive Plants on Existing Public Lands in the TOL. TOL, working with PEC and volunteers, should develop a program to manage invasive plants on existing public lands in the TOL. This includes parks, schools and other TOL property. Extensive coverage by invasive plant species was noted at many sites visited in the watershed, yet the 2006 Urban Forestry Management Plan does not include any recommendations about managing invasive plants. The resulting program may also include managing invasives in forest conservation tracts, and educating the public about managing invasive plants.

- Implement Changes to Local Development Codes and Ordinances Recommended in the TOL's Urban Forestry Management Plan. TOL should implement the recommended changes to its local development codes and ordinances outlined in the Urban Forestry Management Plan. The recommendations are intended to remove barriers to conserving and planting trees during development, and promote forest conservation. TOL may wish to consider some additional changes, such as: making sure tree lists do not include invasive species, requiring adequate space/soil in tree planting areas such as rights-of-way, and encouraging the use of trees for stormwater treatment.

Specific:

PEC and TOL should pursue the reforestation opportunities listed in Table 9, beginning with the high priority sites. Ranking was based on site size, feasibility, and location in watershed, potential for stormwater treatment, land ownership, and project effort. PEC should contact landowners of potential planting sites to determine feasibility of reforestation opportunities. For planting in parks this may require looking at any existing master plans for the park. At feasible sites, soil testing should be done to determine the extent of soils amendment needed, and select appropriate tree species. Planting plans for each site should be developed in coordination with TOL's Urban Forester and a landscape architect, and volunteers may be used to reforest the sites. Since safety is

always a concern when planting trees at schools and urban parks, the concept of CPTED should be considered when developing the planting plan. Planting projects should also clearly identify who will responsible for maintenance, include a long-term maintenance plan, and ensure that parties responsible for planting and maintenance are trained in the proper methods. Map 8 of Appendix A shows the location and ranking of each specific reforestation site.

Table 9. Reforestation Site Recommendations

Site Name	Size of Recommended Planting Area (acres)	Recommendation	Other Considerations	Priority
Cool Spring ES (URSA 7)	1.4	Reforest	Steep slope, connects to adjacent neighborhood trail system, definitely not used for ball fields	High
Fox Ridge Neighborhood (URSA 2)	1.4	Reforest	Some active erosion occurring; focus of recommendation is on upland areas however could be done in conjunction with stormwater retrofit (R-1)	High
Madison Court vacant lot (URSA 4)	0.7	Allow natural regeneration	Natural regeneration project, so other than removing some gravel requires little effort	Medium
Brandon Park (URSA 3)	1.2	Reforest	Active streambank erosion is occurring here and upstream volume reduction may be necessary before repairing/replanting stream bank. Unsure how much of the area can be planted based on recreational use	Medium
John Tolbert ES (URSA 5)	1.2	Reforest	School has indicated interest in planting, unsure if site has existing purpose such as play area	Medium
Fox Ridge Park (URSA 1)	0.1	Reforest	Primarily aesthetic benefit (screening of Votech center)	Low
Harper Park MS (URSA 6)	1.3	Reforest	Unsure if site has existing purpose such as play area	Low

- Pursue Acquisition or other Conservation Measure for the Hunter-Dowdy Tract. This 155-acre site is an excellent candidate for conservation because of its size and high quality. It has few invasive species, and only the upper portion (near the old farm property) appears to be disturbed (a gravel road runs through it). While the property is outside Town boundary, it is included in the Town's future growth area as community office. The extension of River Creek Parkway will run through the lower portion of this site, which may cause further disturbance and entice more development, adding to the development pressure. The parcel is located in proximity to a proposed park area (Phillip Bolen) as well as the W&OD trail, and has potential to connect to a future greenway. PEC should coordinate with the landowner and TOL to investigate the acquisition or conservation potential of this site.

- Restore and Enhance the Forest at Olde Izaak Walton Park. The forest at Olde Izaak Walton Park currently is not in very good condition, with common problems being frequent canopy gaps, trash and invasive species. Olde Izaak Walton Park is the only public park in TOL that contains forested land. While the habitat conditions in the park may not be feasible to fully restore, focusing efforts on invasive species removal, trail maintenance, trash cleanup, and reforestation may make the park more of a public amenity. PEC or other civic groups should utilize volunteers to implement some of these efforts and perhaps even form a Friends of Olde Izaak Walton Park group. Additional restoration of the pond located at the park is recommended in the Section 7 of this report.

7. Stormwater Retrofit Inventory

CWP, PEC, and other project partners conducted a stormwater retrofit inventory in the Tuscarora Upper and Lower Direct Drainage subwatersheds during the week of August 7-9, 2006. The assessment was used to identify restoration and maintenance opportunities at existing and potential structural stormwater management sites.

Stormwater retrofits are structural stormwater management practices that can be used to address existing stormwater management problems within a watershed. They can help improve water quality, increase groundwater recharge, provide channel protection, and control overbank flooding. Stormwater retrofits help to establish a stable, predictable hydrologic regime by regulating the volume, duration, frequency, and rate of stormwater runoff. Without their use, the success of many other watershed restoration strategies, such as bank stabilization, riparian reforestation, and aquatic habitat enhancement, cannot be guaranteed. In addition to their stormwater management benefits, stormwater retrofits can be used as demonstration projects, forming visual centerpieces used to educate residents and build additional interest in watershed restoration.

The three general categories of stormwater retrofits include offsite storage, onsite nonresidential, and onsite residential. Offsite storage retrofits, such as ponds and wetlands, generally provide the widest range of watershed restoration benefits because of their ability to treat relatively large drainage areas. However, onsite retrofit practices, such as bioretention and filtration practices, can provide a substantial benefit when applied to a large number of sites within a subwatershed.

Assessment Protocol

Potential stormwater retrofit opportunities at a number of candidate project sites in the Tuscarora subwatersheds were assessed during the retrofit inventory. More than 60 candidate project sites were identified prior to the inventory using aerial photography, GIS data, and project partner input. Candidate project sites were typically located upstream of impacted stream reaches, at stormwater hotspots, at existing stormwater management facilities, and at relatively large tracts of publicly-owned open space (e.g. school sites, parks).

Field crews visited each of the pre-identified candidate project sites (as well as a few additional sites) during the field investigation. Using the Retrofit Reconnaissance Inventory field form, the stormwater retrofit potential of each candidate site was evaluated by analyzing drainage patterns, drainage areas, impervious cover, available space, and other site constraints (e.g. conflicts with existing utilities and land uses, site access, and potential impacts to natural areas). Unless there were obvious site constraints and/or evidence that a particular stormwater retrofit would offer few or no watershed benefits, a stormwater retrofit concept was developed for each candidate project site.

Stormwater retrofit concepts were based on the size of the candidate project site, particular constraints and characteristics of the candidate site, size of the drainage area to be treated, land use and amount of impervious cover within the drainage area, and overall watershed restoration goals being pursued. For this stormwater retrofit inventory, the primary objective was to identify opportunities to provide water quality treatment. The secondary objective was to identify opportunities to provide channel protection. Stormwater retrofits are designed to match existing water quality and flood control capabilities.

Summary of Sites Assessed

Field forms were completed for 47 potential stormwater retrofit sites in the Tuscarora Upper and Lower DD subwatersheds. Table 10 summarizes the existing condition of the evaluated sites, denoting the sites with existing stormwater management dry ponds. Photo documentation for conditions at each site can be found in Appendix F. Locations of these sites can be found in Map 9 of Appendix A, and completed field sheets are available in Appendix E.

Table 10. Retrofit Site Existing Conditions

Site ID	Name	Existing Condition
R-1	Foxridge Park	Dry Pond
R-2	Farmer’s Way Pond	Wet Pond
R-3	Farm Pond	Wet Pond
R-4	Townhomes along W&OD	Yard inlet
R-5	Leesburg Baptist Church	Open Space
R-6	Stonegate	Dry Pond
R-7	Vacant Lot near Hwy	Meadow
R-8	Olde Izaak Walton Pond	Wet Pond
R-9	Stratford Dry Pond	Large Dry Pond
R-10	Near Freedom Park	Open Space
R-11	Freedom Park (TOL)	Dry Pond
R-12	Park behind Subaru Dealer (TOL)	Concrete channel
R-13	Raflo Park (TOL)	Park
R-14	C.S. Monroe Technology Ctr (County School)	Yard inlet
R-15	Stratford Wet Pond	Wet Pond
R-16	Evergreen Meadows Dry Pond	Dry Pond
R-17	Behind Latter Day Saints	Open Space
R-18	Neighborhood near Tolbert School	Dry Pond
R-19	Tolbert Elementary (County School)	Dry Pond
R-20	Swale behind storage units	Wetland

Table 10. Retrofit Site Existing Conditions		
Site ID	**Name**	**Existing Condition**
R-21	Near Shenandoah U	Dry Pond
R-22	Behind Salvation Army and Surplus Store	Open Space
R-23	Leesburg Corner Outlet Mall	Dry Pond
R-24	Smart's Mill Middle School* (County School)	Dry Pond
R-25	Exeter Dry Pond on Dry Hollow Rd*	Dry Pond
R-26	Hospital	Grass Channel
R-27	Dry pond on Catholic Church property	Dry Pond
R-28	South Haven Apartments	Piped
R-29	Tuscarora Arms Condos	Turf
R-30	Greenway Farms old section	Rip rap channel
R-31	Douglas Rec Center Downstream Wetland	Wetland
R-32	Douglas Rec Center Concrete Channel	Concrete channel
R-33	Vacant Lot beside Fire Station	Grass Channel
R-34	Fire Station	Grass Channel
R-35	Ditch Behind Shopping Center	Rip rap channel
R-36	Petsmart	Parking Lot
R-37	Apartment Dry Pond	Dry Pond
R-38	Outfall at new townhomes	Wetland
R-39	VDOT and adjacent ditch	Stream channel
R-40	Commons at Bellemeade Dry Pond	Dry Pond
R-41	Public Parking behind Catholic Church	Swale
R-42	Soccer field near Hospital	Swale
R-43	Best Buy Dry Pond	Dry Pond
R-44	Rite Aid Shopping Center	Parking Lot
R-45	Catoctin Elementary (County School)	School with no SWM
R-46	Cul-de-sac near Madison Senior Housing	Cul-de-sac
R-47	Gravel Parking for Market	Parking Lot
*In TOL but outside of Tuscarora Creek watershed.		

Potential restoration recommendations at these sites include protecting natural areas that provide stormwater treatment function, changing maintenance plans, and constructing new facilities. A summary of notable restoration opportunities are presented in the following section.

Recommendations

These recommendations encompass programmatic and site-specific recommendations. Several recommendations fit into the scope of the NPDES MS4 Phase II permit programs. Once offset fees are collected, TOL should utilize these watershed fund dollars established in the new stormwater ordinance to implement site specific recommendations. Retrofit recommendations in the Tuscarora Upper and Lower DD subwatersheds are presented below and are organized by broad and specific recommendations.

Broad:

- Add Landscaping Criteria to Stormwater Design Standards. Locally, dry ponds are to be built without any landscaping in the basin. Research shows that vegetation increases the water quality benefits without affecting the flood control properties. Additionally, trees planted on the excavated upstream slopes and the bottom of dry ponds increase forest cover and provide shade that mitigates the temperature effects of ponds. Trees should not be planted within 25 feet of the downstream embankment. The embankment and its side slopes should continue to be mowed a few times a year to prevent woody vegetation growth in these areas. TOL should add minimum landscaping requirements to their to their stormwater design standards. The landscaping requirements should promote the appropriate use of trees. Resources on pond maintenance that include vegetation and trees include:

    - Planting and Preserving Trees in and around Stormwater Management Ponds (Fairfax County, 1999)
    - Maintaining Your BMP: A Guidebook for Private Owners and Operators in Northern Virginia (NVPDC)
    - DRAFT Pond and Wetland Maintenance Guidebook (CWP, 2004)
    - Urban Watershed Forestry Manual. Part 2: Conserving and Planting Trees at Development Sites (Cappiella, *et al*., 2006b)

- Forest Existing Dry Ponds. Small changes to existing dry ponds, such as adding plantings, altering the mowing plan, lengthening the flow path, and altering the riser can add water quality benefits to these flood control structures. The maintenance plan and schedule for each dry pond should be reviewed and discussed with the owner. For ponds that are currently vegetated with turf grass only, mowing should cease except on the embankment and maintenance vehicle access areas. For ponds that are currently unmowed, this management strategy should be continued. However, the embankment and its side slopes should be mowed a few times a year to prevent woody vegetation growth in these areas. Natural regeneration of wetland plants should be allowed where hydrology permits, and trees suitable to the hydrologic regime should be planted in the excavated upstream slopes and pond bottoms. Trees should not be planted within 25 feet of the downstream embankment. PEC should work with homeowners associations, neighborhood groups, and TOL to reforest and stop mowing existing dry ponds. Resources for dry pond management and planting include those listed in the previous recommendation.

- Maintain Existing Condition of Areas that Improve Water Quality. Small isolated wetlands (particularly those upstream of roadway and W&OD trail embankments) and grass channels were identified as providing some stormwater management function in the study area by temporarily storing floodwaters and removing pollutants (Figure 12). While the use of natural wetlands for stormwater treatment is strongly discouraged as a practice, protection of all existing wetlands, regardless of size, is critical because of these important functions they provide. Recent court

rulings have reduced the scope of wetlands protected under the Clean Water Act (e.g., wetlands associated with ephemeral or intermittent streams). Therefore, TOL should ensure that all wetlands are adequately protected by ramping up their existing buffer, floodplain, and/or wetland regulations and/or acquiring key wetland parcels. In addition, existing grass channels should be preserved in their current state rather than being replaced by storm drains to ensure that their stormwater quality and quantity functions are not lost.

Figure 12. Grass channels are preferred to storm drains for their quality and quantity benefits (left); Small wetlands such as this one formed by the W&OD embankment improve water quality and should be preserved (right).

- Encourage Better Site Design through Credits in the Stormwater Requirements. TOL's current requirements do not encourage the use of Better Site Design techniques to reduce the volume of stormwater runoff from development sites. If these techniques are employed, the need for large dry ponds to manage stormwater runoff will be reduced. Some resources for incorporating Better Site Design credits include:

    - State of Minnesota Stormwater Manual, Chapter 11. www.pca.state.mn.us/water/stormwater/stormwater-manual.html
    - Stafford County, VA and James City County, VA stormwater regulations

- Create a Field-verified GIS layer of Existing Stormwater Facilities. To assist in tracking the maintenance of existing stormwater practices, a GIS database should be created and linked to design information and photographs of the site.

Specific:

PEC, TOL or other civic groups should work with specific landowners to pursue all of the restoration opportunities noted in Table 11. The top priority recommendations from this table are described in more detail below. TOL should continue to look at upstream stormwater retrofits as well as localized solutions to improve water quality and prevent downstream flooding.

Table 11. Summary of Retrofit Opportunities	
Type	**Site Description**
Forest Existing Dry Ponds	Eight sites to plant trees, stop mowing, and change the maintenance plan. • Plant trees and modify riser for Foxridge Park pond (R-1) • Stop mowing and modify riser for Stonegate pond (R-6) • Plant trees in Evergreen Meadows dry pond (R-16) • Add plantings and remove concrete channel at Smart's Mill MS (R-24) • Plant trees and stop mowing at neighborhood pond west of Tolbert ES (R-18) • Add wetland plants at neighborhood pond near Catholic Church (R-27) • Add wetland plants and trees, and stabilize eroding slopes at the Best Buy pond (R-43) • Plant trees and stop mowing at Stratford Dry Pond (R-9) Five sites to maintain in current condition and change the maintenance plan to reflect this. • Clear embankment but preserve interior plants at Commons at Bellemeade (R-40) • Keep embankment clear and preserve interior plants at Freedom Park pond (R-11) • Keep embankment clear and preserve interior plants at Tolbert ES (R-19) • Keep embankment clear, preserve interior plants, and remove concrete channel at pond near Shenandoah College (R-21) • Add pretreatment trash collectors at pond inlets, keep embankment clear, and preserve interior plants at outlet mall (R-23)
Maintain Existing Condition of Areas that Improve Water Quality	• Keep drainage at Hospital in dry swale (R-26) • Keep wetland plants in swale behind industrial park/storage units (R-20) • Keep wetland downstream of Douglas Rec Center and upstream of W&OD trail (R-31) • Keep the existing farm pond and fix outlet structure (R-3) • Keep natural channel downstream of VDOT (R-39) • Add plunge pool to new outfall and protect downstream wetland created by W&OD embankment (R-38)
New Stormwater Facilities	*High Priority* • Add forebay to Stratford Wet Pond (R-15) • Convert wet area in Raflo Park to rain garden (R-13) • Construct infiltrating dry swale around soccer field near hospital (R-42) • Construct demonstration rain garden at the C.S. Monroe Technology Center (R-14) *Medium Priority* • Remove concrete channel at Douglas Rec Center and use step pool/wet swale (R-32) • Construct stormwater pond in current meadow adjacent to highway/stream (R-7) • Use non-infiltrating bio-filtration as stormwater practice in future upgrade to downtown gravel parking lot (R-47) • Review SWPPP for the VDOT facility and recommend on-lot water quality treatment. (R-39) *Low Priority* • Purchase Olde Izaak Walton Pond, breach dam, and manage as stormwater wetland (R-8) • Construct small projects at Catoctin ES (R-45) • Construct rain garden at Westpark Golf Course (R-29) • Construct demonstration rain garden at Leesburg Baptist Church (R-5)

- Add Forebay to Stratford Wet Pond (R-15). This large wet pond (Figure 13) was constructed without a forebay. Construction is ongoing at a new development immediately upstream of the pond. A forebay with easy maintenance access should be added to extend the life of this pond, which would be difficult to dredge.

- Plant Trees at Stratford Dry Pond (R-9). This large dry pond (Figure 13) is located immediately downstream of R-15. The pond is currently mowed with the exception of a five foot wetland fringe alongside the perennial stream. The extensive upland areas are well suited for tree planting. However, the embankment and an area 50 feet upstream and downstream of the embankment should be maintained in a mowed condition.

Figure 13. Stratford wet pond (left) and dry pond (right).

- Convert Wet Area in Raflo Park to Rain Garden (R-13). Raflo Park is situated in a highly visible area of downstream TOL. As shown in Figure 14, a small tributary discharges across a flat mowed area in the small park. Soil amendments, rain garden vegetation, and education signs should be added to create a demonstration rain garden.

Figure 14. Raflo Park rain garden site looking upstream (left) and downstream (right)

- Construct Infiltrating Dry Swale around Soccer Field near Hospital (R-42). The grass swale shown in Figure 15 conveys water from the hospital vicinity, past the soccer fields to a residential area, where flooding concerns have been reported. The soils in the swale should be amended with sand to promote infiltration. In addition, small check dams should be installed. Successful infiltration may depend on limiting the parking area to prevent vehicle traffic on the swale.

Figure 15. Swale at site R-42 looking south/downstream (left), and upstream at concrete channel and outfall (right)

- Purchase Olde Izaak Walton Pond, Breach Dam, and Manage as Stormwater Wetland (R-8). Situated adjacent to the mainstem and conveying a sizable tributary, this existing pond at Olde Izaak Walton Park currently serves a recreational/aesthetic purpose. However, as upstream development has increased, algal blooms have become a frequent occurrence that leads to citizen complaints. As seen in Figure 16, the condition of the embankment and spillway is of concern. The flood mitigation and water quality benefits of the pond should be maintained, while eliminating the algal blooms and structural concerns. A controlled breach of the dam to lower the permanent water surface elevation while maintaining a depressional wetland area will achieve these objectives. While this project ranks high from an ecologic and physical feasibility standpoint, a lack of interest from the property owners has reduced the priority for action on this retrofit.

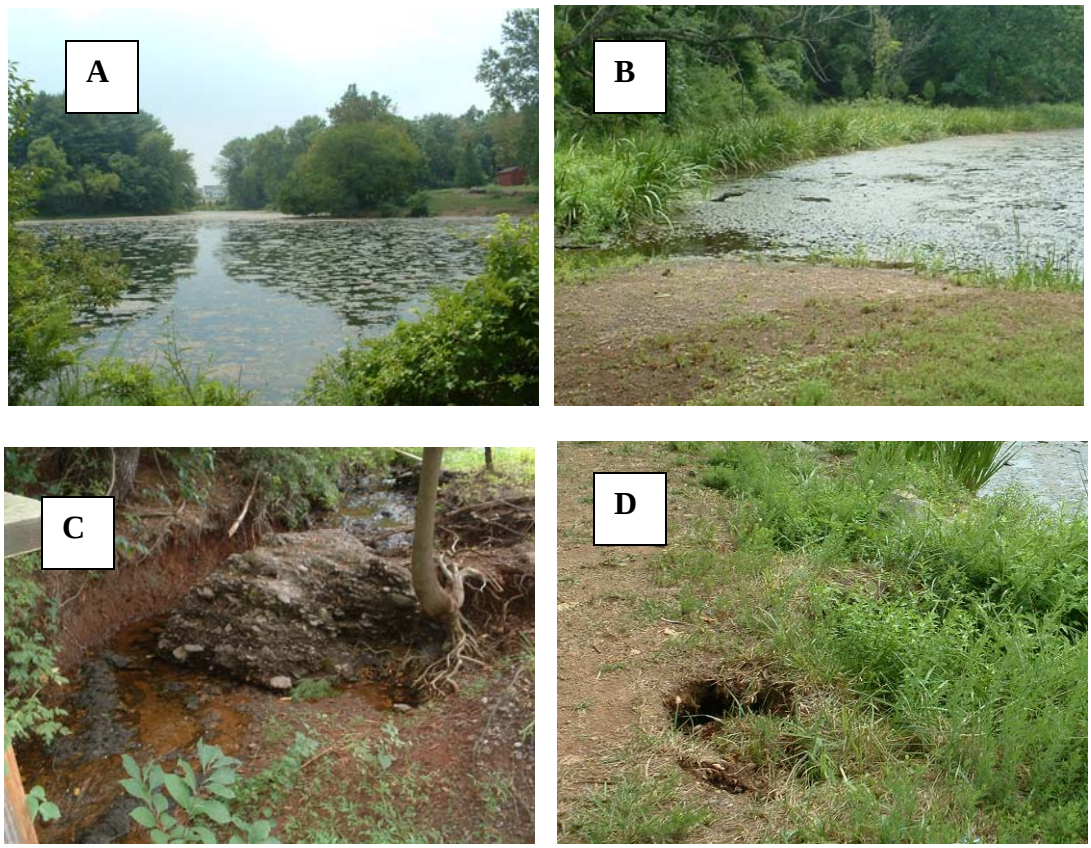

Figure 16. Olde Izaak Walton pond. A) View of pond from embankment; B) Wetland plants established on fringes; C) Erosion and disrepair at outlet; and D) Hole forming in the embankment.

- <u>Plant Trees and Stop Mowing, and Modify Riser at Evergreen Meadows Pond (R-16).</u> This enormous on-line, "dry" detention pond contains a perennial stream and a variety of wetland plants (Figure 17). At least 14 wetland species are present, seven of which are native to the region. Small pools of varying depth and microtopography exist – two desirable elements in a constructed wetland. The presence of sod and the overall design suggest a different design was planned. Left alone, the area will return to a functioning wetland as all of the factors – vegetation, soil, and hydrology- are in place. For the reason of dam safety, the embankment should be mowed and woody vegetation should be discouraged within 25 feet of the embankment. It is acceptable to plant trees on the upstream slopes, adjacent to the homes.

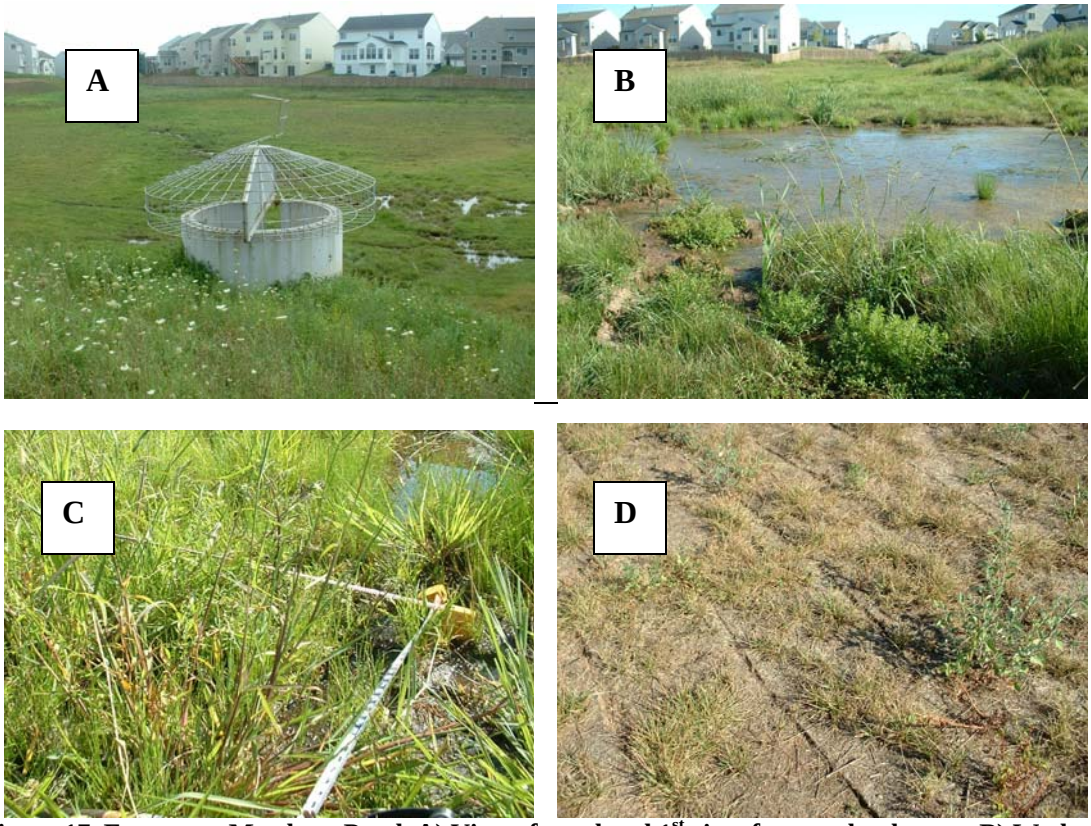

Figure 17. Evergreen Meadows Pond. A) View of pond and 1st riser from embankment; B) Wetland plants and micro-pool near 2nd riser; C) Close-up of variety of wetland plants; and D) Sod strips.

- <u>Add Wetland Plants and Trees and Stabilize Eroding Slopes at Best Buy Pond (R-43).</u> Construction of this large dry pond (Figure 18) was underway at the time of fieldwork. The area was compacted and seeded, though even turf has had a tough time establishing at the higher elevation soils devoid of organic content and moisture. Compost amendments should be added to the soil and slopes should be stabilized. Trees should be planted on the upstream slopes (not the embankment) and wetland seed mix introduced. The interior of the pond should receive minimal routine maintenance and be allowed to establish as a wetland.

Figure 18. Best Buy pond; note person for scale. Looking towards embankment/highway (left) and interior of pond, looking towards building (right).

8. Summary of Recommendations

Table 12 provided below is intended to summarize the recommendations made in this report, and provide PEC and TOL with additional guidance on how to proceed with implementation of the recommendations. High priority recommendations are based on best professional judgment, and typically have the potential for the greatest impact on water quality, and/or may require short-term action due to impending development. The Steering committee, in conjunction with PEC and the TOL, should evaluate each item below and create a prioritized action list for each partner that includes anticipated implementation dates base upon available man-hours and funding.

Table 12. Prioritization of Recommendations for Tuscarora Upper & Lower DD Subwatersheds

Priority	Recommendation	Type (Field Assessment-Broad/Specific)
High	Establish and Enforce River and Stream Crossing Standards	USA-Broad
	Conduct Outreach to Westpark Golf Course	USA-Broad
	Make Improvements to Existing In-Line Pond at CM-401	USA-Specific
	Create Community Amenity Along W&OD Trail at IB-101	USA-Specific
	Replace Stream Crossing at SC-602	USA-Specific
	Investigate Suspicious Discharges at Multiple Locations	USA-Specific
	Work Towards Implementation of the Urban Forestry Management Plan	Sensitive Areas-Broad
	Develop Incentive Programs for Tree Planting on Private Property	Sensitive Areas-Broad
	Implement Changes to Local Development Codes and Ordinances Recommended in the TOL's Urban Forestry Management Plan	Sensitive Areas-Broad
	Pursue Reforestation at Cool Spring ES	Sensitive Areas - Specific
	Pursue Reforestation at Fox Ridge Neighborhood	Sensitive Areas - Specific
	Pursue Acquisition of the Hunter-Dowdy Tract	Sensitive Areas-Specific
	Add Landscaping Criteria to Stormwater Design Standards	Retrofit-Broad
	Forest Existing Dry Ponds	Retrofit-Broad
	Add forebay to Stratford Wet Pond (R-15)	Retrofit - Specific
	Construct Infiltrating Dry Swale Around Soccer Field Near Hospital (R-42)	Retrofit - Specific
	Convert Wet Area in Raflo Park to Rain Garden (R-13)	Retrofit - Specific
	Plant Trees at Stratford Dry Pond (R-9)	Retrofit - Specific
	Plant Trees and Stop Mowing at Evergreen Meadows Pond (R-16)	Retrofit - Specific
	Add Wetland Plants and Trees, Modify Riser, and Stabilize Eroding Slopes at the Best Buy Pond (R-43)	Retrofit - Specific
	Construct Demonstration Rain Garden at C.S. Monroe Technology Center (R-14)	Retrofit - Specific
Medium	Implement Stormwater Regulation Recommendations	Stormwater Code Review-Broad
	Implement a Residential Stewardship Program	USA-Broad
	Conduct Stream Restoration at ER-401	USA-Specific
	Conduct Streambank Stabilization AT ER-901	USA-Specific
	Conduct repair for MI-902	USA-Specific
	Educate Auto Care Shops	USSR-Broad
	Coordinate Public Involvement Activities	USSR-Broad
	Educate Restaurants on Storage Practices	USSR-Specific
	Develop Pollution Prevention Plan for Technology Center	USSR-Specific
	Identify Additional Opportunities for Forest Conservation and Reforestation in the Tuscarora Subwatersheds	Sensitive Areas-Broad
	Explore the Potential for Establishing a Greenbelt that connects Existing Sensitive Area Fragments in TOL	Sensitive Areas-Broad

Table 12. Prioritization of Recommendations for Tuscarora Upper & Lower DD Subwatersheds		
Priority	**Recommendation**	**Type** (Field Assessment-Broad/Specific)
	Allow Natural Regeneration in the Madison Court Vacant Lot	Sensitive Areas - Specific
	Pursue Reforestation at Brandon Park	Sensitive Areas - Specific
	Pursue Reforestation at John Tolbert ES	Sensitive Areas - Specific
	Restore and Enhance Forest at Olde Izaac Walton Park	Sensitive Areas-Specific
	Maintain Existing Condition of Areas that Improve Water Quality	Retrofit-Broad
	Encourage Better Site Design through Credits in the Stormwater Requirements	Retrofit-Broad
	Remove Concrete Channel at Douglas Recreation Center and Use Step Pool/Wet Swale (R-32)	Retrofit - Specific
	Construct Stormwater Pond in Current Meadow Adjacent to Highway/Stream(R-7)	Retrofit - Specific
	Use non-infiltrating bio-filtration as stormwater practice in future upgrade to downtown gravel parking lot (R-47)	Retrofit - Specific
	Review SWPPP for the VDOT Facility and Recommend On-lot Water Quality Treatment. (R-39)	Retrofit - Specific
	Plant Trees and Modify Riser for Foxridge Park Pond (R-1)	Retrofit - Specific
	Stop Mowing and Modify Riser for Stonegate Pond (R-6)	Retrofit - Specific
	Add Plantings and Remove Concrete Channel at Smart's Mill MS (R-24)	Retrofit - Specific
	Plant Trees and Stop Mowing at Neighborhood Pond West of Tolbert ES (R-18)	Retrofit - Specific
	Clear Embankment but Preserve Interior Plants at Commons at Bellemeade (R-40)	Retrofit - Specific
	Add Pretreatment Trash Collectors at Pond Inlets, Keep Embankment Clear, and Preserve Interior Plants at Outlet Mall (R-23)	Retrofit - Specific
	Keep Drainage at Hospital in Dry Swale (R-26)	Retrofit - Specific
	Keep Wetland Plants in Swale Behind Industrial Park/Storage Units (R-20)	Retrofit - Specific
	Preserve Farm Pond and Fix Outlet Structure (R-3)	Retrofit - Specific
Low	Ensure Repair of UT-901	USA-Specific
	Pursue Tree Planting Opportunity at IB-102	USA-Specific
	Establish Treed Stream Buffer at IB-202	USA-Specific
	Establish Treed Stream Buffer at IB-401 and IB-901	USA-Specific
	Implement Natural Stream Channel Design at CM-104	USA-Specific
	Replace Stream Crossing at SC-901	USA-Specific
	Replace Stream Crossing at SC-903	USA-Specific
	Perform Maintenance at OT-801	USA-Specific
	Perform Maintenance at OT-802	USA-Specific
	Conduct Repairs for OT-902	USA-Specific
	Perform Maintenance at MI-901	USA-Specific
	Develop A Rain Barrel Program	USSR-Broad
	Educate the Public on Buffers	USSR-Broad
	Increase Watershed Related Signage	USSR-Broad
	Review Scheduling of Yard Waste Pickup	USSR-Broad
	Increase Street Sweeping	USSR-Broad
	Lawn Fertilization Education in Three Neighborhoods	USSR-Specific
	Develop an Education Campaign Targeted to Schools in TOL that Focuses on Increasing Tree Cover	Sensitive Areas-Broad
	Develop a Program to Manage Invasive Plants on Existing Public Lands in the TOL	Sensitive Areas-Broad
	Pursue Reforestation at Fox Ridge Park	Sensitive Areas - Specific
	Pursue Reforestation at Harper Park MS	Sensitive Areas - Specific
	Create a Field-verified GIS Layer of Existing Stormwater Facilities	Retrofit-Broad

Table 12. Prioritization of Recommendations for Tuscarora Upper & Lower DD Subwatersheds		
Priority	**Recommendation**	**Type** (Field Assessment-Broad/Specific)
	Purchase Olde Izaak Walton Pond, Breach Dam, and Manage as Stormwater Wetland (R-8)	Retrofit - Specific
	Construct Small Projects at Catoctin ES. (R-45)	Retrofit - Specific
	Construct Rain Garden at Golf Course. (R-29)	Retrofit - Specific
	Construct Demonstration Rain Garden at Leesburg Baptist Church. (R-5)	Retrofit - Specific
	Add Wetland Plants at Neighborhood Pond near Catholic Church (R-27)	Retrofit - Specific
	Keep Embankment Clear and Preserve Interior Plants at Freedom Park pond (R-11)	Retrofit - Specific
	Keep embankment clear and preserve interior plants at Tolbert ES (R-19)	Retrofit - Specific
	Keep Embankment Clear, Preserve Interior Plants, and Remove Concrete Channel at Pond near Shenandoah College (R-21)	Retrofit - Specific
	Keep Wetland Downstream of Douglas Recreation Center and Upstream of W&OD Trail (R-31)	Retrofit - Specific
	Preserve Natural Channel Downstream of VDOT (R-39)	Retrofit - Specific
	Add Plunge Pool to New Outfall and Protect Downstream Wetland Created by W&OD Embankment. (R-38)	Retrofit - Specific

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