A Guide to Retrofitting Stormwater Ponds on Private Lands

Prepared by:

Center for Watershed Protection, Inc.

County of Albemarle, Virginia

with funding from:

National Fish and Wildlife Foundation

October 2019

Table of Contents

Table of Tables

Table of Figures

Acronym Definitions

BMP	Best Management Practice
GIS	Geographic Information System
HOA	Homeowners' Association
MS4	Municipal Separate Storm Sewer System
NFWF	National Fish and Wildlife Foundation
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TN	Total Nitrogen
TSS	Total Suspended Solids (often simply "sediment")
VADEQ	Virginia Department of Environmental Quality
WQv	Water Quality Volume

Executive Summary

The purpose of this document is to guide local governments/entities, nonprofit organizations, and consultants in their efforts to retrofit stormwater ponds on private property. While the process of retrofitting on public and private lands is similar, working on private lands presents unique challenges. This guidebook explains the differences between retrofitting on public and private properties and chronicles a case study in Albemarle County and the City of Charlottesville that began as a stormwater retrofit on private property and ended as a collaborative stream restoration. This guidebook and our process is split into five steps: desktop analysis, field reconnaissance, final prioritization, project design, and project construction. Every detail of the process is outlined in this guidebook—from GIS model creation to crediting calculations to property owner outreach to managing legalities.

Each step is related to the Albemarle County case study to illustrate the process with a "real-world" example, which is especially relevant for those working within the Chesapeake Bay Total Maximum Daily Load (TMDL) guidelines. Additionally, throughout the guidebook, you will find Pro Tip, Lesson Learned, and Challenge boxes with professional insight gleaned from the Albemarle County project. These key points can only be learned from experience, so take advantage of them to streamline your project and avoid preventable problems.

We hope this guidebook helps you implement successful projects while navigating the unique constraints of working on private lands.

Introduction to this Guidebook

Target Audience

This guidebook is intended for local governments, nonprofits, and consultants interested in implementing stormwater retrofits on private property. The case study included is especially relevant to communities included in the Chesapeake Bay Total Maximum Daily Load (TMDL) effort. While the discussion around unique constraints and opportunities associated with working on private property will be widely relevant, the specifics associated with calculating pollutant removal toward TMDL objectives will be more relevant to communities located in Virginia, as crediting protocol varies by state.

Purpose

Undertaking stormwater projects on private property presents unique challenges and opportunities. This document serves as both a case study and a guidebook for completing stormwater retrofits on private property. In it, we share details of recent efforts in Albemarle County, Virginia to identify, prioritize, and construct retrofits of privately-owned detention basins in a cost-effective manner that provides value to both private and public stakeholders. Stormwater managers in other communities can take away lessons from our experience as they embark on their own pursuit of retrofits on privately-owned lands.

How to Use this Guidebook

This guide is divided into four sections (desktop analysis, field reconnaissance, final prioritization, and project design/construction) that reflect the major project steps we took in Albemarle County. While many local governments, consultants, and nonprofits have experience identifying and selecting stormwater facilities for retrofits, fewer have experience navigating constraints to work on private property. This guidebook will be particularly useful in documenting how to navigate the unique challenges and opportunities for implementing projects on private property.

In addition to detailing this case study, this guidebook includes highlights of some specific challenges, lessons learned, and ideas for alternative approaches in the quest for private retrofits of stormwater best management practices (BMPs).

Acknowledgements

This guide was prepared by Stavros Calos (Albemarle County), Laurel Williamson, Jordan Fox, and Ari Daniels (Center for Watershed Protection, Inc.).

Organizations involved in this project were Albemarle County, Center for Watershed Protection, Inc., Hirschman Water & Environment, and Ecosystem Services, LLC.

Grant funding was provided by the National Fish and Wildlife Foundation's (NFWF) Chesapeake Bay Stewardship Fund for a project to identify, prioritize, and implement BMP retrofits on private property and for the development of this guidebook.

Project Background

The primary objective of the project was to pilot a system to identify, prioritize, and construct cost-effective stormwater retrofits on private property. In the context of this guidebook, a stormwater retrofit is defined as improving an existing stormwater best management practice (BMP) in a manner that increases its pollutant removal capabilities. Previous studies and experiences by Albemarle County have shown that retrofitting existing dry detention ponds provides a cost-effective method to achieve pollution reductions from urban stormwater and Total Maximum Daily Load (TMDL) goals. Dry detention basins reduce impacts of stormwater quantity by capturing and slowly releasing runoff, but they do not result in significant reduction in pollution from intercepted stormwater.

While Albemarle County has taken advantage of these retrofits on *public* lands, the number of stormwater retrofit candidates located on publicly-owned land is minimal compared to candidates located on privately-owned land. The vast majority of land and stormwater facilities in Albemarle County and other localities are privately-owned. In Albemarle County, for example, only 70 out of 925—less than 8%—existing stormwater BMPs are owned or managed by the county government (at the time of this analysis). Furthermore, Albemarle County owns less than 3% of the land within its urban area, limiting the amount of space available for constructing new BMPs on public land. Many local governments face similar constraints.

Albemarle County is located within the Chesapeake Bay Watershed, which has recognized impairments from and associated TMDLs for nitrogen, phosphorous, and sediment. The County also has local streams with TMDLs for sediment and/or bacteria. All BMP retrofits considered during this project are located within Albemarle County's Municipal Separate Storm Sewer System (MS4) boundary, which would allow the County to claim credit for nitrogen, phosphorous, and sediment reductions as part of Chesapeake Bay and local TMDL goals.

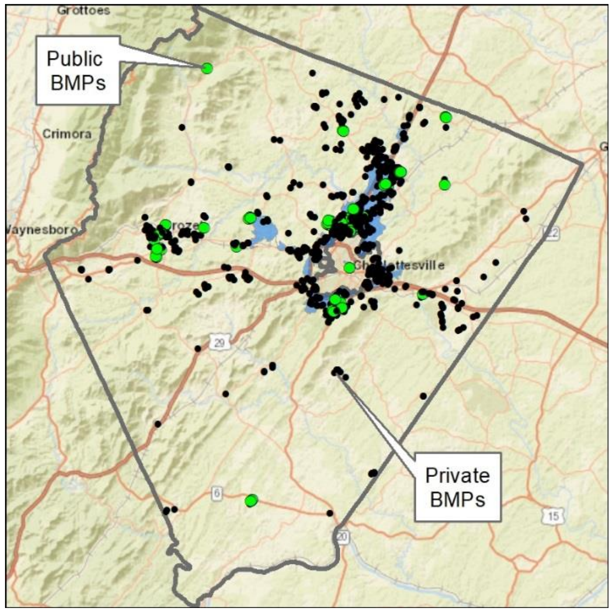

Figure 1. BMPs on public and private lands in Albemarle County, VA.

Approximately 150 of the 259 pre-existing stormwater basins in Albemarle County are dry detention basins. These facilities typically already have major infrastructure and grading in place, and they can often be retrofitted into bioretention facilities, extended detention ponds, constructed wetlands, or wet ponds for improved and cost-effective pollutant removal. Mechanisms for increased pollutant removal typically involve enhanced runoff reduction, sediment settling, and/or water filtration mechanisms. Beyond reducing pollution and stormwater volumes into downstream waterways, these retrofits can also create amenity features from often outdated and unsightly stormwater facilities. They can also serve to reduce the liability associated with underperforming and/or antiquated stormwater facilities.

A hypothesis guiding this project was that stormwater retrofits on privately-owned land will be cost-effective when compared to retrofits on public property, provided that private property owners can be incentivized to participate. This project serves as one test to see if this is indeed true, so that Albemarle and other localities can decide how to best allocate limited funding to ensure maximum water quality improvements.

Desktop Analysis

A desktop analysis was our first step in identifying and prioritizing which BMPs to assess in the field for retrofit possibilities. The factors that one considers during their desktop analysis may depend on data availability. For example, localities that do not have stormwater infrastructure mapped or high-quality elevation data available will have difficulty in mapping drainage areas for stormwater facilities. Localities that do not have landcover data available will have more difficulty calculating pollutant loads flowing into stormwater BMPs. Use your available data as a guide for which screening criteria to use and prioritize in your desktop analysis. At the very least, it is important to have BMP drainage areas, as many calculations involved in prioritizing retrofits ultimately depend on drainage area.

In the Albemarle County project, we used the screening criteria outlined in Table 1 during the desktop analysis.

Table 1. Screening criteria used for desktop analysis.

Screening Criterion	Description
BMP Type	BMPs called "Dry detention" in the County's database
Location	On private property within the MS4 boundary
% Water Quality Volume (WQv)	Estimated the percentage of the drainage area's WQv that could be captured by a potential retrofit in the basin
Phosphorus Reduction	Estimated annual removal of total phosphorus by the potential retrofit (using methods from VADEQ, 2015); phosphorus is the target stormwater pollutant in Virginia
Cost Effectiveness	Estimated construction costs per pound of phosphorus removed, based on King & Hagan (2011)
Ease of Access	Estimate of how easy or difficult it is for heavy equipment to access the basin for construction and maintenance
Number of Parcels Impacted	Number of parcels the basin intersects and/or the number of parcels needed to cross for access
HOA Ownership	Whether the basin is located on Homeowners' Association property

Challenge

In the County's stormwater BMP database, the BMP-type terminology was not standardized (e.g., some basins that are actually extended detention basins were called "detention basins," while others were old sediment traps that served questionable purpose from the beginning). Initial classification of BMPs can present complications in assessing retrofit capabilities.

Several of the screening factors above required GIS-based analysis and calculations.

Table 2 shows which spatial data layers we used and for what purpose.

Lesson Learned

Consider utility constraints in GIS before visiting sites in the field.

Table 2. GIS data used in desktop analysis for site selection.

Layer	Usage
MS4 Boundary	Selecting BMPs within the MS4 boundary only
BMP Type & Location	Selecting only dry detention basins within the MS4 boundary, on private property
Parcel Boundaries & Ownership	Estimating # of parcels impacted by retrofit & associated access
Aerial Imagery	Estimating ease of access and the ponding area of potential retrofit
Contour Lines (2-ft and 4-ft)	Estimating ease of access,ponding area, and storage volume available for potential retrofits
Stormwater Infrastructure	Stormwater conveyance infrastructure helps verify BMP drainage areas.
Drainage Area of BMP[1]	Calculating runoff volume (for WQv calculation) and pollutant loads reaching each basin (total nitrogen, total phosphorus, and total suspended solids)
Ponding Footprint of BMP	Calculating storage volume (%WQv retained/detained)
Land Cover (Impervious, Pervious, & Forest)	Calculating average runoff volume and pollutant loads reaching each basin (total nitrogen, total phosphorus, and total suspended solids)

Layer	Usage
[1] Drainage areas were already mapped prior to this project.	

Overall GIS Model for Desktop Analysis

Many aspects of the GIS desktop analysis may be automated and/or performed in batch processing to reduce the level of effort required to complete desktop analysis. Figure 2 below provides a general model for how key tasks within GIS may be automated to provide metrics and calculations for prioritization.

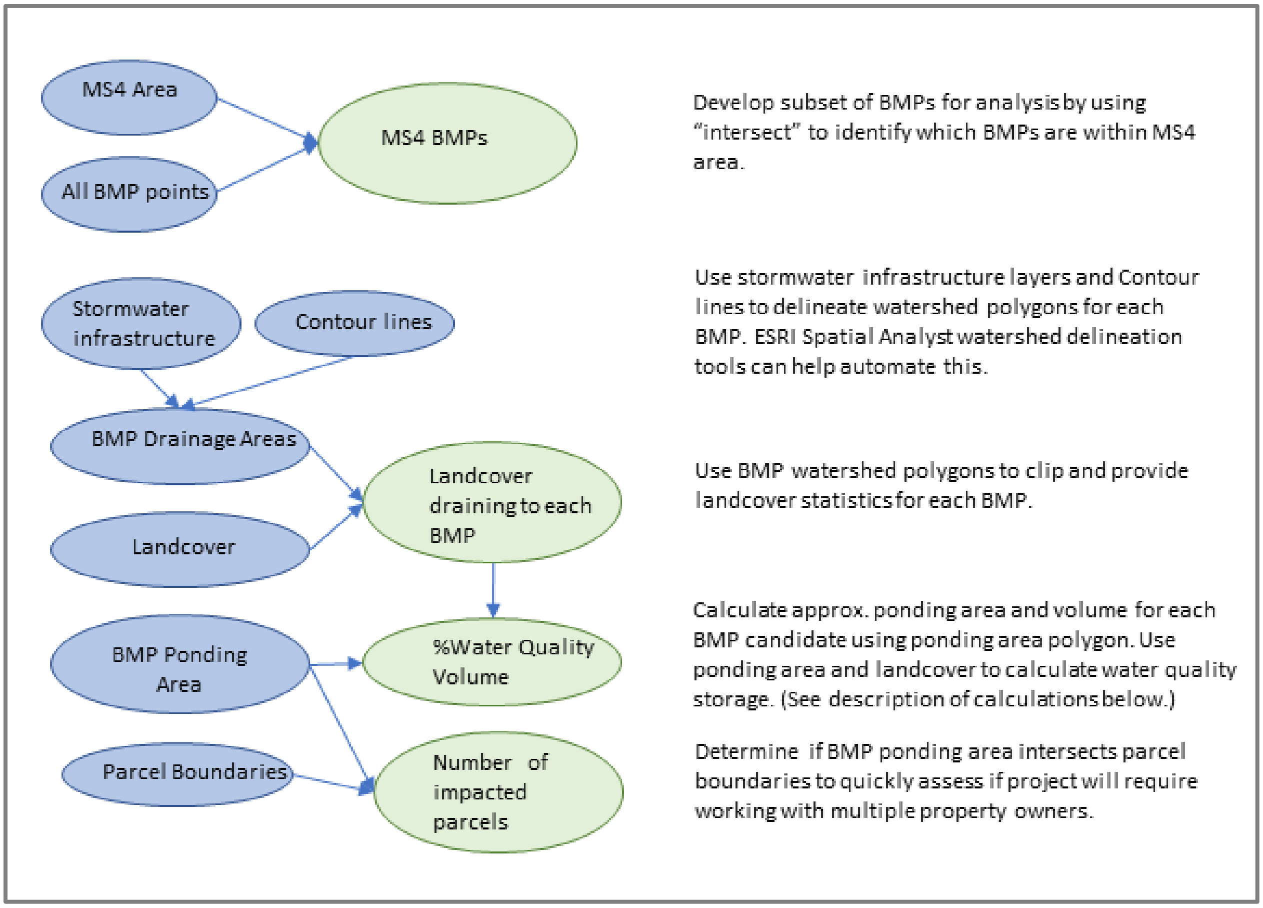

Figure 2. General model for GIS task automation for BMP prioritization calculations.

Metrics & Calculations

This section identifies the metrics and explains the calculations used to estimate the pollutant removal capacity of a potential retrofit in each of the dry detention basins identified on private property in Albemarle County's MS4 area.

Ponding Volume

Ponding volume (cubic feet) estimates the storage volume potentially provided by a potential retrofit, as estimated in GIS. We assumed each retrofit could store one-foot depth of stormwater over the entire ponding area of the existing basin.

Target Water Quality Volume (WQv)

This represents the "target" storage volume for a retrofit, based on treating runoff from one inch of rainfall on the drainage area. For reference, one inch is generally the minimum water quality treatment depth for BMPs installed to treat development or redevelopment in Virginia. Establishing a target water quality removal based on this standard is a useful tool to screen for potential projects that can offer significant pollution removal.

$$[\text{Target WQv}] = 1'' \times R_V \times \text{DA} \times 3{,}630$$

where:

[Target WQv] =	Target water quality volume (cubic feet)
Rv =	Composite runoff coefficient in the drainage area[1]
DA =	Drainage area (acres)
3,630 =	Unit conversion factor

Percent Water Quality Volume (% WQv)

This is a ratio of the ponding volume to the target WQv. The ideal condition is for a retrofit to be able to capture close to 100% of the WQv. Often retrofits cannot store the full target WQv due to site constraints. Values that are substantially lower than 100% show that retrofits are under-sized, and values much higher than 100% show that ponding volumes are over-sized for their respective drainage area. While these calculations are first-order approximations, they provide value in quickly estimating the storage capacity of each BMP relative to its watershed. Larger storage areas relative to watershed areas present more options in retrofit approaches, as water will not need to pond as deeply for the same storage benefits as it would for a facility that has a smaller ponding area relative to its watershed. Note that these calculations *do not* account for variations in depth among facilities—they look merely at the area available for storage and assume a uniform storage depth.

Lesson Learned

One of the most useful criteria from the desktop analysis was the % WQv available (ratio of available storage volume to WQv).

Drainage Area Pollutant Loads

These are the pollutant loads generated by the land covers in each drainage area *without any retrofit or existing practice*. The 2009 edge-of-stream loading rates for total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) were used from Phase 5.3.2 of the Chesapeake Bay Model for the James River Basin, as directed by VADEQ's Chesapeake Bay TMDL Action Plan Guidance (VADEQ, 2015).

$$[\text{Pollutant Load}] = (\text{UIA} \times \text{LR}) + (\text{UPA} \times \text{LR}) + (\text{FA} \times \text{LR})$$

where:

[Pollutant Load] =	TP, TN, or TSS load (lbs)
UIA =	Urban impervious area (acres)
UPA =	Urban pervious area (acres)
FA =	Forest area (acres)
LR =	Loading rate (lbs/acre/year; Table 3)

[1] Rv can be calculated in many ways but was simplified to equal (% Impervious × 0.95) + (% Pervious × 0.22)

Table 3. Loading rates for TP, TN, and TSS for various types of land cover without BMPs.

	TP (lbs/acre/year)	TN (lbs/acre/year)	TSS (lbs/acre/year)
Urban Impervious	1.76	9.39	676.94
Urban Pervious	0.5	6.99	101.08
Forest	0.13	2.36	77.38

Runoff Depth Captured per Impervious Acre

This value is necessary to estimate the pollutant removal credit that the retrofit can receive pursuant to the retrofit curves presented in the VADEQ TMDL Action Plan Guidance Document. This method for calculating pollutant removal is based on the amount of runoff captured per impervious acre and is expressed in inches. Using the assumption of one-foot ponding depth available, we calculated available ponding depth per impervious acre at each existing dry detention basin.

$$[\text{Runoff Depth per Impervious Acre}] = \frac{\text{Ponding Volume}}{\text{Impervious Area in Drainage Area}} \times \frac{1}{43{,}560} \times 12$$

where:

[Runoff Depth Per Impervious Acre] =	Runoff captured (inches) per impervious acre
Ponding Volume =	Storage volume (cubic feet)
Impervious Area in Drainage Area =	Impervious area (acres) in drainage area
1/43,560 =	Conversion factor (square feet to acres)
12 =	Conversion factor (feet to inches)

Pollutant Removal for BMP Conversions

We utilized equations associated with "performance curves" presented in Schueler & Lane (2012) to estimate potential removal of TP, TN, and TSS for each potential stormwater retrofit as a function of runoff depth captured per impervious acre. We assumed that each retrofit would be a runoff reduction retrofit and, therefore, used that curve. An example of a performance curve equation is shown below for a runoff reduction retrofit.

$$[\%\ \text{TP Removal}] = 0.0304(x^5) - 0.2619(x^4) + 0.9161(x^3) - 1.6837(x^2) + 1.7072(x) - 0.0091$$

where:

x = Runoff depth captured (inches) per impervious acre

In addition to the performance curves, pollution reduction totals were also calculated utilizing Chesapeake Bay Program approved efficiencies (VADEQ Chesapeake Bay TMDL Action Plan Guidance, 2015). These efficiencies simply provide a percent reduction of existing drainage area pollutant loads for different types of stormwater practices. For initial screening and prioritization, we assumed that each dry detention basin would be converted into a wet pond or wetland and that associated pollutant reduction would equal whichever method yielded greater total pollution reduction – the performance curves or Chesapeake Bay Program approved efficiencies. Removal efficiencies for dry detention ponds in addition to wet ponds and wetlands are summarized in Table 4.

Table 4. Chesapeake Bay Program approved pollutant removal efficiencies for dry detention ponds and for wet ponds/wetlands.

	% TP Removal	% TN Removal	% TSS Removal
Dry Detention Pond	10	5	10
Wet Ponds/ Wetlands	45	20	60

Since existing dry detention basins do provide minimal pollutant removal efficiency, it is necessary to apply a pre-retrofit performance discount to the total pollutant removal achieved by the retrofit.

Pre-Retrofit Performance Discount

Chesapeake Bay TMDL Guidance dictates that MS4s subtract any existing BMP efficiency from pollution reduction that is achieved through a retrofit. The difference between existing and improved pollutant removal efficiency is the amount that is eligible for Chesapeake Bay TMDL credit.

The BMP efficiencies for existing dry detention ponds are provided in Table 4. These efficiencies were subtracted from the calculated retrofit efficiency to determine the creditable amount of pollutant reduction.

However, based on existing conditions, some ponds exhibit performance issues, such as short-circuiting or bypassing of the treatment area, storage filling with sediment, clogging, or the practice being undersized. For each design deficiency that is present, pre-existing pollutant removal may be reduced by 10%, for a maximum of 50% total reduction of the dry detention efficiencies shown above in Table 4 (Chesapeake Bay TMDL Action Plan Guidance Appendix V.D.). In general, information necessary to determine pre-existing performance discounts was not available until BMPs were inspected in the field. As such, the prioritization spreadsheet was revisited and subsequently updated.

Retrofit Cost

These are planning-level costs for the retrofit type, using unit construction costs ($/per cubic foot treated) from available studies. With the caveat that cost data are notoriously variable, the unit costs were derived from a variety of sources, including James River Association (2013), King & Hagan (2011), Center for Watershed Protection, Inc. (2007), and, where available, actual construction bids for retrofit projects (see, for example, Center for Watershed Protection, Inc., 2011). These represent reasonable planning-level costs, but these data can be modified using local cost data. Additionally, it is important to note that these costs are construction costs and *not* BMP life-cycle costs. This is because construction costs are easier to ascertain and have less “scatter,” so they represent a more reliable metric to compare projects. Life-cycle costs include project planning and permitting, administration, long-term inspection and maintenance, and other costs. Information on life-cycle BMP costs is available from the West Virginia Department of Environmental Protection (2012), King & Hagan (2011), and Water Research Foundation (2009), among other sources.

$$[\text{Cost}] = [\text{Treatment Volume}] \times [\text{Unit Construction Cost}]$$

where:

[Cost] =	Cost to construct retrofit
[Treatment Volume] =	Water volume treated by retrofit (cubic feet)
[Unit Construction Cost] =	Cost of construction unit ($/cubic foot)

Cost Effectiveness

Since phosphorus is the keystone pollutant for Virginia regulations, TP was used to calculate cost effectiveness.

$$[\text{Cost Effectiveness}] = (\text{Retrofit Cost}) \div (\text{TP Removed})$$

where:

[Cost Effectiveness] =	Cost effectiveness ($/lb TP)
[Retrofit Cost] =	Cost of constructing retrofit ($)
[TP Removed] =	TP removed by retrofit (lbs)

Lesson Learned

Cost effectiveness values derived from the desktop analysis had a very large margin of error, making the metric somewhat unreliable as an initial screening criterion.

Results

Our desktop analysis whittled down the list of BMPs to look at in the field from approximately 1,000 to 32. Table 5 summarizes the results of the desktop analysis.

Table 5. Summary of BMPs assessed in desktop analysis.

Type	Count
Total BMPs in Albemarle County	Nearly 1,000
Dry detention basins in Albemarle County	147
Dry detention basins in MS4 area of Albemarle County	Private property: 82 Public property: 19
Dry detention basins selected by desktop analysis for field assessment	32

Bar charts in Figure 3 and Figure 4 show the range of WQv percent captured and pounds of TP removed annually for each of the 82 potential detention basin retrofits analyzed.

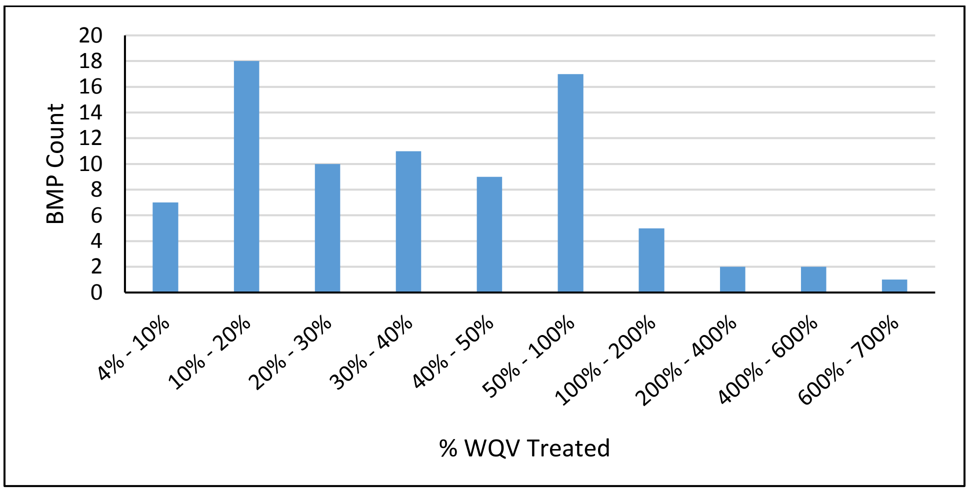

Figure 3. Percent of water quality volume captured.

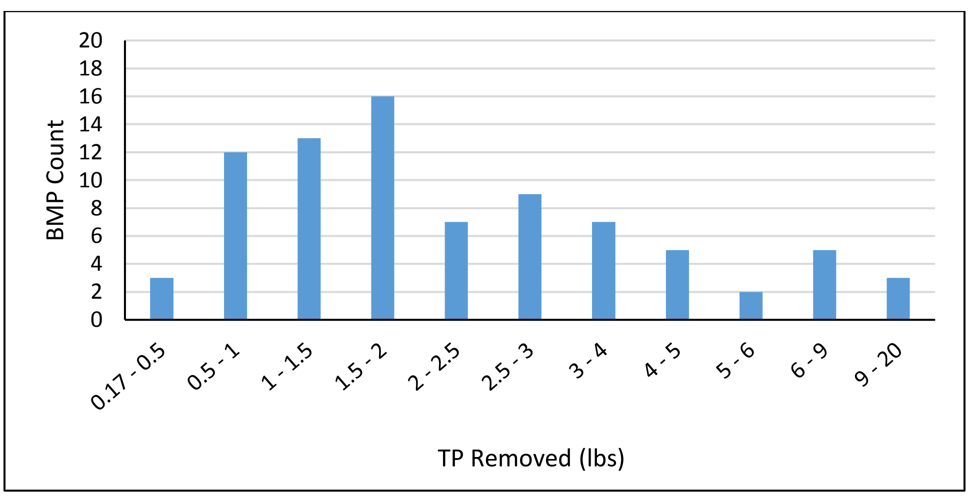

Figure 4. Phosphorus (lbs) removed annually.

Using results from the desktop analysis, "make-or-break" thresholds should be chosen to weed out sites that absolutely are not worth pursuing in the field. The thresholds developed for the Albemarle County project are presented below:

- Any potential retrofit with < 1.5 lbs of TP removal was excluded from further consideration, as these potential projects had such small pollution removal benefits that they were unlikely to present cost-effective pollution removal. Approximately 35% of BMPs did not meet this threshold.

- Any potential retrofit that could capture < 20% WQv was thrown out because these values indicate a stormwater facility that was drastically undersized relative to its drainage area. Approximately 30% of the BMPs did not meet this threshold.

Pro Tip

Use the desktop analysis as a weeding out tool (to identify candidates for field assessment) more so than a definitive ranking tool. Know what your constraints are for what would make a project a "no-go," before doing your desktop analysis. Easy to identify shortcomings such as the size of the facility relative to the size of the watershed make a big difference. During the desktop analysis stage, whittle down your list of BMPs just to the point where you can afford to individually assess BMPs in the field. The fewer BMPs you can afford to visit in the field, the more selective you will likely need to be.

Field Reconnaissance

Develop/use a paper or digital field form to note characteristics of each basin, such as:

- Level of vegetation
- Level of maintenance
- Working order
- Potential construction access
- Required tree clearing
- Relative invert elevations to help estimate available ponding depth
- Potential amenity value
- Options to expand footprints for each facility
- Appropriate retrofit types, based on site constraints (utilizing guidance from the Virginia Stormwater BMP Clearinghouse or other applicable standards and specifications)

> **Pro Tip**
>
> Depending on how many sites you need to visit in the field, collecting data in digital format may be easier to keep track of than on paper forms. This is especially true if you have to share the field data with many different people.

An example retrofit field form, as used during the Albemarle County project is shown in Appendix A.

Conduct your field reconnaissance after poor candidates are weeded out via desktop analysis. Divide up sites among field teams and regularly "calibrate" with each other to ensure that you are answering questions in a similar way. For the project in Albemarle County, there were two field inspection teams, and they each consisted of at least two members—one stormwater inspector and one water resources engineer. To ensure consistency and "calibration" of responses between inspection teams, the entire project team visited approximately one quarter of retrofit candidates together. The remaining three quarters were visited by teams of two to four. Each initial field visit required approximately 30 minutes onsite.

Common Detention Pond Conditions

Table 6 below details the opportunities/pros and challenges/cons of retrofitting detention ponds that have the following characteristics.

Table 6. Common detention pond conditions and associated pros/cons of retrofitting.

<table>
<tr><th colspan="2">1. Overgrown</th></tr>
<tr><td></td><td>Pros:
Retrofitting can clear out invasive species, if present
Retrofitting can provide better access to pond infrastructure
Cons:
A retrofit may reduce the overall biomass available to uptake nutrients in the practice
Significant plant clearing may be necessary before heavy equipment can access the pond (added cost)</td></tr>
</table>

<table>
<tr><th colspan="2">2. Filled In</th></tr>
<tr><td></td><td>Pros:
Good sign that the pond has been able to capture sediment (at least in the past)
Retrofitting and removing accumulated sediment increases storage capacity of the BMP
Cons:
Pipes and outlet structures may need to be cleared of sediment
Dirt will need to be hauled off-site
Potentially a sign that the drainage area continues to have a heavy sediment load that could clog the retrofit</td></tr>
<tr><th colspan="2">3. Frequently Maintained</th></tr>
<tr><td></td><td>Pros:
Signifies highly involved maintenance crew
Improves chances that retrofit won't be ignored in terms of maintenance
Cons:
If crew maintains a retrofit as they did the pond (e.g., frequent mowing), they may eliminate plant diversity</td></tr>
</table>

4. Not Accessible	
	**Pros:** • Retrofitting can provide better access to pond infrastructure **Cons:** • Significant tree clearing and/or excavation may be needed to access site with heavy equipment • Retrofit is not likely to be maintained either if it is in a location that is not very visible
5. Almost a Wetland	
	**Pros:** • Retrofitting may be as simple as planting new species to enhance the biodiversity and nutrient uptake **Cons:** • Current condition may be working well for water quality, so a retrofit may not greatly improve situation • Using heavy equipment may be difficult in boggy conditions

Final Prioritization

Based on observations in the field and any corrections to the initial calculations (described below), score and rank the BMP retrofit candidates from highest to lowest priority.

In our case, some incorrect assumptions about ponding area and watershed area were discovered during field reconnaissance. This allowed us to recalculate % WQv and pollutant removal values.

> **Pro Tip**
>
> Don't overuse the desktop analysis for site screening and final prioritization. Just use it to weed out obviously-incompatible BMPs and do more in-depth screening in the field. Field visits will reveal more information applicable to project cost, which can be used for final prioritization.

Create a scoring system. Give more weight to screening criteria that you think are more important than others. Note that weighting is extremely subjective and depends on criteria that are most important to the local government/entity that is conducting the project. For example, total pollutant removal may sometimes have the highest priority, whereas education and exposure may be more important in other settings. Table 7 below shows the scoring system developed for the Albemarle assessment. The higher the maximum possible score, the more weight was put onto that factor in final prioritization.

Utilizing field assessment results, determine potential retrofit types and associated pollutant removal totals for each facility. Based on the field assessments and unique constraints and opportunities at each site, the project team ultimately relied heavily on professional judgment and opinions of probable cost and risk to decide whether or not each basin was a feasible candidate for retrofit. Access, property boundary constraints, utility constraints, and probable earthwork volumes factored heavily into which facilities were ultimately deemed feasible. Candidates that were deemed infeasible were excluded from further analysis.

> **Pro Tip**
>
> Trust your gut in the field. Some feasibility indicators become obvious very quickly (e.g., very limited access, negligible amenity value, excessive sedimentation, utility constraints, already-high-quality ecosystem in place, etc.).

Table 7. Scoring system developed for the assessment.

	Screening Criteria	Max Possible Score
Desktop Analysis	Total Phosphorus Removal	60
	Cost Effectiveness	45
	% WQv Available	30
	# Parcels Anticipated to Impact	30
	HOA Common Area	10
Field Assessment	Field-Estimated Access	45
	Subjective Evaluation	45
	Working Order	30
	Options to Expand Footprint	30
	Current Downstream Condition	30

Screening Criteria	Max Possible Score
Wetlands Currently in Basin?	30
Education/Exposure Opportunity	30
Significant Tree Clearing Required	15
Utility Constraints	15

The final prioritization exercise identified 10 facilities that were suspected to be meaningful and cost-effective stormwater retrofits worthy of property owner outreach.

Lesson Learned

While the original plan had been to contact owners of all the basins selected during desktop analysis, the team recognized that field reconnaissance was essential for prioritizing which basins were worth pursuing. It is important to conduct field visits and inspections of facilities prior to beginning negotiations with facility owners, as field visits will make it apparent that some facilities are no longer candidates for retrofits.

Pro Tip

In reality, final prioritization and property owner outreach is a simultaneous process. An eager or unwilling landowner can weigh heavily on project feasibility.

Outreach to Property Owners

Develop Preliminary Concept Plans

Some level of concept planning is typically necessary to both determine property access requirements and achieve property owner buy-in. As a result, the team prepared preliminary concept plans and cost estimates for the four facilities where property owners showed the most interest. In some cases, stock drawings and images may serve as sufficient concept examples; however, it is important to understand project site accessibility prior to discussions with property owners since site access may dictate additional requirements for property access.

Property owners may want to pick between several design options. For one specific basin identified as a high ranking retrofit candidate, the team developed three concept plans (bioretention, bioretention/extended detention, and wetland) at the request of the property management company. Each concept plan lists expected maintenance activities. A selection was made based on maintenance requirements and amenity features.

Pro Tip

Private property owners need to receive a clear and tangible benefit in order to buy-in on stormwater projects on their property.

In practice, concept planning will overlap with property owner contact and negotiations.

Identify Property Owners

Following prioritization and preliminary concept planning, use available GIS and real estate parcel data to identify each property that may be impacted by BMP retrofit activities and its associated owner. This data is often provided and maintained by local government. It is crucial to identify owners of parcels that may be required for site access, as a project can be derailed or significantly delayed if it later becomes apparent that access will be required over previously unanticipated parcel(s).

Local government property records typically provide only an owner's name and mailing address. The owner's mailing address quickly reveals if they live onsite or elsewhere. It is much more difficult to obtain signatures from property owners who live far away. It is often possible to find better contact information, such as a phone number and/or email address, through internet searches.

> **Pro Tip**
>
> GIS parcel lines are often inaccurate, so it is important to remain liberal in estimates of which properties may be impacted by a retrofit.

Prepare a Pitch and Contact Property Owners

The preliminary concept plan should make it clear what the property owner(s) can get out of the project (e.g., streamline their maintenance burden; turn a liability into an amenity). Give property owners an opportunity to participate in retrofit design. What improvements would they like to see? Do they have a preference for certain retrofit types? Are there any deal breakers for their participation? Be sure to clarify what may be requested of property owners (e.g. temporary vs. permanent access; permanent maintenance responsibility). It often becomes quickly apparent if a property owner will be supportive or not. Be prepared to walk away if negotiations fail, and maintain a backup plan.

HOAs and institutional properties are likely to have a management company through which grounds maintenance issues are coordinated. If your initial contact with property ownership representatives is promising, request a copy of bylaws so that your legal representative can later help you draft a deed document with correct signatory authority.

> **Pro Tip**
>
> Some property owners may simply not be interested in having their BMP retrofitted by the locality, so it's important to stay willing to "walk away" from negotiations and move on to other options if negotiations begin to seem infeasible.

In discussions with non-HOA/non-institutional property owners, also ask if their property is mortgaged. While not impossible, it can easily take up to a year to obtain required signatures from the lender and trustee. It is much faster and easier to obtain an easement on a private property if there is no mortgage.

The project team attempted negotiations with four property owners, achieved support from three property owners, and ultimately ended up with two highly viable stormwater retrofit project candidates.

Consider Project Expansion / Modification

In response to concept planning and negotiation with property owners, the concept for one of the top-ranked retrofit sites in the Albemarle County project was expanded to include decommissioning a detention pond embankment and restoring a degraded stream reach. This was of a larger scope and greater expense than what was initially envisioned for the project, and stream restorations fall under a different accounting system for pollution reduction than traditional retrofits, but the project also provides more cost-effective pollution reduction than was calculated for a traditional stormwater retrofit. While not the scope of this project, Schueler and Stack (2014) present methods that may be used to account for pollution reduction associated with stream restoration projects.

This specific top-ranked site is located in the RiverRun HOA in Albemarle County. However, the degraded stream reach identified for restoration extends into the City of Charlottesville. As a result, negotiations were more complex and had to involve various tiers of Charlottesville and Albemarle County local governments in addition to the RiverRun HOA. The City and County leadership developed a Memorandum of Understanding to share credits for construction and maintenance costs in addition to Chesapeake Bay and Local TMDL credit for the project.

Develop Maintenance Agreements

Request that property owners accept maintenance responsibility for the retrofit. This should be used as a negotiation tool, recognizing that the property owners are receiving an amenity where there may have previously been a greater liability.

> **Pro Tip**
>
> Be extremely liberal when estimating the duration of time required for negotiations and subsequent signoffs for projects that involve multiple stakeholders. It usually takes longer than you would originally anticipate!

Legal Considerations

After property owners express verbal willingness for a BMP retrofit, significant legal involvement will be required to secure rights to install permanent improvements on private property.

Two major constraints are typically involved for local governments to retrofit private property. Many governments have rules in place that prohibit the expenditure of public funds on improving private property. However, funds may generally be spent on private property in order to meet a mandate such as a TMDL. Additionally, public easements and/or maintenance agreements will be required to permanently protect and access BMPs that are located on private property. This requires significant legal coordination.

> **Pro Tip**
>
> Get a lawyer and speak to your legal representation early in the process. Significant legal assistance is required to prepare deeds of easement and often to communicate with any banks who hold mortgages on private property.

Once the landowner has expressed firm verbal support for the project, work with legal counsel to determine signatory requirements for easement dedication and/or other property access. For a privately owned and un-mortgaged property, only the signature of the landowner(s) will be required. These easements are often the easiest to obtain. A privately owned and mortgaged property will also require signatures from the lender and trustee listed on the property's deed of trust. These signatures are typically very difficult and time consuming to obtain. In addition, they require significant legal review and coordination, as lender and trustee representatives may only be willing to speak to a lawyer. Avoid easements on mortgaged property if possible.

Challenge

Sites with many different property owners can make a project very difficult due to number of signatures required. Signatory requirements can make or break a project. In the team's experience, easements on mortgaged properties are the most difficult to obtain.

If a small easement is required exclusively for temporary construction access, then a **"right of entry letter"** may suffice. These documents enable the private property owner to provide written consent for the project owners and representatives to enter the property for a specified time period. In addition, they don't require filing at the local courthouse, and they don't require notarization or signatures from any lenders or trustees, as deeds of easement do. An example right of entry letter is included in Appendix B. Keep in mind that property owners may revoke right of entry letters at any moment (contrary to temporary easements, which are irrevocable), so it is important that backup locations for access and/or work exist if right of entry letters are used.

Lesson Learned

If property owners are supportive, it is important to conduct boundary surveys as the first step in the project design process to verify the location of existing property lines and necessary private property access.

If working with an HOA or other institutional property, have legal counsel advise on who has legal authority to sign over easements. For HOAs, it can be as simple as needing the board president's signature or as complicated as needing to obtain a signature from three quarters of all HOA members at an annual meeting. These signatory requirements can make or break a project. Based on guidance from legal counsel, develop timeline for easement acquisition and/or right of entry signatures.

Retrofit Design and Construction

Aside from property rights considerations, design and construction for stormwater projects on private property function fairly similarly to projects on public property. However, there are some important caveats to keep in mind throughout the process.

This section documents considerations that became uniquely apparent during engineered design and construction for the two projects that were ultimately selected as part of this project:

1. A bioretention retrofit in the Minor Hill HOA, and
2. A dam decommissioning and stream restoration that began in the RiverRun HOA and culminated on City of Charlottesville property

The RiverRun project completed construction in spring of 2019, and the Minor Hill project has not been built as of the publication of this guide. Ironically, the project that was ultimately constructed as part of this pond retrofit endeavor involved removing a dam and restoring the stream that had initially been dammed to create the pond.

Retrofit Design

Challenge

It can be difficult to determine the timing and extent of necessary boundary surveying required for easements because most GIS property lines are inaccurate. It is crucial to answer these questions of "where and when" to survey at an early stage in the project.

Property line boundaries are a crucial constraint for all projects on private property. Before formal easement signatures can be obtained, the project must be designed to an extent that relevant property lines and easement boundaries can be precisely identified, surveyed, and platted. As project design progresses and potentially reveals other constraints, additional surveying may be required. Project design, survey, and platting represent significant costs, so it is imperative that the property owner is fully supportive of the project prior to making this investment.

It is also imperative that the design team understands which privately-owned properties must be accessed. For example, the County gained support from the Minor Hill HOA to retrofit a failing detention pond as a bioretention facility. This project was one of the highest ranking. GIS property lines indicated that there was adequate access to the facility. However, project surveying revealed that access was *not* feasible exclusively on HOA property without significant tree clearing and utility impacts. This necessitated a different access approach (see Figure 5). While rights of entry letters were sufficient to allow construction access via the route that was initially planned, it was necessary to have a backup option and rights to access for permanent maintenance. The best option for permanent maintenance access required a 170 square foot easement on a privately-owned parcel.

While the property owner was supportive of the project, obtaining the additional easement resulted in significant delays and required many months of coordination with the property owner and his lender and trustee for their signatures on a deed of easement. Had the homeowner or lender not been willing to grant easements, the entire project may have been derailed.

In addition, it is important to involve and educate local government plan reviewers at an early stage of the project. Plan reviewers are typically not accustomed to seeing stormwater retrofits (especially not ones on private property). It is important to ensure they are aware of permanent maintenance plans and needs in addition to the inherent stormwater benefits of the project so that they do not impose unnecessary requirements to offset pollution from the land disturbing activity.

Challenge

Local government plan reviewers are not typically accustomed to seeing stormwater retrofit projects, so they may inappropriately assign strict requirements as they would for typical, new stormwater practices.

Figure 5. Easement considerations for Minor Hill bioretention retrofit.

The red rectangle in Figure 5 depicts initial plan to access stormwater facility at Minor Hill while staying fully within HOA property. Surveying revealed that property lines extended throughout the entire red rectangle and precluded access on HOA property, instead involving eight individual homeowners in addition to the HOA entity. As a result, the County had to obtain an additional easement to access property via the orange line, reducing the number of individual homeowners to one.

Retrofit Construction

The construction phase will, in general, be fairly similar regardless of whether the project is on private or public property. However, there are some important caveats to keep in mind when working on private land.

- Property owners or managers may change between initial conversations and consent and project construction
    - As a result, it is very important to keep property owners and managers informed about project intentions and progress to avoid any confusion or confrontation.
    - It is also important to keep property owners informed and happy if they have authorized work via a right of entry letter, as they may later revoke permission. Permission does not automatically transfer between owners.
- Develop and communicate a plan for if construction bids come in too high.
    - It is important that stakeholders recognize the project will only be built if it can be built within budget.
    - While the RiverRun stream restoration received bids within budget and was ultimately constructed fairly seamlessly, the low bid for Minor Hill (approx. $293,000) was unjustifiably high compared to project estimates (max cost of approx. $171,000). While the County currently intends to rebid the project and believes it can get a better cost, the high bid presented risks to both the County and NFWF (the funding partner). High bids are a real possibility, and it is important that all parties recognize and have a contingency plan for if project bids come in too high.

The County ultimately constructed a single large-scale retrofit under this project instead of multiple small retrofits, recognizing that economies of scale matter, overall benefits and cost-effectiveness were much greater through one large project instead of several small retrofits.

Conclusions

Stormwater projects on private property present a significant opportunity to reduce stormwater pollution in the Chesapeake Bay watershed (and others) because such a large percentage of developed land is privately-owned. As such, it is crucial for practitioners to understand both the opportunities and constraints around constructing stormwater retrofits and stream restorations on private property. This pilot project has shown that working on private property can offer a very cost-effective way to make meaningful reductions in stormwater pollution and turn environmental nuisances into environmental amenities.

The benefits to implementing voluntary stormwater projects on private property are numerous. Property owners can gain from their participation by way of reduced maintenance burden, reduced stormwater utility fees, and/or by creation of an environmental amenity. And the local government or other implementing authority stands to gain by obtaining cost-effective environmental benefits and by potentially sharing the maintenance burden with the private entity.

However, these projects also present a unique set of challenges and risks that must be addressed in order to maximize chances of project success. By keeping a few key points in mind, you can maximize impact from your efforts to construct meaningful stormwater projects on private property.

- Economies of scale matter—it is almost always more cost-effective to do fewer, larger projects than more small projects.
- Speak early and often with the plan review authority, as stormwater retrofits will not likely be familiar to them. It is quite common for municipal permitting departments to have processes in place for permitting development/re-development, which place undue constraints on restoration projects.
- Think critically and early about your surveying needs. Which property lines must be surveyed, and when will you survey them?
- Maintain a good relationship with legal counsel—you will need their assistance!
- Be conservative in what you promise to stakeholders (including local residents, local government, and any grant partners), as **timelines, costs, and outcomes cannot be guaranteed**.
- Have a flexible timeline, realistic expectations, and a backup plan for any easements you attempt to obtain on private property.

Given the ultimate success and cost-effectiveness of this pilot project, however, our recommendation for stormwater retrofits on private property is clear: **go for it!**

Before Construction	During Construction	After Construction

Figure 6. Before and after conditions of the RiverRun stream restoration that was constructed in place of a historic dry detention basin.

References

Center for Watershed Protection (CWP). 2007. Urban Stormwater Retrofit Practices Version 1.0. Manual 3 in the Urban Subwatershed Restoration Manual Series. CWP. Ellicott City, MD.

Center for Watershed Protection (CWP). 2011. In-Lieu Fee Proposal for On-Site Stormwater Management. Unpublished draft. Prepared for the Delaware Department of Natural Resources and Environmental Control Division of Soil and Water conservation. CWP. Ellicott City, MD.

James River Association (JRA). 2013. Cost-Effectiveness Study of Urban Stormwater BMPs in the James River Basin. JRA. Richmond, VA.

King, D., & P. Hagan. 2011. Costs of Stormwater Management Practices in Maryland Counties. Prepared for Maryland Department of the Environment by the University of Maryland Center for Environmental Services. Technical Report Series No. TS-626-11 of the University of Maryland Center for Environmental Science.

Schueler, T. & B. Stack. 2014. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Center for Watershed Protection and Chesapeake Stormwater Network. Ellicott City, MD.

Schueler, T. & C. Lane. 2012. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects. Chesapeake Stormwater Network. Ellicott City, MD.

Virginia Department of Environmental Quality (VADEQ). 2015. Chesapeake Bay TMDL Action Plan Guidance. Guidance Memo No. 15-2005. May 18, 2015.

Water Environment Research Foundation (WERF). 2009. BMP and LID Whole Life Cost Models: Version 2.0. Alexandria, VA. Available at: http://www.werf.org/i/a/Ka/Search/ResearchProfile.aspx?ReportId=SW2R08

West Virginia Department of Environmental Protection (WVDEP). 2012. Guidance for Developing an Off-Site Stormwater Compliance Program in West Virginia.

Appendix A. Field Form

Detention Pond Retrofit Checklist		
Site Name: Facility Code:	Location/Address:	
Assessed by:	Date:	Picture #s:
Pond Dimensions and Shape (sketch on map)		
Approximate depth (ft, decimal)		
Approximate side slopes		
Low-flow outlet size and shape (inches)		
Existing Conditions	Circle any that apply. Provide descriptions if necessary.	
Level of maintenance	Completely abandoned Poor maintenance Moderate maintenance Regularly Maintained	
Vegetation	Inadequate vegetation (estimate % vegetated) Proper vegetative cover Overgrown	
Working order	Components broken or missing Good working order	
Constraints	Circle response / provide description as necessary.	
Options to expand footprint? (Or is existing practice confined by adjacent slopes, utilities, development, etc.) (Add *approximate* post-expansion basin floor size/dimensions, ft x ft or sf)	1 – Few Constraints 2 3 4 – Significant Constraints	
Approximate depth of water quality storage available? (ft, decimal)		
Access for construction and long-term maintenance?	1 – Excellent Access 2 3 4 – Poor Access	
Significant tree clearing required?	1 – Minimal Clearing 2 3 4 – Lots of Clearing	
Potential Utility Constraints? And probable level of interference; 1 (low) to 4 (high)	Water? Sewer? Gas? Electric? Other?	
Other		

<table>
<tr><th>First Impression Retrofit Potential
(please circle one)</th><th colspan="2">Notes</th></tr>
<tr><td>Excellent Candidate
(Many options, good access and footprint for retrofit, few apparent constraints)</td><td colspan="2"></td></tr>
<tr><td>Moderate Candidate (Retrofit possible, but faces several limitations / constraints)</td><td colspan="2"></td></tr>
<tr><td>Poor Candidate (Retrofit would be technically difficult or have marginal benefits)</td><td colspan="2"></td></tr>
<tr><th colspan="3">Downward Modifications</th></tr>
<tr><th colspan="3">Condition</th></tr>
<tr><td colspan="2">Absence of sediment forebay</td><td></td></tr>
<tr><td colspan="2">Absence of micropool or other protection at outlet</td><td></td></tr>
<tr><td colspan="2">Short circuiting (inlet and outlet very close)</td><td></td></tr>
<tr><th colspan="3">Elevations of Components (relative to pond bottom)</th></tr>
<tr><th colspan="3">Inlets or inlet pipe inverts – elevations relative to pond bottom, in feet (decimal)</th></tr>
<tr><td colspan="3">Upstream ends of inlet pipes:</td></tr>
<tr><td colspan="3">Invert at inlet to pond:</td></tr>
<tr><th colspan="3">Outlets – elevations relative to pond bottom (feet, decimal)</th></tr>
<tr><td colspan="3">Low-flow orifice:</td></tr>
<tr><td colspan="3">2/10-year overflows:</td></tr>
<tr><td colspan="3">Emergency overflow/spillway:</td></tr>
<tr><td colspan="3">Invert of outlet pipe from riser structure (relative to pond bottom):</td></tr>
<tr><td colspan="3">Invert of downstream end of outlet pipe:</td></tr>
</table>

Possible/Suggested Retrofit(s)			
Check any that seem viable, and expound if necessary:			
In basin	D/S of basin	U/S of basin	
			Bioretention
			Benched bioretention
			Subsurface gravel wetlands
			Constructed wetlands
			Wet pond
			Horizontal (surface) sand filter, or Outlet filter
			ED outlet restriction (small CDA)
			Other outlet structure modification
			Micropool, Multiple pool, Pocket pool
			Dry Swale / Wet Swale / Bioswale (specify)
			Other

Possible Retrofit Sketch

Picture Checklist			
	Overall		Issues/Problems
	Inlet(s)		Access
	Outlet(s)		Unusual characteristics (like odd structures)

Appendix B. Example Right-of-Entry Letter

COUNTY OF ALBEMARLE
401 McIntire Road
Charlottesville, Virginia 22902-4596

FROM: [Signatory Authority]
Property address

RE: Stormwater improvements on Parcel ID XX-XXXX-XXXX

Dear County of Albemarle:

As the owner (the "Owner") of Albemarle County Parcel ID XX-XXXX-XXXX (the "Property"), I hereby grant permission to the County of Albemarle, its employees, agents, contractors, and assigns (collectively, the "County") to enter upon the Property to enable the installation of stormwater improvements by the County.

I hereby make this Property available to the County as is. Further, the County, its employees, agents and contractors enter the Property at their own risk for the term of the installation. This Right-of-Entry shall expire upon completion of installation.

OWNER

____
[Signatory Authority]

Date: ____________________________

Witness: ____________________________