SECTION 4 CENTENNIAL AND WILDE LAKE IMPLEMENTATION PLAN RECOMMENDATIONS

Section 4 contains the substance of the watershed restoration plan recommendations for both the Centennial Lake and Wilde Lake subwatersheds. It provides cost estimates for projects and identifies partners that may be able to participate in the implementation process. Sections 4.1 and 4.2 serve as the blueprints for watershed protection and restoration efforts in Centennial Lake and Wilde Lake respectively, and Section 4.3 outlines a number of programmatic recommendations that are valid for both subwatersheds and should improve coordination and effectiveness and ultimately reduce long-term costs to the County for restoration efforts. It should be acknowledged that the implementation of the restoration projects will require a number of years to design, permit, construct, and fund and that delays including permitting issues, private property issues, and funding are likely and may render some of the projects impossible to implement.

4.1 CENTENNIAL LAKE SUBWATERSHED PLAN RECOMMENDATIONS

Characterization

The Centennial Lake and its watershed are affected by phosphorus and sediment inputs that have resulted in its being placed on the State's 303d list of impaired water bodies. Based on field and technical analysis, that stress is coming from a number of sources including unstable streambanks, untreated stormwater, agricultural land, nonmigratory resident waterfowl, and turf areas located in neighborhoods, parks, and schools. The watershed has excellent restoration potential, however, as it contains several outstanding attributes, including a large block of protected, well-managed agricultural land and significant forested headwaters. Stream assessment results also revealed generally good to excellent stream habitat scores.

Table 4.1 provides a summary of land use and watershed characteristics.

Table 4.1 Centennial Lake Characteristics

Drainage Area		**2,272 acres (3.6 sq. miles)**
Lake Surface Area		53 acres
Stream Miles		10.5 miles
Current Impervious Cover		8.8% SENSITIVE
Land Use 2002*	Cropland	32.0%
	Low Density Residential	23.0%
	Deciduous Forest	20.4%
	Medium Density Residential	9.5%
	Brushland	6.1%
	Institutional	4.6%
	Pasture	2.5%
	Water	1.7%
	Commercial	0.2%
Future Impervious Cover		10.1% IMPACTED
Stream channel conditions		Generally good to excellent
Lake conditions		Increasing eutrophic and low oxygen conditions

*Landuse data from Maryland Department of Planning

A blueprint for the long-term protection and restoration of the Centennial Lake subwatershed is provided in the following pages. A series of actions are identified and detailed to provide needed watershed protection and restoration. The actions recommended in this section would result in the treatment of the majority of untreated stormwater, unstable streambanks, upland pollution sources, and the protection of the largest remaining developable agricultural tract in the watershed. A summary of the major types of recommended actions follows and includes stormwater retrofits and stream restoration, pollution prevention, and conservation areas, as well as a number of important maintenance issues identified in the watershed. Although the maintenance items do not necessarily result in immediate pollutant reductions, proper maintenance ensures the longevity and proper function of these practices into the future.

STORMWATER RETROFITS AND STREAM RESTORATION OPPORTUNITIES

The stormwater retrofits identified for Centennial Lake together would result in treatment of the majority of uncontrolled stormwater in the watershed. The only remaining untreated area includes portions of Centennial Lane that do not lend themselves to additional treatment, as much of the road runoff already sheet flows off the road into grass and field vegetation. The benefit of these projects is in reducing transport of two key pollutants, sediment and phosphorus, to the lake. Stormwater retrofits provide pollutant removal and flow attenuation, which can improve water quality and reduce downstream channel erosion. Stormwater retrofits and stream restoration opportunities are an important component of the restoration approach in the Centennial Lake subwatershed. Profile sheets for some of the high-priority projects are described in more detail later in this section, and the remainder of the priority retrofit projects are described in Appendix A, Retrofit Field Forms for Priority Projects.

Pollution Prevention

Pollution prevention activities are a cost-effective tool in reducing the sources of pollutants in urban and suburban watersheds. Very often a cost savings can be realized through pollution prevention activities. One example is the conversion of areas managed in turf grass to natural vegetation, which can reduce fertilizer and pesticide use, as well as reduce gasoline costs and air pollution emitted from lawn care equipment. In the case of Priority 2 in Table 4.4, goose manure transport to the lake would be reduced through conversion of a steeply sloped hillside used by geese to native gardens that would both filter runoff and discourage geese from using the area. Typically, management of turf areas results in a cost of $240 per acre versus $80 per acre for land managed in a natural condition (CWP, 1998). Pollution prevention activities by individual landowners can also have a considerable impact on nutrient reduction in suburban and urban watersheds due to a significant portion of the land is managed as turf. As a result of these factors, pollution prevention plays an important role in the Centennial Lake priority subwatershed recommendations.

Conservation Areas

An important consideration in small, lightly developed watersheds with sensitive resources such as Centennial Lake is the preservation of conservation areas that act to preserve water quality. The Doughoregan Manor parcel is the single priority conservation area in the Centennial Lake subwatershed. This large tract is mostly forested and helps preserve the headwaters of Centennial Lake in a relatively pristine condition. Efforts should be made to maintain the current condition,

since once headwater streams are degraded, it is difficult to improve water quality conditions in downstream larger reaches (see Table 4.2 for more detail).

Table 4.2 Priority Conservation Areas for Centennial Lake

Site Name/Practice Type	Project ID	Description	Treated Area or Length*	Estimated Cost	Coordination Team/ Project Partners
Doughoregan Manor Tract	C-1	Important primarily forested headwater tract in Reach A	411 acres	$30,000–$40,000/ acre density exchange program	• DPZ

IA = Impervious acres

Maintenance

While not considered a priority restoration practice, stormwater facility maintenance is an important component of a sustainable watershed management plan to ensure the long-term function and effectiveness of stormwater practices. Three stormwater facilities were found to be in need of maintenance in the Centennial Lake Subwatershed (Table 4.3). Maintenance can be critically important in stormwater facilities; without it, pond failure or reduced pond performance can occur. Without proper maintenance, existing ponds could have future structural concerns. Additional maintenance guidance has been provided to DPW separate from this document.

Table 4.3 Priority Maintenance Areas for Centennial Lake

Site Name/Practice Type	Project ID*	Description	Treated Area or Length**	Coordination Team/ Project Partners
Centennial Park Small Pond	CL-8	Maintenance – riser appears to be set too high and results in frequent topping of gabion dam – may need to expand capacity of pond and lower or modify riser structure	14.3 Impervious Acres (IA)	• REC • DPW
Gaither Farm Estates Stormwater Pond	CL-3	Stormwater pond not yet mucked out and converted from sediment pond	1.4 IA	• Pond owner • DPW
The Willows Stormwater Pond	CL-5	Clogged orifice. Drains below Lake.	0.7 IA	• Pond owner • DPW

Summary of Recommended Priority Restoration Efforts for Centennial Lake

Table 4.4 summarizes seven high priority restoration projects. This table also sets forth the estimated costs for the overall effort and suggests a planning horizon of approximately 5 years for implementation. The critical management issues identified in the watershed include stream erosion associated with two unstable reaches located on Clark's Farm, untreated stormwater

from Centennial Park, resident geese, and the cumulative effects of watershed residents on the lake.

A number of the projects also lend themselves to grant opportunities or federal dollar matches for implementation, including the Clark's Farm project, which would be eligible for federal cost share dollars from the Department of Agriculture/Natural Resources Conservation Service (NRCS) under programs such as Conservation Enhancement Reserve Program (CREP) and the Wetland Reserve Program. The priority projects in Centennial Lake were grouped for implementation according to land ownership, as many projects occurred in relative proximity to one another on land with a single owner. The locations of these projects are shown in Figure 4.1.

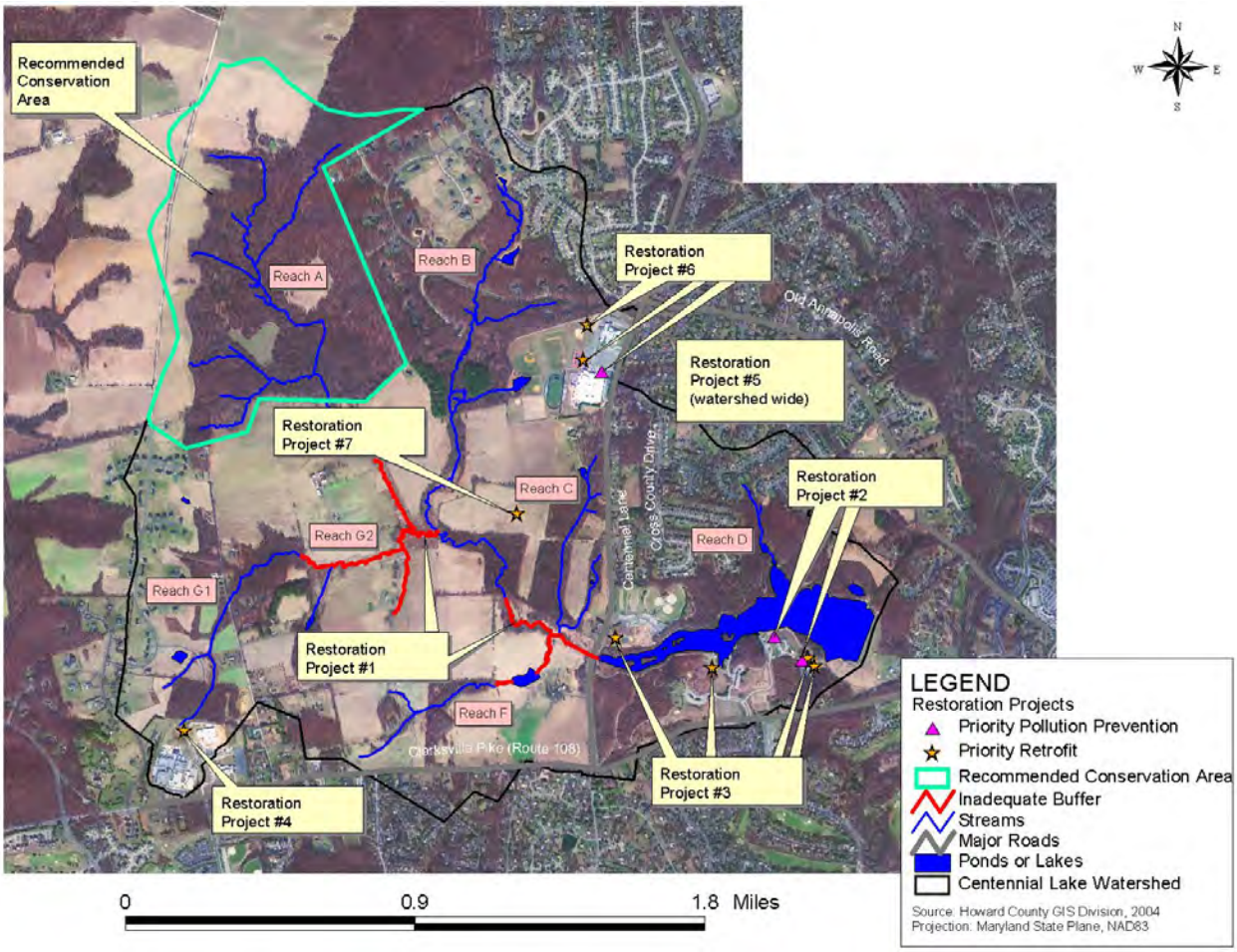


Figure 4.1 Priority projects for the Centennial Lake subwatershed.

It is important to remember that watershed conditions change over time, and adaptive management must be practiced in order to address new issues as they arise. One example in the not-too-distant future is the proposed widening of a portion of Centennial Lane near the intersection with Route 108, which may result in an opportunity to treat existing uncontrolled

stormwater from the intersection and roadway. Good adaptive management practiced by the County will ensure that impacts are reduced rather than increased as these events occur.

The restoration and protection opportunities listed in Table 4.4 represent a short list of key priority projects, each of which are important for achieving key watershed goals including reducing phosphorus and sediment loads, improving watershed awareness, and implementing projects that result in improvements to watershed conditions. The opportunities include stormwater retrofits, protection of a conservation area, pollution prevention, and improved maintenance and housekeeping.

Although Reach E was studied in the field and retrofit possibilities were discovered there, they are not included in this report. The goal of this study was to investigate opportunities to restore the Centennial Lake watershed and thus improve the quality of Centennial Lake. Since Reach E flows directly to the Little Patuxent River projects implemented along this reach would not further the goal of this study, although the County has recognized that the possible projects investigated for Reach E would be worth future study for protection/restoration of the Little Patuxent watershed.

Table 4.4 Summary Table of the Overall Priority Restoration Projects for the Centennial Lake Subwatershed

Project	Site Name/ Practice Type	Project ID	Description	Treated Area or Length	Estimated Cost	Coordination Team/ Project Partners
1	Clark's Farm Stream Buffer Reforestation and Wetland Creation	IB-1&2, ER1&2	Improve stream stability by creating floodplain wetlands to dissipate energy currently eroding an incised channel severely affected by invasive species	22 acres 3,600 ft of stream	$200,000*	• SCD • NRCS • DPW
2	Centennial Park Pollution Prevention	CL-H1	• Reduce goose pollutant transport from the turf hill adjacent to the boat ramp area i.e., convert portions of hill to native gardens • Consider resident goose removal program • Institute pollution prevention measures at the Park maintenance yard (see Maintenance Profile Sheets in Appendix C)	4 acres	<$10,000 also, cost savings associated with less turf manage-ment	• REC • DPW

Table 4.4 Summary Table of the Overall Priority Restoration Projects for the Centennial Lake Subwatershed (continued)

Priority	Site Name/ Practice Type	Project ID	Description	Treated Area or Length	Estimated Cost	Coordination Team/ Project Partners
3	Centennial Park Stormwater Retrofits	CL-101, 102, 104, CL-2	Provide stormwater treatment for untreated roads, parking, and maintenance facility	6.8 impervious acres (IA)	$200,000–$300,000	• REC • DPW
4	Applications and Research Lab (ARL) Stormwater retrofit	CL-1	Provide stormwater treatment for ARL (Technology School)	10.4 IA	$250,000–$350,000	• DPW • BOE
5	Residential Pollution Prevention	Watershed-wide	• Residents – Lawn care, downspout disconnection, rain gardens, rain barrels, bayscapes, car washing and pet waste • HOAs – Reforestation, lawn care • Buffer Education – target only homeowners that abut the stream	Set goals	$10,000	• DPW • LPWA • Master gardeners
6	Centennial High and Burleigh Manor Middle School Pollution Prevention and Demonstration Retrofits	PP CL-H3 Retrofits CL-105 CL-9	• Stormwater demonstration project to treat parking lot runoff at both Burleigh Manor and Centennial High School • Pollution Prevention through better maintenance of dumpsters and storage materials	2.1 IA	$75,000**	• BOE • DPW • Centennial and Burleigh students • LPWA
7***	Covenant Park	CL-11	Demonstration bioretention retrofit at Covenant Park	1.9 IA	$20,000**	• Master Gardeners • LPWA
Total			Over 1 mile of forested stream restored 12 acres of wetlands restored 0.5 acre of meadow buffer restored near lake Over 18 acres of impervious area treated Source reduction of pollutants from residential and institutional uses		$1 million	

*Existing agricultural grant programs can potentially fund the majority of this restoration project.

** Opportunities gain support from grants by partnering with local schools and nonprofit institutions.

*** This project is outside the control of Howard County DPW but would be a good opportunity for non-County groups to work on a demonstration project on private property.

The following pages consist of project profile sheets for six key restoration or retrofit sites recommended as priorities for implementation. These individual sites represent all or a portion of the seven priority restoration projects identified in Table 4.4. The goal was to provide additional implementation details for critical projects and projects that demonstrate innovative stormwater management practices and/or implement successful projects on public lands.

The following sites are included as Priority Restoration Project Profile Sheets:

- Project 1: Clark's Farm Reforestation/Stream Restoration IB 1&2 and ER1&2 and Invasive Species Management
- Project 2: CL-2 Centennial Park and CL-101 Centennial Park Maintenance Yard
- Project 3: CL-1 Applications and Research Lab
- Project 6: CL-105 Centennial High School and CL-9 Burleigh Manor Middle School

IB 1&2, ER 1&2 CLARK'S FARM REFORESTATION/STREAM RESTORATION AND INVASIVE SPECIES MANAGEMENT

Location
Agriculturally preserved land located upstream (west) of Centennial Lane above the lake (Figure 4.1)

Jurisdiction
Howard County, Centennial Lake Watershed

Stakeholders
- Owners of the Clark Farm
- Soil Conservation District

Figure 4.2 Site for forested wetland complex.

Site Description
Clark's Farm is a large agricultural parcel that has been preserved under an agricultural conservation easement. The farm appears to be well managed and operating as a sheep-raising operation and petting zoo/educational area open to the general public. Stream buffers exist on the property and appear to have been enrolled in the Conservation Reserve Enhancement Program (CREP); however, the success of the CREP plantings is far less than optimal because of the presence of invasive species and the use of plantings, many of which do not appear to be native. Several sections of stream also appear to be very incised and, in combination with the presence of invasive species, are eroding considerably.

Proposed Practice
Two primary recommendations are being made for this site. The first is to recouple the stream with its floodplain in locations where there is considerable incision and streambank erosion. This could be accomplished by raising the invert of the stream or by decreasing the elevation of the existing floodplain. Decreasing the elevation of the stream would more closely represent the historical condition of the floodplain but would require the use of the excavated material on site or selling it for use as topsoil, as hauling costs would be prohibitive. The second

recommendation is to replant the existing stream buffers that are overrun with invasive plant species with native trees suitable for the floodplain and develop a 10- year maintenance schedule to ensure success of the plantings.

Area
22 acres

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Reduction in channel erosion, increased nutrient and sediment retention through recoupling the stream with its floodplain and decreased water temperature with canopy closure over time.
	Channel Protection	Stabilization of currently eroding channels.
	Wetland or Forest Impacts	There should be a net creation of both wetlands and forest, though permits may be necessary for recoupling the stream with its floodplain.
Implementation	Planning Level Construction Cost	Medium ($50,000–$100,000) to High (> $100,000) Likely can be paid through existing agricultural grant programs and County costshare.
	Implementation Feasibility	Land owned in one family, which makes implementation easier.
	Physical Feasibility	Easy access. Area already taken out of production and preserved.

Features

- Planting with native species indigenous to the historical floodplain in the watershed including sycamore, green ash, box elder, red maple, tulip poplar, and black cherry (Brush, 1976).
- Increasing the width and health of the riparian corridor and connecting forested tracts in the headwaters with Centennial Lake.
- Expanding educational opportunities and signage because of site's proximity to the road. There may be a possibility to have school students participate in the tree plantings.
- Creating a 10-year maintenance schedule to ensure control of invasive species and forest succession (Figure 4.2).
- Estimating improvement and creation of 22 acres of forest buffer, up to 14 acres of wetlands, and an estimated 9,600 trees and shrubs to be planted based on 10-foot spacing to improve maintenance access (Figure 4.3).
- Creating a forested wetland complex approximately 300 to 400 feet wide on the site to the west and, on average, 100 to 150 feet wide on the site to the east closer to Centennial Lane (the road on the far right of the picture in Figure 4.4).
- Recoupling the stream with its historic floodplain and creating floodplain wetlands that can help improve nutrient and sediment retention prior to entering Centennial Lake (Figure 4.5).

Next Steps

- Gauge owner interest.
- Discuss with Howard County Soil Conservation District or National Resource Conservation Service (NRCS) and Kevin Smith with Maryland Department of Natural Resources to determine potential funding and implementation mechanisms.

Note the dominance of invasive grasses and lack of recruitment of trees on the left, and the sediment deposition in the picture on the right where invasive species also hide an eroding stream bank.

Figure 4.3 Examples of invasive species.

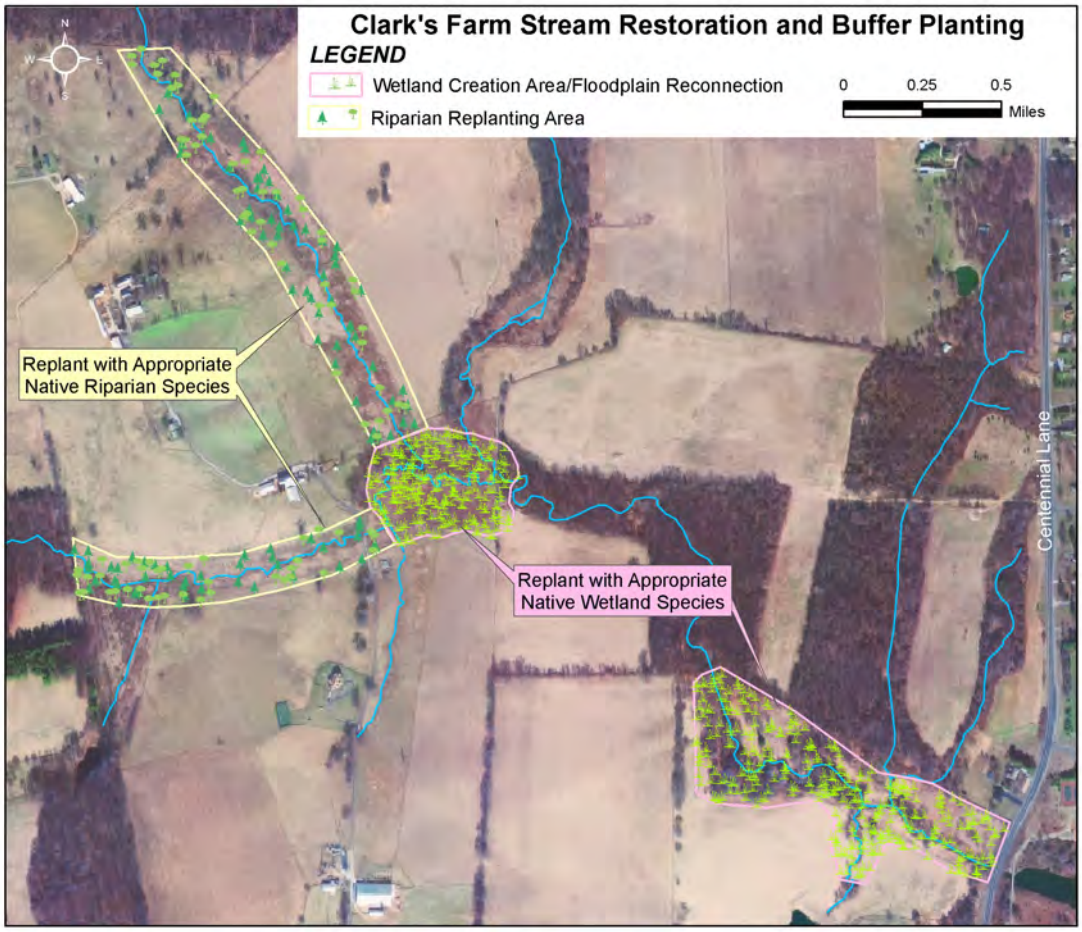


Figure 4.4 Clark's farm conceptual design sketched on orthophoto.

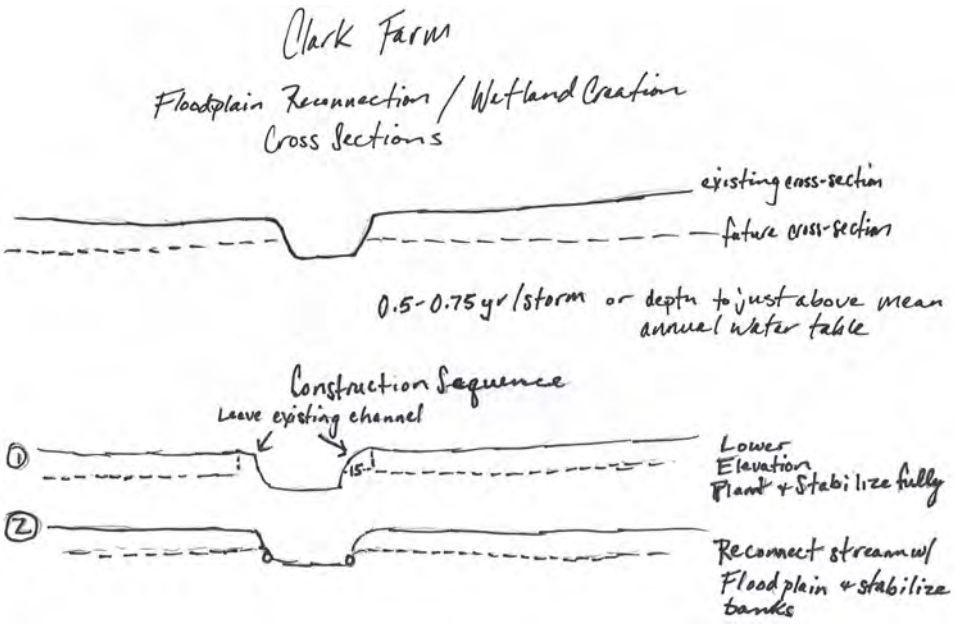


Figure 4.5 Possible construction sequence for the Clark farm floodplain reconnection.

CL-2 CENTENNIAL PARK

Figure 4.6 Centennial Park.

Location

Located at Centennial Park below the parking lot near the boat rental pavilion (Figure 4.6)

Jurisdiction

Howard County, Centennial Park

Stakeholders

- Department of Recreation and Parks

Site Description

The site consists of two locations approximately 150 feet apart. Site A is a low-lying spot between the existing paved walking path and the waterfowl exclusion fencing. During the field visit the ground was saturated and evidence of erosion and attempts at erosion control were observed. Further investigation of the topography revealed that stormwater flows through the vegetated area above the paved path before entering a shallow, naturally formed depression. The stormwater flows overland through the depression to a storm drain inlet. The inlet then flows to an outfall directly to Centennial Lake.

Site B is a highly vegetated area below the parking lot and a grassed channel that carries runoff from the upper parking lot before entering a field inlet down and bypassing the vegetated area. There is a storm drain running underneath the area conveying runoff from both parking lots and access roads directly to the lake. There is an additional field inlet near the pathway collecting additional runoff from the area. This inlet is also connected to the inlet in Site A, which flows to

an outfall directly to Centennial Lake. The storm drain inlet will be retrofitted with an outlet structure connected to the inlet in Site A.

Proposed Practice

The proposed concept involves creating bioinfiltration cells at Sites A and B (Figure 4.7). The bioinfiltration cells at both sites will be designed to provide water quality treatment to reduce the nutrient and sediment load directly discharged to the lake.

Evaluation Factors		
	Factor	Comments
Environmental	Water Quality Benefits	Water quality treatment will be enhanced for 3.5 acres of impervious cover and recharge will be promoted.
	Channel Protection	No channel protection design is being incorporated.
	Wetland or Forest Impacts	Area is mostly upland area that should have no wetland or forest impacts.
Implementation	Planning Level Construction Cost	$85,000
	Implementation Feasibility	• Land is publicly owned, which makes implementation easier. • Educational opportunities should also serve as an incentive.
	Physical Feasibility	• Easy access. • Routine maintenance could be provided by school groups during the school year and by community groups in summer.

Drainage Area

- 17.83 acres (approximately 20% imperviousness)
- 3.6 impervious acres (IA)

Features

- Three bioinfiltration cells to provide water quality treatment.
- Existing storm drain system left intact to prevent flooding.
- Excavated bioinfiltration cell composed of 24- to 30-inch recharge zone containing washed #57 stone or a combination of #57 stone and perforated half-round plastic pipe.
- Overlay stone reservoir with 6-inch perforated underdrain manifold that ties to storm drain inlet.
- Backfill stone reservoir with 18 inches of sand/soil mixture that is planted with native plants, including shrubs and trees. Trees and shrubs should not be planted directly on top of underdrain.
- Signage describing native plantings and the purpose and benefit of stormwater treatment.

Next Steps

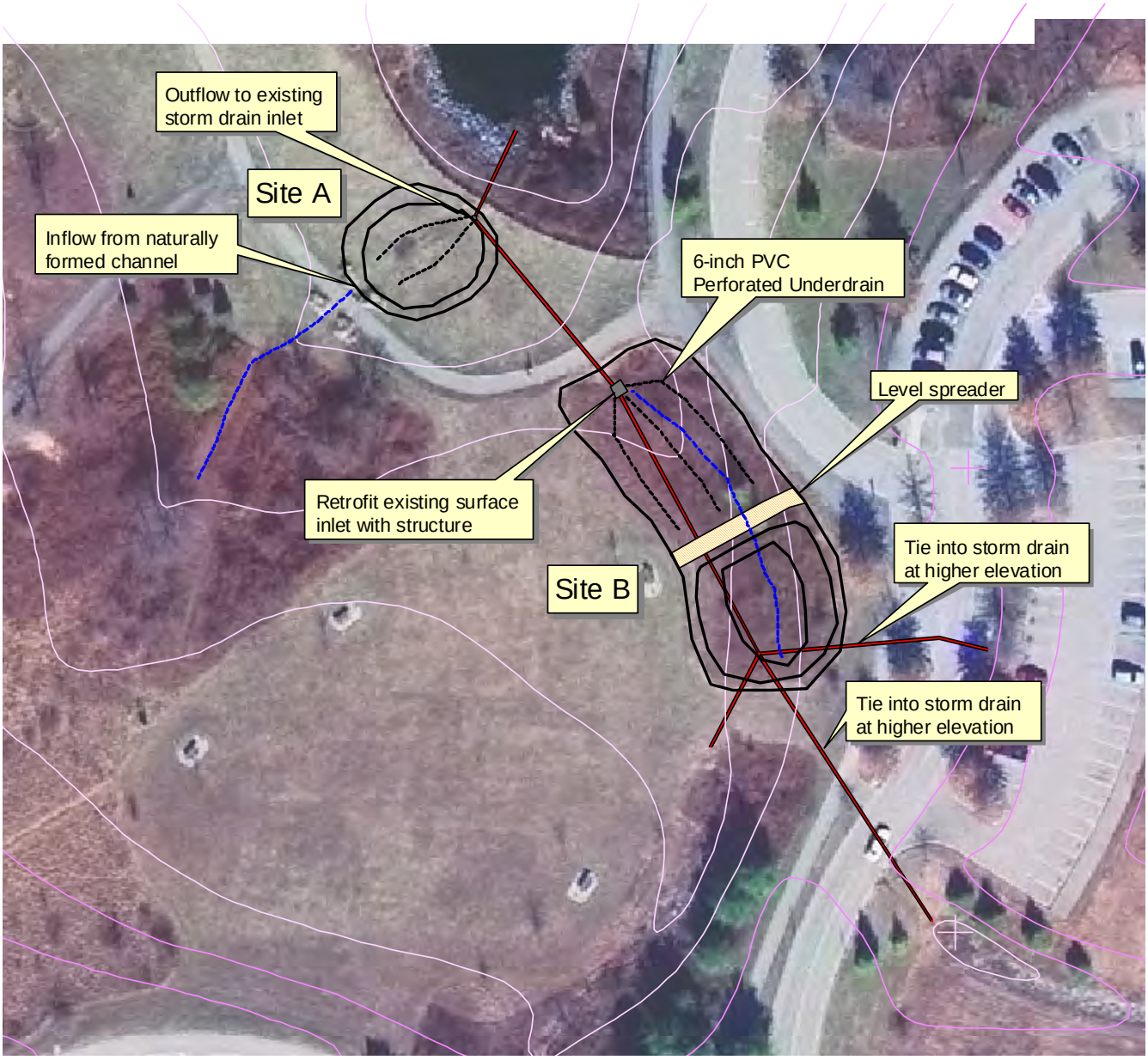
- Initiate discussions with Department of Recreation and Parks representatives about the benefits, costs, and feasibility.
- Investigate soil properties 3 to 10 feet below the proposed location.

Site A

Site B

Figure 4.7 Sites A and B.

Figure 4.8 is a map showing how the recommended features would work in Centennial Park.



CL-2 Centennial Park

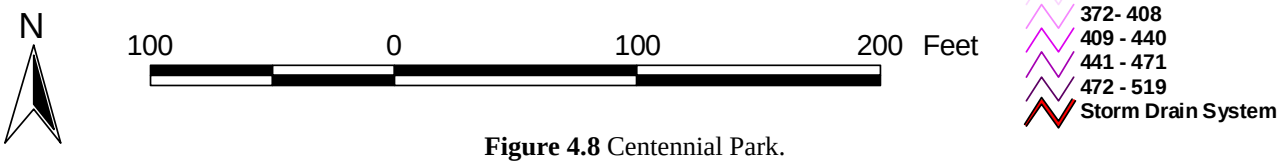


Figure 4.8 Centennial Park.

CL-101 CENTENNIAL PARK MAINTENANCE YARD

Location
Located on the south side of Centennial Lake at Park Headquarters on the access road past the boat ramp (Figure 4.9)

Jurisdiction
Howard County, Centennial Lake Watershed

Stakeholders
- Department of Recreation and Parks
- Department of Public Works

Figure 4.9 Location of Centennial Park maintenance yard.

Site Description
The park maintenance facility consists of a central maintenance building and several smaller storage sheds. There is a large asphalt area and rooftop that drains untreated off the site via sheet flow primarily to the northwest corner of the site. From there the site runoff flows overland and enters a swale leading down to the lake. An uncovered fueling station was observed with petroleum sheen apparent and some additional staining. The eastern perimeter of the site contains a row of unlabeled, uncovered storage drums.

Proposed Practice
The proposed concept involves providing a perimeter sand filter or bioretention cell at the surface drainage outlet point along the edge of the maintenance yard (Figure 4.10). Other site design elements include provision of an overhead canopy to cover the fueling area and covered storage for all drums and containers stored on-site. The development of a pollution prevention plan for this site is also recommended.

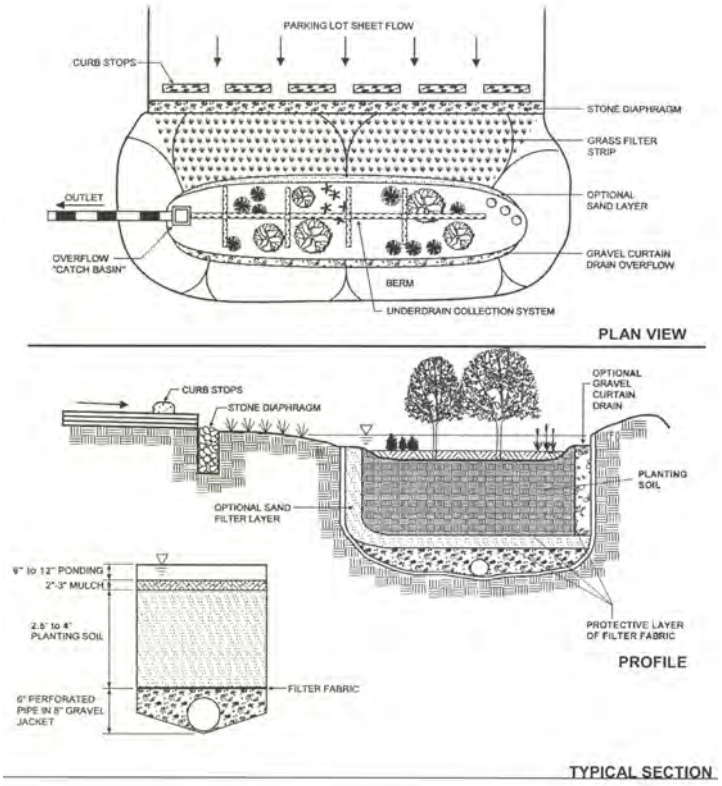
Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Water quality treatment will be provided for .7 acre of "hotspot" impervious cover.
	Channel Protection	No channel protection design is being incorporated, as site discharges directly to lake.
	Wetland or Forest Impacts	Site is an upland area that should have no wetland or forest impacts.
Implementation	Planning Level Construction Cost	Medium ($50,000–$150,000)
	Implementation Feasibility	Land is publicly owned and a high priority for treatment. There is an opportunity to lead by example and demonstrate maintenance yard pollution prevention techniques.
	Physical Feasibility	Easy access. Minor changes to site drainage infrastructure will be necessary.

Drainage Area
0.7 acre (approximately 100% impervious).
Estimated 1,520-square-feet surface area for treatment cell needed.

Features
- Collect surface drainage through a combination of curbs and/or swales to direct as much site runoff as possible to the down-gradient collection point.
- Extend roof leaders to same collection point and/or install rain barrels or cisterns.

- Provide energy dissipation and a filter strip prior to an underdrained bioretention cell along the perimeter of site (shown in Figure 4.11 schematic).
- Provide energy dissipation at the discharge point at the swale upstream of the lake.
- Construct permanent overhead cover for fueling operations and liquid storage drums; label all storage; develop a site pollution prevention plan and training materials for maintenance personnel.

Figure 4.10 Maintenance facility.



Source: Maryland Stormwater Design Manual, 2000)

Figure 4.11 Schematic of bioretention area.

Next Steps

- Initiate discussions with Recreation and Parks staff and Park Manager about the benefits, costs, and design options.
- Develop a pollution prevention plan and training materials.

CL-1 Applications and Research Lab

Location

Located next to the Department of Education, on Route 108. Existing wet pond is behind school.

Jurisdiction

Howard County, Centennial Lake Watershed

Stakeholders

- Board of Education

Site Description

An existing stormwater pond treats runoff from the Homewood School site (Figure 4.12). Currently, runoff from much of the ARL bypasses this facility in a concrete-lined trapezoidal channel. In particular, the maintenance area of the school drains to this conveyance channel and appears to receive no or limited (some oil and grit separators may exist) stormwater treatment. In addition to the concrete conveyance channel, there is also a pipe bypass that receives higher flows at the beginning of the conveyance. The outfall of this piped bypass was not seen in the field; however, it is believed to discharge somewhere downstream of the existing wet pond.

Figure 4.12 Stormwater pond at the Homewood School.

Proposed Practice

Two primary options are proposed for this site. The less costly option involves replacing the existing concrete channel with a dry swale to provide water quality volume treatment. This option would require maintaining a flat (~1%) channel grade using grade control structures such as weirs. Larger flows would continue to bypass the channel the way they currently do. Flow would initially pass through a stilling basin to provide pretreatment and drop out the coarser sediment. The second and more expensive option involves diverting both water quality and channel protection flows from the ARL to the pond and modifying the pond to provide both water quality and channel protection treatment. This would require almost a doubling in size of the existing pond and involve significant excavation. Under this option, approximately 2.1 acre-feet of additional storage would be required. This second option would also likely require modification of the existing outlet structure. Under the second option, a new conveyance (either pipe or open channel) would need to be created that combines the open channel with the bypass pipe flows. A flow splitter would still be required to bypass the largest events. A second forebay to the pond would be created to provide

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Water quality treatment will be provided for ~10 acres of impervious area. Additional treatment and recharge potential can be realized by converting the concrete channel to a dry swale.
	Channel Protection	A new outlet structure and increased storage capacity are likely needed if providing channel protection is pursued with design.
	Wetland or Forest Impacts	Area is mostly upland area that should have no wetland or forest impacts.
Implementation	Planning Level Construction Cost	Option 1: Medium ($50,000–$150,000) Option 2: High (> $150,000)
	Implementation Feasibility	Land is publicly owned, which makes implementation easier. Option 2 requires significant excavation and disposal of fill could be a constraint.
	Physical Feasibility	Easy access. Ample area appears to be available for pond expansion and land is publicly owned.

pretreatment to the ARL runoff. For both options, there appears to be ample space to provide the target treatment.

Drainage Area
13 acres (including ~ 10 acres impervious)

Features (Option 1)
- Provide plunge pool at existing splitter box for pretreatment prior to discharge to new dry swale.
- Replace concrete channel with dry swale (Figures 4.13, 4.14, and 4.15). Swale slope to be ~1%, which will require check dams using timber or concrete weir walls.
- Maximum flow depth allowed—18 inches.
- Filter media 2.5 feet deep with perforated underdrain to be used for water quality treatment.
- Bottom widths ~ 6 feet, with slide slopes of 3H:1V.
- Underdrain to daylight downstream of pond outfall using rock-lined level spreader/apron.
- See retrofit concept sheet for typical details.

Features (Option 2)
- Provide new conveyance (pipe or open channel) to direct water quality and channel protection runoff from school site to pond. Flow splitter will be required, where larger flows are bypassed into existing bypass pipe or concrete channel.
- Create new forebay to provide wet pretreatment for runoff from ARL site.
- Expand wet pool volume to accommodate WQv and channel protection volume from school site.
- Modify outlet structure to provide channel protection storage.
- Enhance pond edge with emergent wetland plants to deter waterfowl and improve pollutant uptake.
- Add educational signage and potentially incorporate site monitoring into curriculums at schools.
- See retrofit concept sheet for plan view of proposed facility modification.

Next Steps
- Initiate discussions with Department of Education representatives about the benefits, costs, and design options.
- For option 1, perform more detailed site hydrology to understand volumes and peak flows and how the existing infrastructure works. Need to know site and infrastructure elevations to determine stable slope and allowable depths.
- Obtain as-built drawings of existing facility as well as the bypass pipe from ARL. Need to better understand the basis of design of the existing facility and also sizing assumptions of the bypass pipe. If excess storage is available in the existing pond, then limited excavation will be required.

Figure 4.13 Typical plan and section view of dry swale.

Figure 4.14 Existing concrete channel looking down channel.

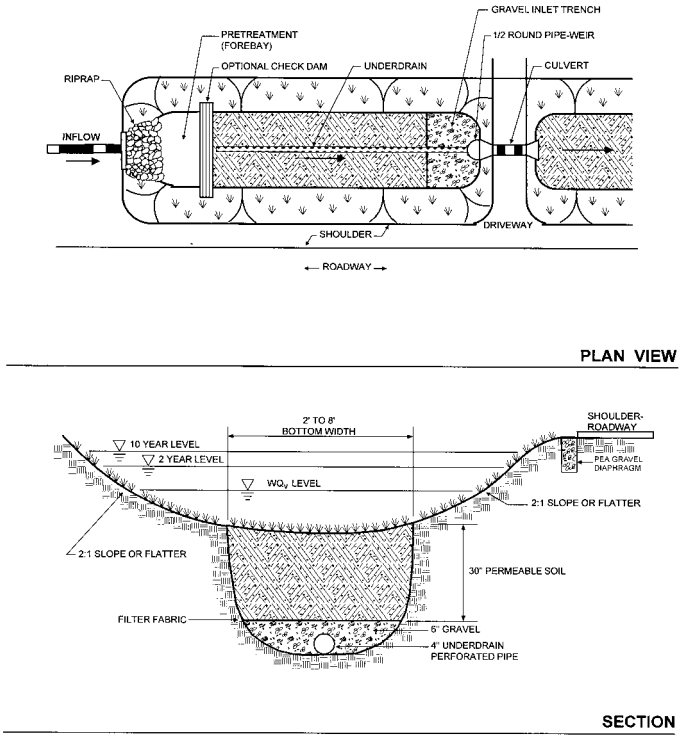


Figure 4.15 Existing concrete channel looking up channel.

L-105 CENTENNIAL HIGH SCHOOL

Location
Located off Centennial Lane just north of Route 108

Jurisdiction
Howard County, Centennial Lake Watershed

Stakeholders
- Board of Education
- Students and faculty of Centennial High School

Figure 4.16 Centennial Lane High School.

Site Description
Large asphalt paved school parking lot drains to conventional curb and gutter system, which ties into a larger stormwater management facility (wet pond). Entire parking lot is about 3.2 acres. The proposed concept would treat approximately 1.6 acres of parking lot and use area currently used as compacted turf landscaping (Figure 4.16). Additional parking lot enhancements can be made to provide various levels of treatment of the remaining area not draining to main concept location. This site represents a good opportunity to implement a demonstration project and to provide an educational message to an important target audience.

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Bioretention will provide redundant treatment of parking lot runoff but should also result in runoff volume reduction through ET and some infiltration.
	Channel Protection	No CPV explicitly provided in design, but lagged flow due to filtering of runoff will result in longer times of concentration to downstream wet pond, which could reduce flow peaks.
	Wetland or Forest Impacts	Existing vegetation in island may have short-term impact, but there will be a net gain in native plantings associated with bioretention planting plan.
Implementation	Planning Level Construction Cost	Low (< $50,000)
	Implementation Feasibility	• Requires cooperation of Centennial High School. • Maintenance can be provided by students, particularly if site is incorporated in various ways into curriculum.
	Physical Feasibility	• No significant utility impacts apparent. • Easy access • Some parking spaces may be eliminated or a new configuration may need to be implemented.

Proposed Practice
The proposed practice involves converting the existing raised turf island paralleling the entrance to the parking lot into a bioretention cell. There is approximately 5,000 square feet of space that is available to provide treatment, which is within the range of surface area requirements needed to be able to treat about one inch of runoff from the drainage area. Existing inlets would be sealed off to surface flows but accessible to larger overflows. Runoff can enter bioretention cell via curb cuts with small rock-lined stilling pools at each inlet point to provide some pretreatment and energy dissipation.

Drainage Area

3.2 acres for entire parking lot. Only 1.6 acres to drain to proposed site. Impervious cover ~ 95%. Target water quality volume is about 0.13 acre-feet, which corresponds to a footprint of approximately 4,700 square feet.

Features

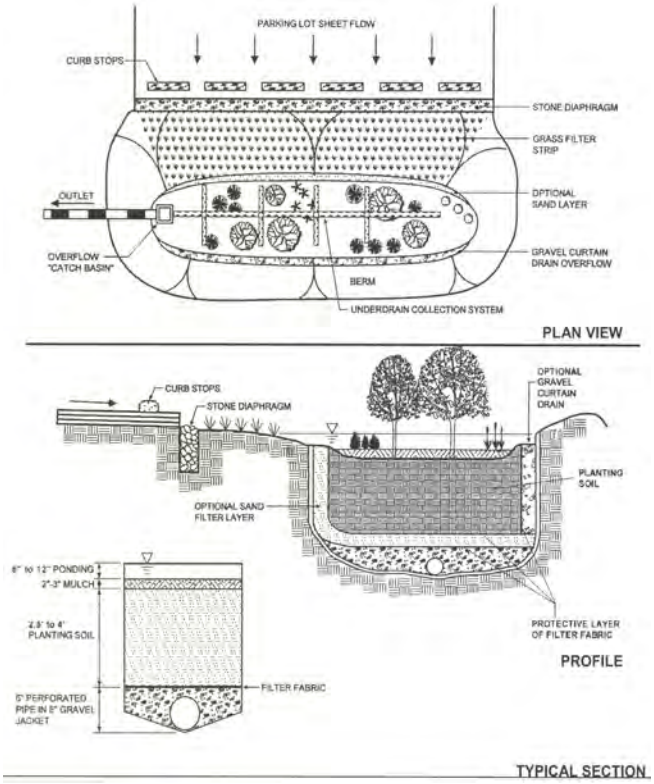
- Excavated landscaped island with curb cuts that allow sheet flow to enter every 10 to 15 feet.
- Perforated underdrain tied into existing storm drain infrastructure.
- Existing inlet sealed off to surface flows so that it enters bioretention cell
- New planting media approximately 2.5 feet in depth and native plant planting plan that includes tree and shrub species.
- Addition of native landscaped strip (underdrain optional) on west side of parking lot near tennis courts to receive sheet flow runoff from limited parking area not draining to proposed bioretention area. This area is approximately 1 acre of 100% impervious cover, which requires a minimum bioretention planting area of about 1,500 square feet (300 ft x 5 ft).

Next Steps:

- Contact school about interest in supporting concept and incorporating different features into student curriculums (either classes or clubs)
- Investigate any existing plans to resurface parking lot and consider planning project in conjunction with the resurfacing.
- Obtain storm drain plans for school site to determine alignment and elevations of existing collection system.

Figures 4.17 through 4.22 illustrate current condition of school parking lot and representative photographs and schematics of bioretention features being proposed for this site.

Figure 4.17 Views of Centennial High School parking lot and proposed area for bioretention.



Source: Maryland Stormwater Design Manual, 2000)

Figure 4.18 Bioretention schematic.

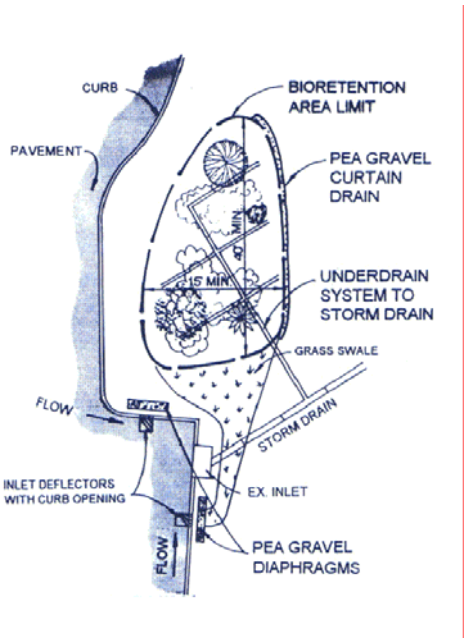


Figure 4.19 Schematics of bioretention applications adjacent to parking lots.

Figure 4.20 Examples of bioretention in parking lots with curb cuts and mixtures of tree and shrub plantings.

Figure 4.21 Typical linear bioretention strip proposed for area adjacent to tennis courts.

Figure 4.22 Typical inlet with rock-lined entrance to provide energy dissipation and pretreatment.

CL-9 BURLEIGH MANOR MIDDLE SCHOOL BIORETENTION

Location
Burleigh Manor Middle School

Jurisdiction
Howard County, Centennial Lake Watershed

Stakeholders
- Burleigh Manor Middle
- Howard County School Board

Figure 4.23 Burleigh Manor Middle School.

Site Description
There is a parking lot in the rear of the school that is estimated to be a little more than a half-acre of impervious cover (Figure 4.23). Stormwater runoff drains to the southwest corner of the lot and collects in the corner where there is some erosion occurring where vehicles have driven off the pavement. The visibility for school students and access to the site for educational purposes make this an ideal demonstration site.

Proposed Practice
The practice proposed for this site is for a rain garden or bioretention cell to treat stormwater runoff from the adjacent parking lot and to stabilize an area that is subject to erosion. The facility could be planted by school children and used for experiential learning. The cell would be designed to promote infiltration and evapotranspiration.

Facilities would be planted with native species and would require agreements from the school for maintenance. An additional alternative is to plant the facility with low maintenance native plants and a fescue grass so it could be more easily maintained by school maintenance personnel. Figure 4.24 shows examples of a similar practice.

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Treatment of at least a portion of the 1st inch of runoff – roughly equaling 90% of annual runoff and the water quality storm.
	Channel Protection	Promotion of infiltration.
	Wetland or Forest Impacts	None.
Implementation	Planning Level Construction Cost	Low (< $20,000) Possible to apply for grants to reduce public costs.
	Implementation Feasibility	Good access—Board of Education property.
	Physical Feasibility	Easy access.

Area
0.6 impervious acres

Features

- Planting with native species indigenous to the area
- Promotion of infiltration to reduce runoff volumes
- Water quality treatment of parking lot runoff
- Signage for public education

Next Steps:

- Discuss site with Board of Education and School Administration
- Identify potential funding mechanisms

Figure 4.24 Low maintenance application of a biofilter project (Carroll County, MD).

4.2 WILDE LAKE SUBWATERSHED PLAN RECOMMENDATIONS

Characterization
The Wilde Lake subwatershed is a 1.9-square-mile drainage area composed of an urban stream system that drains to a 21-acre man-made lake. Very little additional development is expected to occur in the subwatershed, beyond the occasional redevelopment project. The drainage area has a very high level of imperviousness, greater than 30%, and the streams draining this area generally have fair to poor stream habitat conditions as a result of channel erosion stemming from many years of uncontrolled stormwater runoff. Although there is a sizable forested buffer around much of the stream length, stormwater runoff is typically piped directly through the buffer areas to the stream channel. The development of this subwatershed generally dates back at least 30 years to the 1960s and 1970s', however; there is still much active channel erosion as the streams continue to adjust to the increased stormwater volumes and discharges. This active erosion is seen in the

upper reaches of all the tributaries, with the exception of Reach E in the Beaverbrook community where the development density is lower relative to the other drainages. Figure 4.24 shows a map of the Wilde Lake reaches. In addition to the overall high residential density throughout most of the reaches, there are several large blocks of contiguous impervious cover in the headwaters of most of the reaches, such as large commercial or institutional uses, or large blocks of townhouses or apartments piped to a single outfall. Addressing these large expanses of impervious surface in the headwaters is a high priority for addressing channel erosion in these streams.

A summary of land use and characteristics of Wilde Lake is provided in Table 4.5.

Table 4.5 Wilde Lake Characteristics

Drainage Area		1.9 square miles
Lake Surface Area		21 acres
Stream Miles		4.5 miles
Current Impervious Cover		32%
Land Use 2002*	Deciduous Forest	3.3%
	Pasture	4.1%
	Open Urban	4.6%
	Low Density Residential	19.9%
	Medium Density Residential	28.2%
	High Density Residential	26.6%
	Institutional	5.8%
	Water	1.7%
	Commercial	5.8%
Future Impervious Cover		32%
Stream Channel Conditions		Generally fair to poor
Lake Conditions		Increasing eutrophic and low oxygen conditions; high sediment and associated nutrient loads

*Landuse data from Maryland Department of Planning

Stream Reach Descriptions and Project Recommendations

The following sections provide a blueprint for the restoration of the Wilde Lake subwatershed. The conditions found in each reach are summarized, and priority projects are identified for implementation. Section 3 provided a description and map (see Figure 3.6) showing the location of these problem areas identified, including 12 damaged outfalls, five major erosion areas, three locations where sewer lines have been exposed by channel downcutting, one dumping site, eight areas of inadequate buffer and minor erosion, and two large scour holes. Figure 4.25 shows the location of priority project locations, which are described in the following sections. Project profile sheets are provided at the end of this section, giving a more detailed conceptual design for selected projects, and Appendix A, Retrofit Field Forms contains forms describing the other priority sites referenced in Table 4.6.

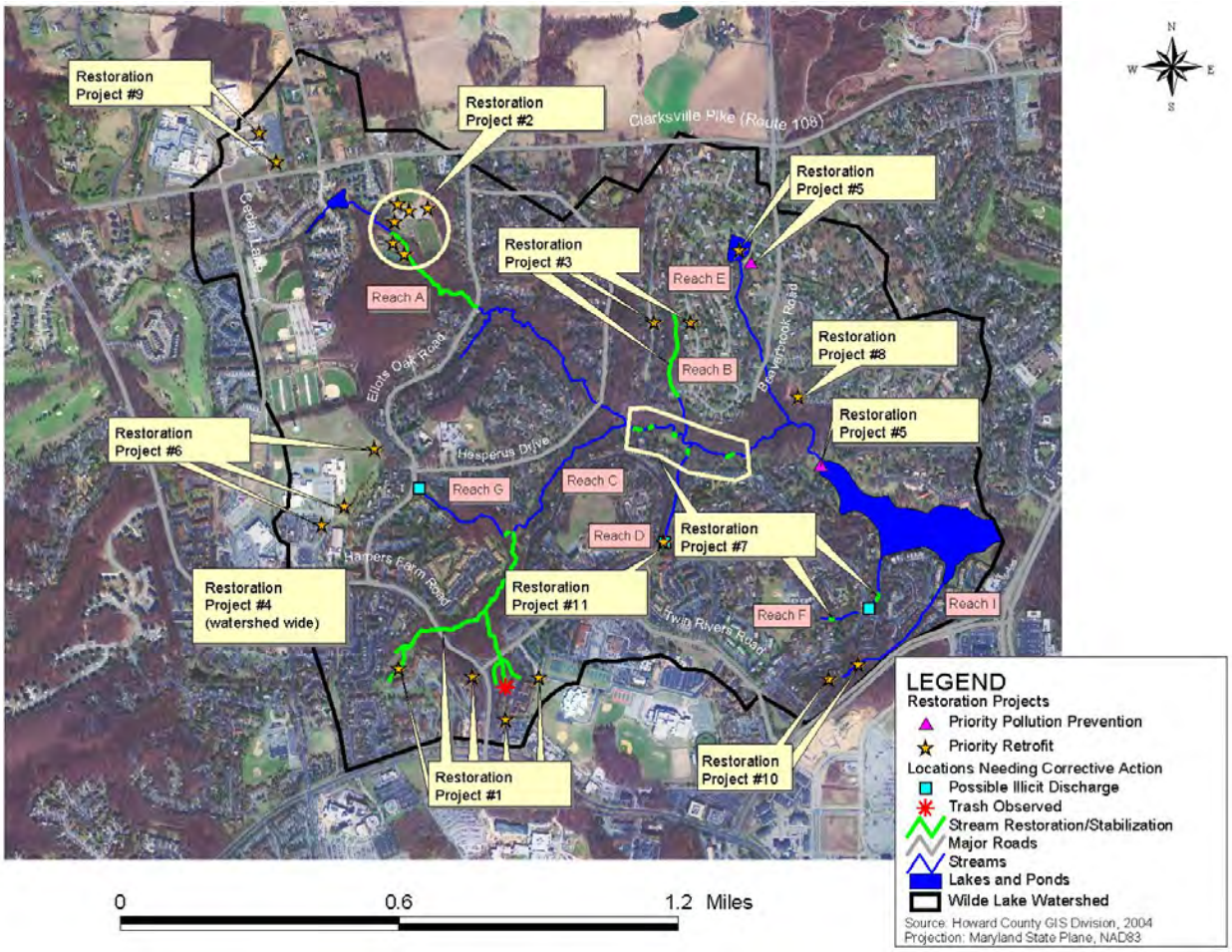


Figure 4.25 Priority projects for the Wilde Lake subwatershed.

Table 4.6 Summary Table of the Overall Priority Restoration Projects for the Wilde Lake Subwatershed

Project	Site Name/ Practice Type	Project ID	Description	Treated Area or Length	Estimated Cost	Coordination Team/ Project Partners
1 of 11	Reach C Retrofits and Stream Restoration	WL-01b WL-02 WL-03 WL-04 ER1,2,6	Series of retrofits including a stormwater wetland and bioretention facilities to provide water quality benefits and flow attenuation, stream restoration to improve channel stability and reduce sediment transport	9.6 Impervious Acres (IA) 1,000 ft of stream	>$750k–$800k**[1]	• DPW • CA • Private Property Management

Table 4.6 Summary Table of the Overall Priority Restoration Projects for the Wilde Lake Subwatershed (continued)						
Project	**Site Name/ Practice Type**	**Project ID**	**Description**	**Treated Area or Length**	**Estimated Cost**	**Coordination Team/ Project Partners**
2 of 11	Reach A Stormwater Projects and Stream Restoration	WL-104	Cedar Lane Park series of bioretention and small scale retrofits to treat park – use adaptive management to determine if additional stream instability continues, if so, consider hydrologic modeling to determine appropriate flow attenuation upstream	1.6 IA acres on-site 1000ft of stream	On-site retrofits and stream restoration $400k–$450k*[2]	• DPW • REC
3 of 11	Reach B Beaverbrook Streetscapes and Stream Stabilization	WL-102a, b	Provide street edge runoff management demonstration projects and 200 ft of stream stabilization in area closest to outfalls – utilize adaptive management to determine if additional in-stream work is needed	3.8 IA	$300k–400k[1]	• DPW
4 of 11	Pollution Prevention Program	Water-shed-wide	Residents – Lawn care, rain gardens, rain barrels, bayscapes, car washing, buffer education, and pet waste HOAs – Reforestation, turf management Municipal, Schools, County/CA-owned land Businesses	Set goals	$30k*	• CA • DPW • Little Patuxent Watershed Association • Master Gardeners
5 of 11	Waterfowl Management/ Wetland Fringe	WL-103	Reduce goose pollutant transport from Beaverbrook farm pond and Wilde Lake; manage lakeside areas, create wetland fringe and pond improvements at Beaverbrook. Educate residents and look to convert mowed areas to wildflower meadow or field	NA	$10k–$15k	• DPW • CA • Beaverbrook Community
6 of 11	Reach G Three Dry Pond Retrofits	WL-15 WL-16 WL-17	Three dry ponds in close proximity to one another near schools and CA fitness center	9.6 IA	$350K*	• DPW • CA
7 of 11	Multiple reaches Wilde Lake Impacted Buffer/Mini Restoration	IB-1-8	Reforestation/ stream repair projects to fill in gaps in the forested stream buffer and address minor stream instability problems caused in part by lack of buffer	250 feet	$15k–20k[3]	• CA • Beaverbrook Community
8 of 11	Reach E Beaverbrook dry pond retrofit	WL-101	Dry pond retrofit to eliminate stormflow short-circuiting, and improve water quality treatment	4.4 IA	$150k–250k	• DPW • Beaverbrook Community

Table 4.6 Summary Table of the Overall Priority Restoration Projects for the Wilde Lake Subwatershed (continued)						
Project	**Site Name/ Practice Type**	**Project ID**	**Description**	**Treated Area or Length**	**Estimated Cost**	**Coordination Team/ Project Partners**
9 of 11	Reach A Board of Education Retrofit/ Innovative Treatment Park	WL-113/ 114	Retrofit dry pond to provide smaller storm control and water quality treatment; and/or implement several small on-site treatment demo projects (Innovative treatment park)	5.5 IA dry pond 2 IA On-site	$200K–250K	• BOE • DPW
10 of 11	Upper I Outfall Stabilization/ Retrofit	WL-12a WL-12b	Outfall stabilization/stream restoration and infiltration practice	100 feet 1.8 IA	$150K [1]	• CA • DPW
11 of 11	Reach D Adaptive Management	WL-10b	Practice adaptive management—monitor stability of recent stream restoration project and downstream conditions; if stability and erosion issues, consider feasibility of this large wet pond retrofit with water quality and channel protection	17.7 IA	$300K	• DPW • CA
Total			Over 50 acres of IA managed Close to ½ mile of stream restored Resident geese impact reduced Source reduction of pollutants by residents, CA, County, and businesses		$3 million	

* Opportunities to gain support from grants by partnering with local schools and nonprofit institutions.

[1] Stream restoration cost based on $300 per linear foot for stream restoration.

[2] Primarily grade control and some bank reshaping estimate of $150 per linear feet.

[3] Done "in house" by Columbia Association under general permit; assumption of $75 per linear foot for imbricated riprap, grade control, and bank reshaping.

Table 4.7 shows possible problem sites within the Wilde Lake watershed, including those with evidence of illicit discharges.

Table 4.7 Issues Discovered at Wilde Lake			
Site ID	**Reach**	**Practice Type**	**Description**
OT-1	C1	Stream Cleanup	18in outfall; Lots of trash below outfalls at Bentwood Apartments; lots of automotive parts and oil containers; volunteers could clean up; good education focus
OT-9	D	Ilicit discharge monitoring/detection	48-inch pipe; Possible Illicit Car wash at gas station and reddish benthic growth, apron subsiding
OT-11	I	Ilicit discharge monitoring/detection	42-inch pipe; black oily discharge on concrete channel
UT-1	C	Utility crossing	14ft exposed in stream bottom; Small pipe (appears to be water line exposed in stream)
UT-2	B	Utility crossing	Pieces of clay pipe; Remnants of old sewer pipe ensure no longer in use
UT-3	A	Utility	Sanitary sewer; Located in the middle of the stream on a bank between where two streams met

Reach A - Fair

Stream Reach A is the longest of the tributaries to the lake and is the mainstem of the drainage above the lake. The reach is in overall fair condition, with a number of problem areas. There are three existing stormwater management facilities in the headwaters: two dry ponds that treat large expanses of impervious area located at the Cedar Lane Park and Board of Education sites, and a large wet pond with double-barrel risers that also receives the drainage from these sites and other residential and road runoff (WL-105, 107, 113). These ponds merit further investigation to improve their combined function for channel protection storage and water quality improvements. The barrel risers on the wet pond should be investigated for maintenance needs and placed on a replacement schedule (the County inspects these facilities on a triennial basis). At that time, options for improving channel protection storage at this pond should be explored. Although not recommended as priority retrofits at this time because of the need for more detailed investigation, these sites could provide beneficial channel protection control to address the headwater imperviousness and improve the success of stream restoration efforts recommended downstream. It is recommended that any stream restoration approaches be designed in conjunction with providing upstream hydrologic control.

Downstream of these ponds, the east side of Cedar Lane Park contributes another sizable area of impervious surface, and a potential retrofit project combining bioretention and floodplain storage (WL-104) is recommended at this site. More than 1,000 feet of eroding stream channel is recommended for restoration (ER-7) downstream of the park.

Reach A has a very good forested riparian buffer within Columbia Association open space for most of its length; however, four small areas of inadequate buffer and associated stream erosion in the lower section of the reach were identified (IB-2, 3, 4, 6). An exposed sanitary sewer was identified at the confluence of Reaches A and C (UT-3), and a 30-inch storm-drain outfall (OT-12) was severely undercut. All of these problem areas are recommended priorities for follow-up action.

Reach B - Poor

Reach B drains the Beaverbrook community and is in very unstable condition above Durham Road West. Prior stream repair efforts have been undertaken in the reach below Durham Road West, but the upper reaches (ER-5) have remained unaddressed, as the private ownership of this area makes coordination and access a significant issue. Though the stream is relatively small, the potential sediment source from this erosion is significant and ongoing. Two retrofit projects are recommended to address the street runoff in this area—the primary source of uncontrolled stormwater (WL 102a, b) (Priority 4). These projects are an innovative approach to treating runoff through street edge alternatives that use attractive landscaping and bioretention incorporated into space within the street right-of-way. This project is recommended as a high priority and should be investigated prior to designing stream repair practices for this reach.

Reaches C and G - Poor

Reach C is the second largest stream reach and contains significant areas of extremely high impervious cover in the headwaters. Reach G is in a similar condition and is a headwater tributary to C. Several past stream restoration activities have been pursued along the lower section of Reach C that appear to date back to the 1970s; however, significant areas of active channel erosion are still found in the headwaters (ER-1,2,6). Existing stormwater controls are

minimal, and a number of problem areas were identified. Fourteen potential retrofit sites were identified in these two reaches (WL-1 through 9 and 15 through 18), nine of which are recommended priorities for follow-up implementation (WL-1, 2, 3, 4, 8a,b, and 15, 16, 17). These retrofits, however, are primarily water quality treatment and very little opportunity was identified to significantly reduce the volume of flows, although some flow attenuation may be achieved by the cumulative effect of the projects recommended. Though the channel protection benefits may be limited, the water quality improvements that can be achieved with these projects target high-intensity uses such as commercial parking and high-density residential areas and will be valuable for reducing pollutants to the streams and lake.

Stream repair is the priority restoration approach recommended for Reaches C and G, along with aggressive pollution prevention efforts. The stream restoration approaches should include measures to repair the many outfall failures identified (OT-1 through 7), along with velocity dissipation measures at the outfalls to reduce scour problems (SC-1, 2) and channel instability. One area was identified for buffer improvements (IB-5) that should also be addressed through a comprehensive stream repair plan.

Restoration designs have been completed for portions of Reach C. The construction documents have been approved but the County is applying for grant funding to perform the construction.

Reach D - Poor

This stream reach receives drainage from highly impervious residential and commercial areas and includes a failed outfall at the top of the tributary (OT-9) that exhibits signs of potential illicit discharge. The entire stream reach is actively eroding and is the site of a stream repair project finished in the Spring of 2005. There is an area of inadequate buffer at the confluence with Reach C that should be targeted for stream repair and reforestation efforts. The high level of uncontrolled stormwater runoff affecting this reach makes monitoring of the restoration and repair work a high priority to ensure that any problems are identified and addressed early. An additional retrofit site at the top of the reach was investigated in the past and estimated to be infeasible; however, upstream controls, including at the Village Center and adjacent apartment complexes could be reevaluated in the future, if monitoring of the restoration effort indicates ongoing instability problems.

Reach E - Poor

This stream reach is located in the Beaverbrook community and is relatively stable. The development densities in the drainage area are the lowest found in the Wilde Lake subwatershed, consisting of low- to medium-density single family residential. The poor stream condition is related to water quality problems more than physical channel problems. High levels of algae were identified, and significant nutrient sources exist in the drainage area, including large expanses of manicured lawns, and a significant resident goose population in the old farm pond at the top of the reach. The farm pond is recommended for retrofit activities to improve the aquatic fringe and provide a landscaped buffer to deter resident geese. A waterfowl management program is highly recommended for this site, and could consist of a community project conducted through the National Humane Society's Geese Peace program. The lower portion of the reach contains an existing dry pond that has naturally converted to a wetland marsh. The pond is partly responsible for the relatively stable stream channel conditions, as it provides flow attenuation and prevents downstream headcuts from migrating further. The pond is

recommended for retrofit, however, because it has a severe short-circuiting problem that limits the water quality benefit. In addition to these management activities, a residential lawn care program is highly recommended for this drainage. As this reach is the closest confluence to the lake, nutrient management efforts in this drainage are of particular importance.

Reach I - Poor
This intermittent stream reach has severe channel erosion in the upper reaches that ultimately drains into a concrete channel. Infrastructure damage and erosion need to be addressed to stem ongoing sediment loads to the lake. Two retrofit projects were identified to address these problems (WL-12 a,b) that consist of outfall repair and energy dissipation, along with efforts to reduce runoff through a combination of infiltration and on-site drainage improvements. Soils in this area need further investigation but appear to be somewhat sandy and potentially suitable for infiltration.

Stormwater Retrofits and Stream Restoration Opportunities
A total of 35 project sites were identified as potential retrofit locations, and these sites were ranked based on five ranking criteria including water quality treatment potential, channel protection potential, stakeholder goals, educational value, and feasibility. The ranking level of detail is at a preliminary concept stage; therefore, it should be considered a "first cut" and not an exhaustive analysis of the projects for the purpose of prioritization. The outcome of this ranking effort is provided in Appendix F. This initial project ranking serves as a preliminary comparison tool for screening out the most effective projects. Best professional judgment has been used to further refine the priority projects listed for implementation, based on an understanding of stakeholder goals, and some practical considerations in terms of project acceptability and implementation such as aesthetic appeal, level of maintenance concern, and land ownership.

Two key goals of the priorities are stabilizing stream channels subject to erosion and treating existing uncontrolled stormwater runoff. The benefit of these projects is their cumulative effect in reducing urban pollutants from high-intensity uses and addressing erosion and associated nutrient and sediment delivery to the lake. Figure 4.25 details the locations of the priority projects, many of which have stormwater retrofit and stream rehabilitation components. Six profile sheets, including detailed restoration concepts, are provided following this section. The remainder of the priority concepts are contained in Appendix A.

Pollution Prevention
Pollution prevention activities are a cost-effective tool for reducing the sources of pollutants in urban and suburban watersheds. Very often a cost savings can be realized through pollution prevention activities. One example is converting areas managed in turf grass to natural vegetation which can reduce fertilizer and pesticide uses, as well as reduce gasoline costs and air pollution emitted from lawn care equipment. Typically, management of turf areas results in annual costs of $240 per acre versus $80 per acre for land managed in a natural condition (CWP, 1998). Pollution prevention activities by individual landowners can have a considerable impact on nutrient reduction in suburban and urban watersheds because a significant portion of the land is managed in turf.

In addition to turf conversion of residential lawns, goose manure transport to the lake can be reduced through conversion of mowed and manicured areas used by geese to a more natural field

or meadow. More natural buffers are recommended around much of the lake as well as the farm pond on Reach E. The National Humane Society has developed a population management program for geese, Geese Peace, which uses a humane, community involvement approach to manage nuisance geese populations. There is evidence that many homeowners in the vicinity of the farm pond have attempted to exclude geese from their yards, and there may be resident support for a community effort to better manage this problem.

In addition to individual landowner actions, pollution prevention activities are recommended for commercial hotspot locations, such as at loading/unloading areas in the commercial zone and at gasoline service stations. A number of institutional land uses, particularly school sites, were identified that would benefit from improved pollution prevention activities, again primarily associated with dumpster management and loading/unloading. Finally, a number of actions are recommended for municipal operations, including improved grounds/turf management around the lakes to reduce resident geese populations, and improved practices at park maintenance facilities. Several of the priority recommendations in Table 4.6 include pollution prevention as an important component.

Summary of Recommended Priority Restoration Efforts for Wilde Lake

The summary of recommended projects for implementation are outlined in Table 4.6. These projects are expected to result in the reduction of the amount of sediment and nutrients delivered to Wilde Lake. A public education and involvement program to support residents and promote stewardship actions is recommended for implementation in this subwatershed to address yard chemical and fertilizer use, improper disposal of household hazardous wastes and pet waste, and better management and use of riparian buffer areas. Other key projects to be pursued over the next 5 to 10 years include the procurement of funding for stormwater retrofit projects and stream channel repair projects. A public involvement process to involve local residents should be continued through the design and implementation phases. The prioritization process on Wilde Lake focused on a reach-level restoration/rehabilitation approach because of the importance of addressing the causes of channel instability before to attempting to restore the channel itself. Secondary goals included improvement of overall water quality by addressing upland sources of pollution from residential, municipal, and commercial land uses and reducing the impact of resident geese on the lake.

The following pages consist of project profile sheets for six projects recommended as top priorities for implementation. These six projects are selected from the priority project sites based on the opportunities presented at each of these sites to demonstrate innovative stormwater management practices for urban areas and to implement a number of successful projects on public lands. Two of the projects, Cedar Lane Park (WL-104) and the Beaverbrook alternative street edge (WL-102), address conditions that are important for subsequent high-priority stream restoration efforts.

The following sites are included as Priority Restoration Project Profile Sheets:

- Project 1: WL-1 Wilde Lake Middle School Bioretention and WL-3 Harpers Forest Apartments stormwater wetland
- Project 2: WL-104 Cedar Lane Park East
- Project 3: WL-102 Beaverbrook Streetscape

- Project 6: WL-15 Harpers Choice Middle School Dry Pond
- Project 7: IB-1 through 8 impacted buffer and mini stream restoration

WL-01 WILDE LAKE MIDDLE SCHOOL BIORETENTION

Location
Wilde Lake Middle School (Figure 4.26)

Figure 4.26 Wilde Lake Middle School site.

Jurisdiction
Howard County, Wilde Lake Watershed
Might be on Columbia Association (CA)-owned land

Stakeholders
- Wilde Lake Middle School
- Board of Education
- Columbia Association
- Wilde Lake Residents

Site Description
Wilde Lake Middle School is located adjacent to the Wilde Lake Village Center, Wilde Lake High School, and the CA Tennis Center. The location is on the corner of the west side entrance drive adjacent to the school parking lot. The proposed bioretention project would treat a parking area and entrance to the Middle School. Based on the parcel boundary, the site appears to be owned by Columbia Association as part of a tennis center.

Proposed Practice
The practice proposed for this site is bioretention.

The site would use an underdrain system, though infiltration and evapotranspiration would be promoted (if soils are amenable) to reduce flow volumes delivered downstream. Facilities would be planted with native species and constructed to minimize maintenance activities.

Area
4.14 acres
50% IC
IC acres 2.07
4,573 square feet needed minimum (5%)
5,500 square feet available

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Treatment of the 1st inch of runoff – roughly equaling 90% of annual runoff and the water quality storm.
	Channel Protection	Promotion of infiltration to reduce the volume of runoff from smaller storm events (< 1 inch).
	Wetland or Forest Impacts	None.
Implementation	Planning Level Construction Cost	Medium ($50,000–$100,000) Possible to apply for grants to reduce public costs.
	Implementation Feasibility	Access good—site likely owned by Columbia Association. Some issues with electrical utilities (several street lights may need to be moved or worked around). Construction may generate excess soil that would need to be hauled away from site.
	Physical Feasibility	Easy access.

Features

- Planting with native species indigenous to the area.
- Promotion of infiltration to reduce runoff volumes.
- Water quality treatment of road and parking lot runoff.
- Participation by school students in the creation and upkeep of the sites.
- Signage for public education.
- Potential for the sites to be used as part of experiential learning for school students.
- May consider the use of salt-tolerant shrubs and trees, including green ash, serviceberry and a low maintenance species such as red osier dogwood.
- Optional rain garden above the proposed facility to promote additional infiltration and water quality treatment (Figure 4.27).

Next Steps:

- Discuss site with Columbia Association, Board of Education, and Wilde Lake Middle School.
- Test soil to determine potential for infiltration.
- Identify funding mechanisms such as Chesapeake Bay Trust.

Figures 4.28 and 4.29 show examples of the restoration concepts.

Figure 4.27 Raingarden. Similar application though proposed facility would be larger (LID Center, 2005).

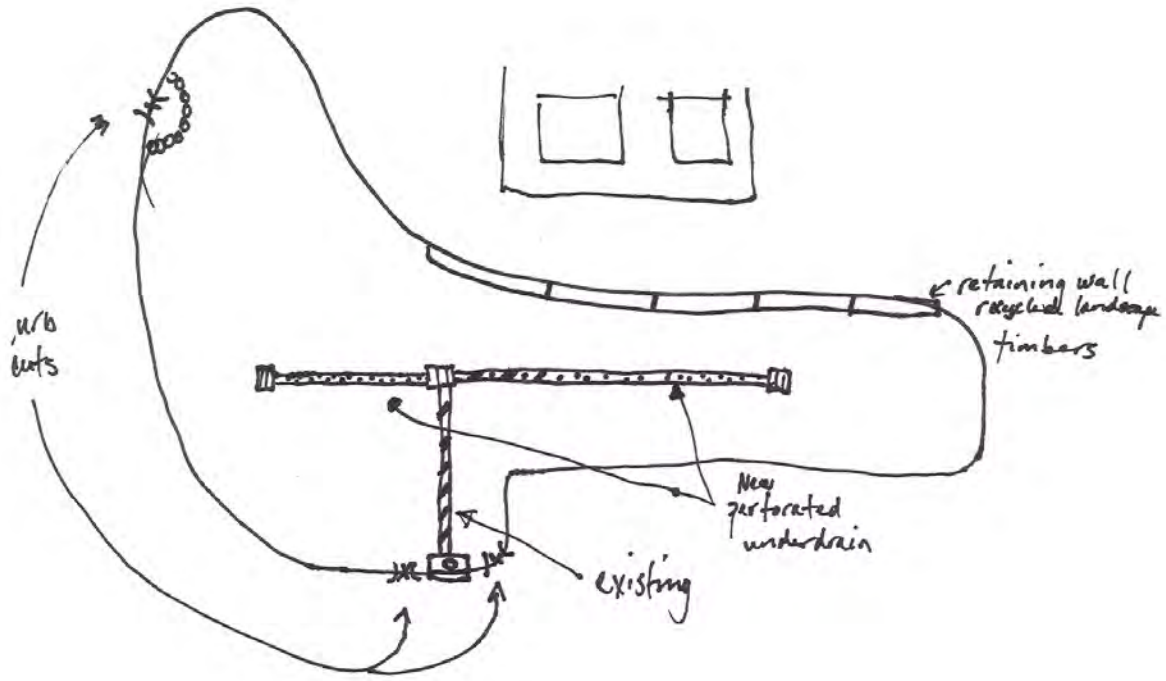


Figure 4.28 Plan view.

Figure 4.29 Sketch of WL-01 concept on aerial photo.

WL-03 HARPERS FOREST APARTMENTS

Location
Apartment complex off of Turnabout Lane

Jurisdiction
Howard County, Wilde Lake Watershed

Stakeholders

- Property Management Company
- Columbia Association

Site Description
The apartment complex and some neighboring townhomes currently discharge untreated stormwater runoff to an ephemeral drainage channel that was likely a historic headwater stream

(Figure 4.30). Two 18-inch RCP outfalls exist, both showing signs of impacts from significant uncontrolled flows. The easternmost outfall is actively eroding and has recently been repaired by placement of riprap. The receiving channel is incised and a source of significant sediment loads downstream. Some woody riparian growth is present immediately adjacent to the channel. The channel is located within CA's park area and has a sanitary line running roughly parallel on the north side.

Figure 4.30 Apartment complex.

Proposed Practice

The proposed concept involves constructing a shallow marsh wetland facility at this location that would have forebays for pretreatment at each outfall. Some parkland would be consumed to accommodate that necessary footprint, and some temporary tree loss would occur. An embankment will need to be created at the downstream end in the vicinity of the current footbridge to establish a permanent pool. Once complete and allowed to establish, the facility would result in a net increase in habitat and would provide needed water quality and channel protection treatment for a significant drainage area. The site would also provide educational opportunities using interpretive signage and provide an opportunity for community residents to participate in long-term routine maintenance activities.

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Water quality treatment will be provided for ~ 14 acres of currently untreated runoff.
	Channel Protection	Channel protection will be provided that should reduce downstream sediment loads, where active channel erosion is occurring as a result of uncontrolled urban runoff.
	Wetland or Forest Impacts	Temporary wetland and forest impacts will occur with construction, but should result in a net increase once the stormwater wetland is fully established.
Implementation	Planning Level Construction Cost	High (> $250,000)
	Implementation Feasibility	• The proposed facility would be mostly on CA lands; however, some construction may be needed on private property associated with apartments, which makes implementation harder. • Wetland permits could be issued. • Educational opportunities should also serve as an incentive.
	Physical Feasibility	• Easy access. • Routine maintenance could be provided to community groups.

Drainage Area

14.0 acres (approximately 40% impervious). The target water quality volume (based on a 1-inch runoff depth) is 0.5 acre-feet. The target channel protection volume is approximately 0.7 acre-feet. Using some simplified rules of thumb, there appears to be adequate space to accommodate the target storage volumes for both water quality and channel protection. The estimated footprint of the facility would be about 0.8 acre.

Features

- Forebays at two existing outfalls to provide pretreatment and energy dissipation.
- Excavated wetland cell.
- Embankment with outlet control structure (e.g., weir wall with hooded orifice) in the vicinity of the existing foot bridge.
- Signage describing native plantings and the purpose and benefit of stormwater treatment.

Next Steps

- Discuss concept with key stakeholders to gauge interest.
- Develop better understanding of depth to seasonally high groundwater table and assess water balance for the proposed concept.
- Investigate past issues in the area with respect to flooding and erosion mitigation.
- Explore permitability of retrofit at this location through discussion with U.S. Army Corps of Engineers and MDE representatives.

Figures 4.31, 4.32, and 4.33 show examples of the concepts presented for the Harpers Forest Apartments.

Figure 4.31 Left photo shows 18-inch RCP outfall adjacent to apartments that has been recently lined with riprap to reduce erosion. Right photo shows managed turf area adjacent to the conveyance channel.

Figure 4.32 North side of conveyance channel that contains sewer ROW.

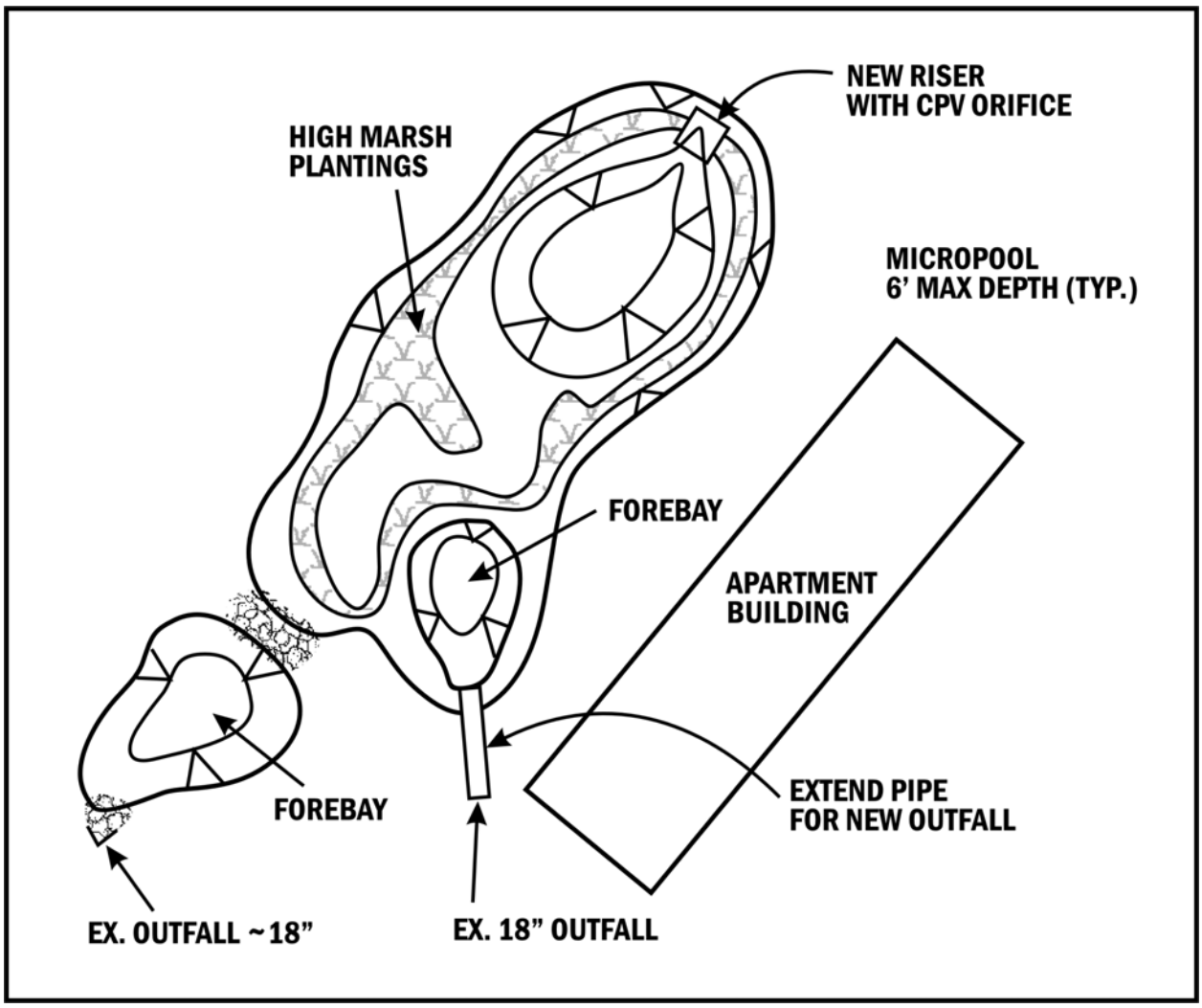


Figure 4.33 Concept sketch for shallow marsh wetland.

WL-104 CEDAR LANE PARK, EAST SIDE

Location
Located on the south side of Route 108, east of Cedar Lane (Figure 4.34)

Jurisdiction
Howard County, Wilde Lake Watershed

Stakeholders
- Department of Recreation and Parks
- Local park users

Figure 4.34 East side of Cedar Lane Park.

Site Description
The east side of Cedar Lane Park contains a variety of paved surfaces for access, parking, tennis courts, and other park services, that drain directly to Reach A. The stream channel below this area begins to show signs of instability, and stormwater runoff improvements at this location will help to reduce erosion in the immediate area and offers an opportunity to demonstrate on-site control techniques. Runoff is generated from the parking lot, entrance road, and park facilities, including rest rooms and tennis courts. Runoff from the site flows directly into the tributary that bisects the site. A storm drain outfall located just upstream of the maintenance road crossing conveys a significant amount of runoff from the parking area and entrance road.

Proposed Practice
The proposed concept involves a suite of on-site retrofits to treat runoff at or near its source. Treatment #1 consists of two small bioretention cells to treat parking lot runoff—one along the top edge of the parking lot and the other in an expanded island; #2 consists of a small linear native planting strip or bioretention to capture runoff from the tennis courts; #3 consists of a new water quality retrofit/floodplain connection project adjacent to the stream channel; #4 consists of a rain barrel/rain garden demonstration project at the rest rooms, and #5 consists of a rain garden adjacent to the entrance road, discharging to a grassed swale that drains to the stream channel.

Evaluation Factors		
	Factor	Comments
Environmental	Water Quality Benefits	Water quality treatment will be enhanced for 6 acres of drainage (1.4 impervious acres) and recharge will be promoted.
	Channel Protection	The on-site treatment projects do not include channel protection, but the grass swale and recharge component should reduce the peak discharge rate to some extent.
	Wetland or Forest Impacts	Riparian area in mowed condition does not contain existing wetlands or forest.
Implementation	Planning Level Construction Cost	On-site: Medium ($50,000– $150,000) Storage: High (>$200,000)
	Implementation Feasibility	• Land is publicly owned, which makes implementation easier. • Educational opportunities should also serve as an incentive.
	Physical Feasibility	• Easy access.

Drainage Area
6 acres on-site drainage, including 1.4 impervious acres

Target water quality storage area needed is about 1,750 sqare feet for treatment #1, 1,090 square feet for treatment #2, and 544 square feet for treatment #5. Treatment #4 is a very small rain barrel concept. Drainage area to storage treatment area is approximately 100 acres, with about 30% impervious cover. The available space is inadequate to treat the entire WQv; however, this site is recommended for further investigation for floodplain reconnection to relieve downstream channel stress.

Features
- #1 – Excavated and expanded landscaped island with curb cuts that allow sheet flow to enter every 10–15 feet, as well as curb cuts along north edge of parking lot to a second cell.
- #2 – linear native landscaped strip (underdrain optional) on north side of tennis courts to receive sheet flow runoff.
- #4 – curb cut and flow diversion into rain garden area with grassed swale to carry overflow drainage
- Grass filter strip pretreatment on bioretention and rain garden.
- Perforated underdrains tied into existing storm drain infrastructure/drainage swale system.
- Existing inlet sealed off to surface flows so that it enters the bioretention cell.
- New planting media approximately 2.5 feet in depth and a native plant planting plan that includes tree and shrub species.
- Floodplain reconnection provided with notched streambanks to allow flow to expand into floodplain area that is graded with mircopools and microtopography to provide temporary storage. Area to be reforested and stabilized at inlet and outlet points

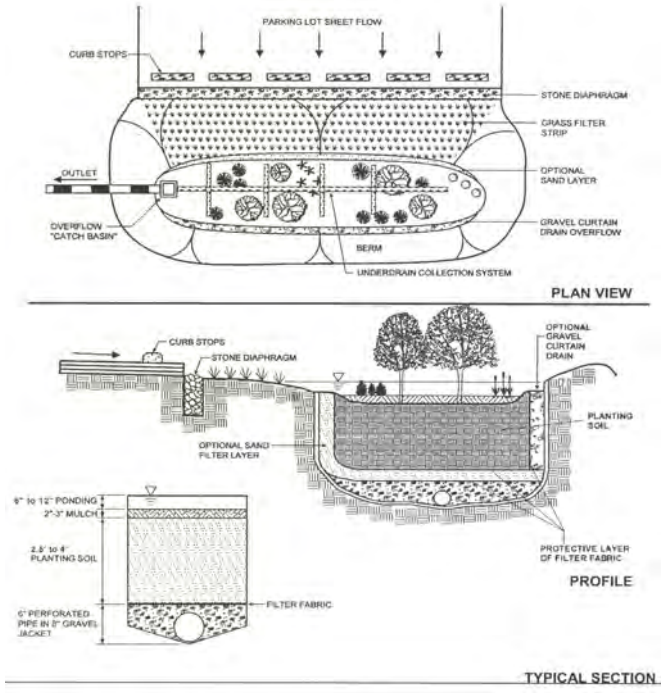
Next Steps
- Initiate discussions with Department of Recreation and Parks about the benefits, costs, and design options.
- Determine whether maintenance access can be accommodated in conjunction with floodplain reconnection in the grassed floodplain area.
- Explore permitability of floodplain reconnection.

Figures 4.35 through 4.40 show examples of current problems and recommended restoration techniques for this site.

Figure 4.35 Proposed rain garden location and example.

Figure 4.36 Eroding outfall from parking area/road.

Figure 4.37 Proposed floodplain reconnection.



Source: Maryland Stormwater Design Manual, 2000)

Figure 4.38 Bioretention schematic.

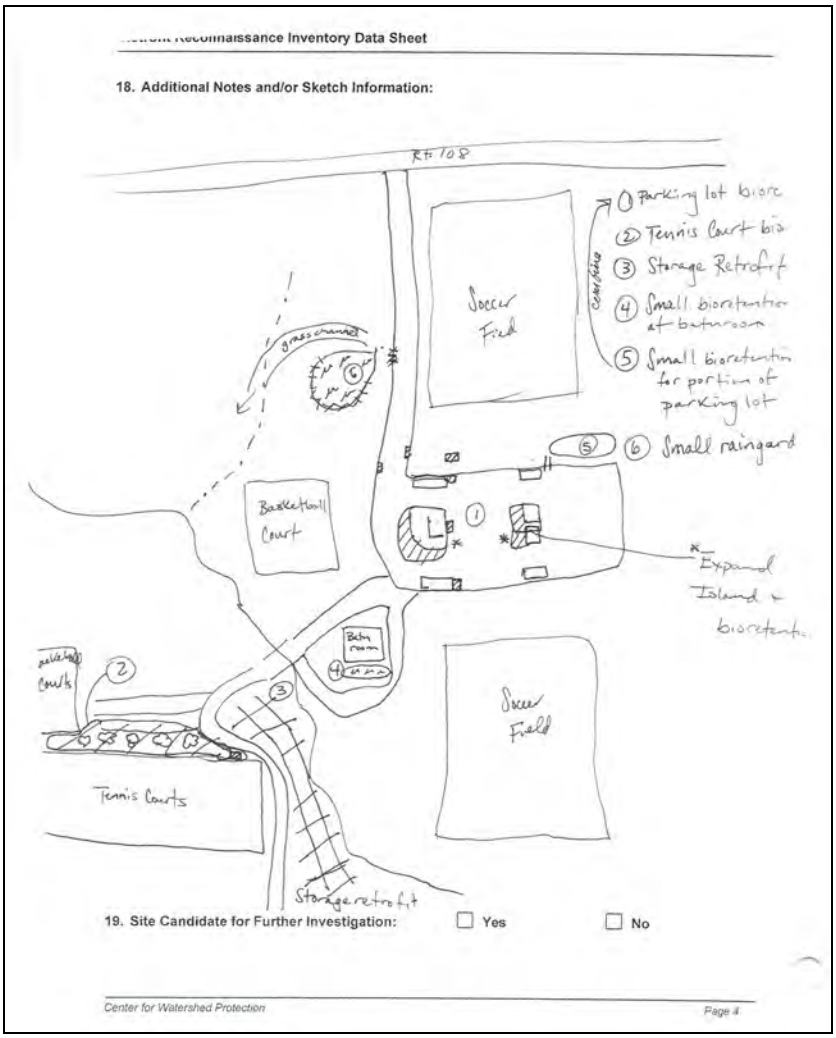


Figure 4.39 Additional sketch of restoration concepts.

Figure 4.40 Proposed rain barrel/rain garden.

WL-102A/B BEAVERBROOK

Location
Beaverbrook (Figure 4.41)

Jurisdiction
Howard County, Wilde Lake Watershed

Stakeholders
- Beaverbrook Homeowners Association
- Residents on Durham Road West and Lake Circle West and a small portion of Castle Moor Drive

Figure 4.41 Existing conditions.

Site Description
Beaverbrook is located south of Maryland Route 108 near the intersection with Centennial Lane. Beaverbrook residents live in close proximity to both Centennial Lake and Wilde Lake, though the community drains primarily to Wilde Lake. The two sites for the Streetscape projects are Durham Road West on both sides of the intersection with Castle Moor Drive and Lake Circle West below the intersection with Castle Moor Drive. The location is a priority because of a highly eroding stream reach that flows between Durham Road West and Lake Circle West.

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Treatment of at least the 1st inch of runoff—roughly equaling 90% of annual runoff and the water quality storm.
	Channel Protection	Promotion of infiltration to reduce the volume of runoff from smaller storm events (< 1 inch).
	Wetland or Forest Impacts	None.
Implementation	Planning Level Construction Cost	High ($150,000–$250,000) each. Possible to apply for grants to reduce public costs.
	Implementation Feasibility	Access good—road right of way owned by Howard County. Possible issues with utilities and uninterested landowners.
	Physical Feasibility	Easy access.

Proposed Practice
The practice proposed for this site is streetscaping and bioretention. The concept reduces street widths and creates linear bioretention cells within the existing street right-of-way. The cells are designed to promote infiltration and evapotranspiration. Facilities are planted with native species and require agreements with the landowners to permit construction and to assist with maintenance activities. Examples are provided in Figures 4.42, 4.43, 4.44, and 4.45 of similar practices that have been implemented in the Pacific Northwest and represent some of the possible options for these two sites. Public education, acceptance and participation in the design process are critical factors for whether this project can be implemented.

Area
Area 1—2.7 acres IA
Area 2—1.1 acres IA

Features

- Planting with native species.
- Promotion of infiltration to reduce runoff volumes.
- Water quality treatment of road and lot runoff.
- Signage for public education.
- Traffic-calming and aesthetic benefit.
- Potential for increase in property values.

Next Steps:

- Discuss the site with Homeowners' Association, individual homeowners, and Howard County Roads Department.
- Identify potential funding mechanisms.

Figure 4.42 Example streetscape stormwater filtration (Seattle, WA).

Figure 4.43 Seastreets in Seattle before and after construction (SPU, 2004).

Figure 4.44 SeaStreets aerial photo postconstruction.

Figure 4.45 Streetscaping bioretention project and signage within the existing roadway (Portland BES, 2005).

WL-15 HARPERS CHOICE MIDDLE SCHOOL

Location
Located at end of Beaver Kill Road, which is off of Harpers Farm Road, north of Little Patuxent Parkway

Jurisdiction
Howard County, Wilde Lake Watershed

Stakeholders
- Board of Education
- Columbia Association

Figure 4.46 Harpers Choice Middle School dry pond.

Site Description
An existing dry pond (Figure 4.46) provides limited stormwater management function at this school site. The existing practice suffers from eroding conditions at the two inflow points as well as a riser structure. Standing water is commonly found during wetter periods of the year (i.e., spring and fall). Runoff is primarily from the parking lot, the road, and some rooftops. Outflow from facility ties into the existing storm drain infrastructure.

Proposed Practice
The proposed concept involves modifying the pond bottom to provide both recharge and enhanced water quality treatment using a bioinfiltration approach. Recharge is provided by overexcavating (~3–4 feet) the existing pond bottom and backfilling with rock or a combination of rock and perforated arch pipe. The rock layer is then covered by a 12- to 18- inch sand/soil planting media. A perforated underdrain can also be provided that ensures effective drainage of the soil media. The underdrain discharges via a connection to the riser. Native plantings, including trees and shrubs, can be planted in the soil media, providing a good educational opportunity for the school and local community. New forebays that provide more effective pretreatment are also proposed.

Drainage Area
4.4 acres (approximately 90% impervious)

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Water quality treatment will be enhanced for 4 acres of impervious cover and recharge will be promoted.
	Channel Protection	No channel protection design is being incorporated, but recharge component should reduce downstream flow volumes to some extent.
	Wetland or Forest Impacts	Area is mostly upland area that should have no wetland or forest impacts.
Implementation	Planning Level Construction Cost	Medium ($50,000 - $150,000).
	Implementation Feasibility	• Land is publicly owned, which makes implementation easier. • Educational opportunities should also serve as an incentive.
	Physical Feasibility	• Easy access. • Routine maintenance could be provided the school groups during the school year and by community groups in summer.

Features

- New forebays with deeper sumped plunge pools to be provided to drop out coarse sediment, provide energy dissipation, and better distribute flows to bioinfiltration cell.
- Excavated bioinfiltration cell composed of 24- to 30- inch recharge zone containing washed #57 stone or a combination of #57 stone and perforated half-round plastic pipe.
- Overlay stone reservoir with a 6-inch perforated underdrain manifold that ties into the riser.
- Backfill stone reservoir with 18 inches of sand/soil mixture that is planted with native plants, including shrubs and trees. Trees and shrubs should not be planted directly on top of underdrain.
- Signage describing native plantings and purpose and benefit of stormwater treatment.

Figures 4.47, 4.48, and 4.49 show examples of the concepts presented here.

Next Steps

- Initiate discussions with Board of Education representatives about the benefits, costs, and design options.
- Determine whether existing riser structure can be used.
- Investigate soil properties 3 to 10 feet below the current facility bottom elevation.

Figure 4.47 Existing inflow to dry pond.

Figure 4.48 View of riser from opposite embankment.

Figure 4.49 Typical perforated plastic half pipe used for recharge.

WL – IB 1 THRU 8 IMPACTED BUFFER AND STREAM REPAIR

Location
Small areas of impacted stream buffer (Figure 4.50) and associated stream channel erosion located along Reaches A, C and F

Figure 4.50 Impacted buffer.

Jurisdiction
Howard County, Wilde Lake Watershed

Stakeholders
- Columbia Association
- Local park users

Site Description
Seven locations of impacted stream buffer have small areas of channel erosion resulting from poor streambank vegetative cover and channel incision. These areas are recommended for stream repair and buffer enhancement measures to reduce the sediment source caused by ongoing bank erosion.

Proposed Practice
The proposed practice at these locations consists of a combination of stream repair measures, including grading back and shaping the streambanks, toe protection, riparian planting, and, in some cases, wing deflectors or similar treatments to redirect flows. The affected areas are small and the use of large stone and grade control is not deemed necessary.

Evaluation Factors		
	Factor	**Comments**
Environmental	Water Quality Benefits	Eroding streambanks will be repaired, reducing sediment loads to the local streams and ultimately to the Lake.
	Channel Protection	N/A
	Wetland or Forest Impacts	Impacted areas, though in riparian areas, are in disturbed condition with no wetlands present. Access should be carefully planned to avoid impacts.
Implementation	Planning Level Construction Cost	$15,000 - $20,000 Done in-house by Columbia Assocation
	Implementation Feasibility	Columbia Association ownership will require some coordination for funding and permitting.
	Physical Feasibility	• Access varies. Sites IB 1, 2, 5 and 7 have good access; other sites involve longer access routes and some potential tree and/or path disturbance.

Stream Length for Treatment
A total of 280′ of impacted buffer area is recommended for treatment:

IB-1: 40′, IB-2: 20′, IB-3: 20′, IB-4: 70′, IB-5: 40′, IB-6: 60′, IB-7: 30′, IB-8: 30′.

Features
- Bank shaping to achieve 3:1 slope
- Revegetation of streambanks using shade tolerant native live stakes in shadier areas and soil lifts and live stakes in sunnier locations
- Stone toe protection

Next Steps
- Develop detailed planting plans and an access and pedestrian management plan
- Develop permit application materials including a detailed erosion and sediment control plan and pump around details if in-stream practices are used

Figures 4.51 through 4.54 show examples of current problems and potential controls for this site.

Figure 4.51 Typical inadequate buffer and streambank repair areas.

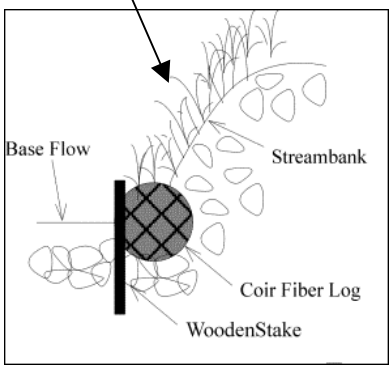
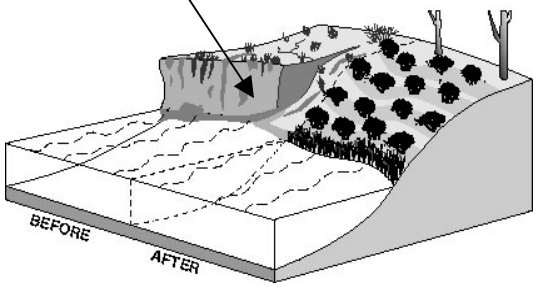
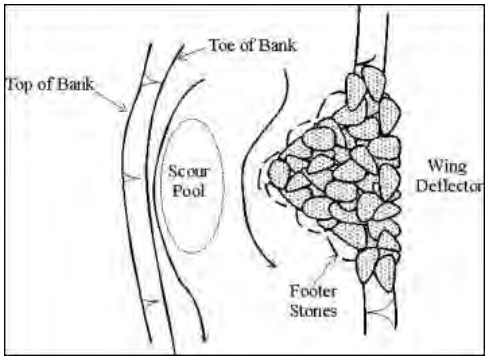


Figure 4.52 Example of how flow can be controlled.



Source: FISWRG, 1998

Figure 4.53 Before and after a streambank shaping project.



Streambank shaping and grade control

Figure 4.54 Examples of deflectors and grade control where more structural bank protection is needed.

Figure 4.55 shows the location of impacted buffer sites 1-8.

Figure 4.55 Location of impacted buffer sites 1-8.

4.3 PROGRAMMATIC RECOMMENDATIONS FOR THE CENTENNIAL AND WILDE LAKE SUBWATERSHEDS

Several different programmatic recommendations were identified that should benefit watershed implementation and other county planning efforts and improve future project development, as outlined in Table 4.8. These projects are also likely to reduce long-term costs because of the ability to cost-share projects, obtain grants, have other organizations take the lead on projects, and reduce time associated with assessment through better mapping, improved cooperation, and providing of seed funding for priority retrofits on private and public land.

Table 4.8 Summary of Programmatic Recommendations for Both the Centennial and Wilde Lake Watersheds

Site Name/Practice Type	Description	Estimated Cost	Coordination Team/ Project Partners
Improved GIS mapping of stormwater infrastructure schools, parks, etc.	Improve and make seamless the stormwater infrastructure layers for the county. In a number of instances stormwater infrastructure information was missing from the GIS data set particularly associated with schools, parks, and some CA land. Use a student intern to ground truth and improve the layers.	$10,000*	DPW
Improved cooperation and coordination	There are a number of overlapping goals of improved water quality, education, public aesthetic improvements, and compliance with federal permits that are of shared interest Stakeholders should work cooperatively and coordinate efforts to apply for grants, low interest loans, foundation support, and other innovative funding sources.	Time cost	Recreation and Parks (REC) DPW Board of Education (BOE) Stakeholder groups i.e., Little Patuxent Watershed Association (LPWA) Planning and Zoning (DPZ)
Green Fund	Provide financial incentives for businesses and nonprofit organizations to provide stormwater retrofits for untreated roads, parking, and maintenance facilities (those identified in a watershed plan). May need an initial threshold for funding, e.g., treatment of 0.5 IA/$25,000 and a maintenance agreement. A higher threshold/funding could be established for larger projects, e.g., >2.0 acres IA/$200,000.	3 projects/year $25k/ project 1 project/year $125/project total $200k	Public Works
County Sustainability Program	Create a three-tiered educational program that targets homeowners, businesses, and municipal practices. Form a sustainability workgroup composed of citizens, private businesses, CA, and County staff from different agencies and examine existing municipal practices and make a set of sustainability recommendations on municipal practices including turf management on County properties, outdoor storage and fueling, reforestation on County properties, deicer usage, road maintenance, pollution prevention standards for contractors, and alternatives to extension of curb and gutter; all in order to reduce impacts on streams and the overall environment. (See Appendixes C and E for more guidance.)	1 staff position	DPW

In addition, Appendix C contains fact sheets on a number of pollution and source control practices recommended for the Wilde Lake subwatershed, including the following:

- Reduced Fertilizer Use
- Reduced Pesticide Use
- Natural Landscaping
- Tree Planting
- Yard Waste Composting
- Safe Car Washing
- Car Fluid Recycling
- Downspout Disconnection
- Pet Waste Pickup
- Bufferscaping
- Storm Drain Marking
- Vehicle Maintenance and Repair
- Vehicle Fueling
- Vehicle Washing
- Vehicle Storage
- Loading and Unloading
- Outdoor Storage
- Spill Prevention and Response
- Dumpster Management

Appendix D contains guidance for creating rain gardens and rain barrels.

Appendix E details information from a similar sustainability program (though with a slightly different focus).