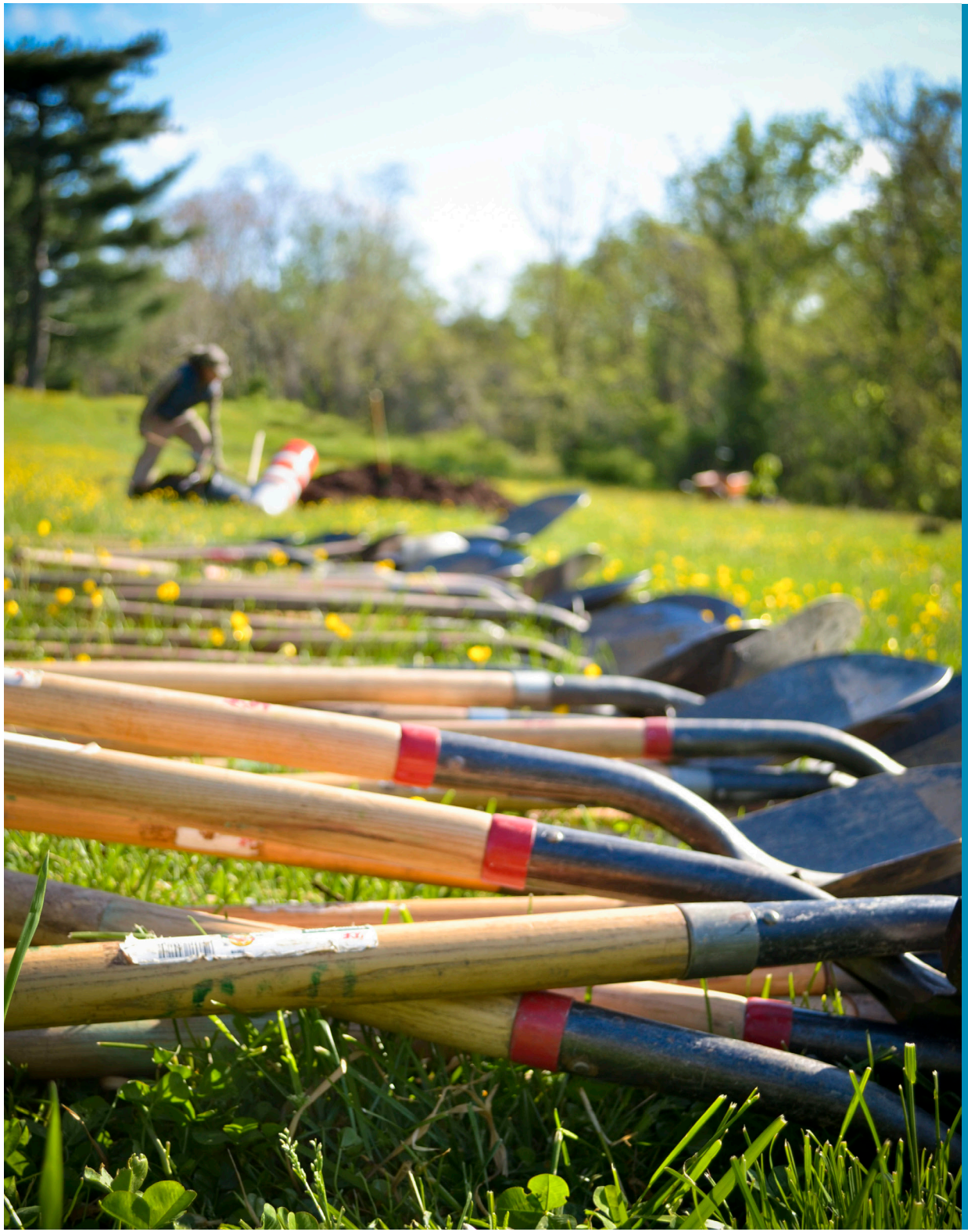

SUSTAINABLE LANDSCAPE MAINTENANCE MANUAL

for the Chesapeake Bay Watershed

By Cheryl Corson

Pilot Edition
October 2016

CBLP CHESAPEAKE BAY Landscape Professional

Developed for the Chesapeake Bay
Landscape Professional Certification Program

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This publication was developed for the Chesapeake Bay Landscape Professional Certification Program.

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CONTENTS

PREFACE

Twenty-first century imperatives to clean the Chesapeake Bay make designing landscapes in its 64,000-square-mile watershed especially gratifying. We have a large, multidisciplinary professional community with numerous, often free, continuing education opportunities. Public agencies keep us accountable by requiring proof of storm water calculations with our designs. And increasingly, we have clients who "get it" and even demand more sustainable landscape maintenance. What we are still developing is a maintenance infrastructure capable of caring for these landscapes. This manual has been undertaken to support those with boots on the ground in their efforts to manage and maintain green infrastructure now being put in place.

"The more you cultivate good relationships with all those involved with a landscape, the better future that landscape will have," says landscape architect Michael Van Valkenburgh. The Chesapeake Bay Landscape Professional (CBLP) certification program is an important regional step in connecting those involved at every stage in the process. It is dedicated to a paradigm shift toward greater collaboration between clients, designers at all levels, installers, and those entrusted with landscape care. Van Valkenburgh, my former professor, writes that collaboration is the "unheralded key to management," and I heartily agree.

I write this as a landscape architect with decades of experience in the Mid-Atlantic, starting with a National Park Service internship focused on historic landscape preservation, which is very long-term management. Now in private practice since 2003, I have had some landscapes thrive over many years while others perform vanishing acts before they ever had a chance to realize their potential. The enduring successful projects have one thing in common: an ongoing relationship between the designer, the client, and the landscape contractors who observe the site most often.

Even when clients are committed to maintaining their landscapes sustainably, contractors with the necessary skill sets are not easily found. And when willing folks are available, fragmentary guidance — perhaps buried within lengthy manuals or regulatory documents — is hard to find or follow. Other times, beautifully written maintenance documents provided to clients by landscape architects or designers, never make it into a landscape contractor's hands. This manual provides a condensed review of the most important landscape maintenance considerations. It is the book I would want to offer my own contractors and clients in the transition from the installation phase to the (hopefully) much longer management phase.

—Cheryl Corson

"Landscapes Over Time: The Maintenance Imperative," by Michael Van Valkenburgh (FASLA), with William S. Saunders, *Landscape Architecture Magazine,* March 2013, pp.106–114.

HOW TO USE THIS MANUAL

This document is available on the Chesapeake Bay Landscape Professional Program website. Check back periodically for updated versions of the manual: cblpro.org/downloads/CBLPMaintenanceManualPilotVersion.pdf.

Reference to any specific commercial product, process, or service by trade name or service provider does not constitute or imply its endorsement, and shall not be used for advertising or to endorse products.

Specific practices or methods required by any jurisdiction within the Chesapeake Bay watershed shall take precedence over methodologies presented in this manual in the event of any discrepancy.

It is anticipated that those using the manual will need to adjust the templates and processes to suit their needs. However, the basic sequence of steps in any Landscape Maintenance Plan set forth will remain the same. Readers are encouraged to examine manuals and resources from other jurisdictions cited in this publication as they customize their own maintenance strategy and processes.

More detailed discussions of sustainable landscape design and installation will be found in the Chesapeake Bay Landscape Professional program curriculum at cblpro.org.

TABLE OF ABBREVIATIONS

ADA	Americans with Disabilities Act
AEM	Agriculture Environmental Management
ASLA	American Society of Landscape Architects
ASDZ	Anacostia Watershed Development Zone
BMP	best management practice
CBF	Chesapeake Bay Foundation
CBLP	Chesapeake Bay Landscape Professional
CBP	Chesapeake Bay Program
CBT	Chesapeake Bay Trust
CBWI	Chesapeake Bay Watershed Initiative
CCLC	Chesapeake Conservation Landscaping Council
CDA	Contributing Drainage Area
CLE	Certified Landscape Expert (for DC DOEE)
CLL	Contract Limit Line
CLR	Cultural Landscape Report
CPSI	Certified Playground Safety Inspector
CREP	Conservation Reserve Enhancement Program
CGP	Construction General Permit
CRP	Conservation Reserve Program
CRZ	Critical Root Zone
CSN	Chesapeake Stormwater Network
CSO	Combined Sewer Overflow
DBH	diameter at breast height (of a tree)
DC	District of Columbia
DC DOEE	District of Columbia Department of Energy & Environment
DC DOT	District of Columbia Department of Transportation
DE	Delaware
DE DA	Delaware Department of Agriculture
DE DNREC	Delaware Department of Natural Resources and Environmental Control
DE FS	Delaware Forest Service
EPA	Environmental Protection Agency
ESC	Erosion And Sediment Control
EWF	engineered wood fiber
FSA	Farm Service Agency
GAR	Green Area Ratio (DC DOEE program)
GI	Green Infrastructure
GIS	Geographic Information System
GPS	Global Positioning System
HOA	homeowners' association
IPM	integrated pest management
ISA	International Society of Arboriculture
LBS	pounds
LCA	Landscape Contractors Association
LEED®	Leadership in Energy and Environmental Design
LID	Low Impact Development
LMA	landscape maintenance areas
LMP	Landscape Maintenance Plan
LOW	limit of work
LOD	limit of disturbance
MD	Maryland
MD DNR	Maryland Department of Natural Resources
MDA	Maryland Department of Agriculture
MDE	Maryland Department of Environment
MSDS	Material Safety Data Sheet (amended to Safety Data Sheet [SDS] in 2012)

MNCPPC	Maryland-National Capital Park and Planning Commission
MS4	Municipal Separate Storm Sewer System
MSDS	Material Data Safety Sheet
NACD	National Association of Conservation Districts
NFWF	National Fish and Wildlife Foundation
NGO	non-governmental organization
NMP	Nutrient Management Plan
NOFA	Northeast Organic Farming Association
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NY	New York
NY DAM	New York State Department of Agriculture and Markets
NY DEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
OWTS	on-site wastewater treatment system
PA	Pennsylvania
PA DEP	Pennsylvania Department of Environmental Protection
PA DA	Pennsylvania Department of Agriculture
PE	Professional Engineer
PHC	Plant Health Care
PLA	Professional Landscape Architect
PLNA	Pennsylvania Landscape & Nursery Association
QA/QC	Quality Assurance/Quality Control
RLA	Registered Landscape Architect
RPA	Resource Protection Area
RCP	Resource Conservation Plan
SDS	Safety Data Sheet
SITES™	Sustainable Sites Initiative Rating System for Sustainable Land Design and Development
SHPO	State Historic Preservation Office
SWM	stormwater management
SWMP	stormwater management plan
TCLF	The Cultural Landscape Foundation
TMDL	Total Maximum Daily Load
UNM	urban nutrient management
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGBC®	United States Green Building Council®
USGS	U.S. Geological Survey
VA	Virginia
VA DACS	Virginia Department of Agriculture and Consumer Services
VA DCR	Virginia Department of Conservation and Recreation
VA DEQ	Virginia Department of Environmental Quality
WIP	Watershed Implementation Plan
WRP	Wetland Reserve Program
WSA	Watershed Stewards Academy
WV	West Virginia
WVCA	West Virginia Conservation Agency
WVDA	West Virginia Department of Agriculture
WV DEP	West Virginia Department of Environmental Protection

INTRODUCTION

Landscapes and those who design and manage them are part of a dynamic system with great implications for water quality in the Chesapeake Bay. In any region, although especially in the Bay region, monitoring, managing, and maintaining green infrastructure so that it functions as intended after establishment, with as few inputs as possible, is not only a good idea — it's a federal mandate. In 2010, the U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL) "pollution diet."

To meet the Bay's TMDL, we must involve designers, contractors, and clients in all aspects of projects in a cyclical, nonlinear fashion. In our longstanding industry and the marketplace in which it exists, this approach represents a necessary paradigm shift. Not only is communication and coordination a core value of a sustainable landscape maintenance plan (LMP), but so is the awareness that as a landscape matures and changes, so must its care. The critical process of annually evaluating and updating an LMP is called adaptive management. Over time and with greater client awareness and engagement, an adaptive management process for landscapes will become the norm.

This manual assumes prior knowledge of landscape design and installation methods, whether from previous exposure to CBLP curricula or experience working in the field. The sources cited in reference sections refer to maintenance only. Design and installation information contained in previous sections of CBLP curricula are not repeated here. This manual does not attempt to compile jurisdiction-specific information for the Chesapeake Bay watershed, though it does point to key state and federal resources and offers some good local or regional examples of programs and requirements.

The manual is divided into five parts: Human Systems, Tools and Working Methods, Natural Systems, Plant Materials, and Hardscapes. Human Systems gathers information not commonly found in one place, especially in a landscape maintenance context. However, if maintenance managers and staff are to play a more active role in design and management, it is important that they understand the larger framework in which landscapes are situated, including the regulatory environment.

Beyond that, the anatomy of an LMP involves steps to be repeated throughout the lifecycle of a designed landscape or particular stormwater best management practice (BMP). These include inventory, assessment, prioritization, monitoring, managing, maintaining, and documenting. We understand that there is a difference between management and maintenance. At times those performing maintenance tasks are also responsible for overall landscape management, but this is not always the case. At times there is no manager at all, although sustainably maintained landscapes need someone to be responsible for knowledgably monitoring performance and coordinating future activities.

According to Larry Weaner in *Garden Revolution,* "Coordinating design and management can be a very powerful tool in ecological garden design, allowing much larger areas to be effectively managed than would likely be possible through traditional practice in which the design and management of the landscape are disconnected." This manual is intended to establish landscape maintenance on an equal footing with design as in the best interests of our clients and of the Chesapeake Bay watershed.

Acknowledgments

The District of Columbia Department of Energy & Environment provided generous funding to support development of this manual. The Low Impact Development Center served as fiscal sponsor for the project. Thanks to the Maryland Sea Grant communications team for providing expert copyediting and graphic design.

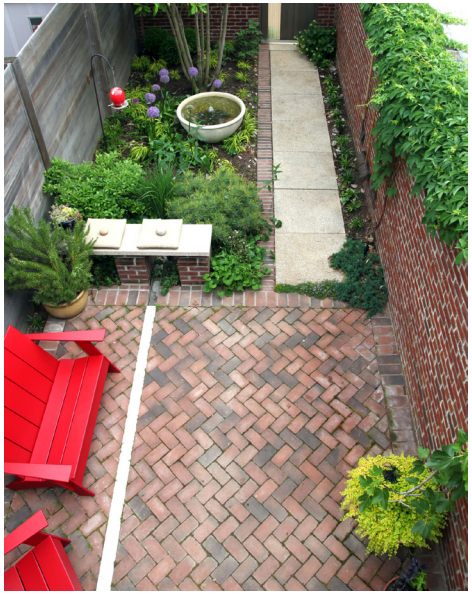
The author wishes to thank the Chesapeake Conservation Landscape Council, and CBLP Coordinators Beth Ginter and Shereen Hughes, for their support in developing these ideas and making this project possible. Thanks to Janet L. Waibel, RLA, for writing, *Sustainable Landscape Management: Standards for Care in the Desert Southwest,* which planted the seed for this manual. Thanks go to all the clients, contractors, and colleagues who care about this work, and to my husband Chris Corson, for his legal and editorial advice but mostly for his kindness.

HUMAN SYSTEMS

SECTION 1: INVENTORY, ASSESSMENT, AND PRIORITIZATION

1.1 Inventory

A sustainable landscape maintenance plan (LMP) begins with a site inventory. If you were not the designer or installer, the first step in determining a maintenance strategy for a built landscape is to compile information necessary for budgeting time and resources. Rare is the client who can hand over a detailed site file containing design drawings and specifications, installation proposals, as-built drawings, product cut sheets and warranties, maintenance manuals, or records of previous maintenance work performed. Often detective work is needed. The level of detail needed will vary depending on the site size and complexity, but compiling a site history and inventory will make it much easier to conduct a site assessment and then establish priorities with a basis in fact.



This designed landscape includes a rain garden and trench drain with grate through the brick patio. Reviewing the design drawings will clarify whether patio pavers are permeable or not.

PHOTO: GEORGE BROWN.
RYAN MOODY, RLA, LANDSCAPE ARCHITECT

The following checklist may be adapted to suit your needs. For checklists regarding specific best management practices (BMPs), see Plant Materials and Hardscapes of this manual.

Site Inventory Checklist: Background Information

1. Gather information about the design history: Were design drawings done? Are there separate specifications? Are there as-built drawings? If so, what is available? Will the client allow you to contact the designer directly with questions, or does the client prefer to be the point of contact? Sometimes the client does not want the designer to be contacted. If the designer is available, don't hesitate to consult with them since they already know a great deal about the site and project.
2. Depending on the project scale, a professional site survey may already exist. If so, it may be referenced on the design drawings. Knowing the site's underground utilities, or water and sewer lines and other survey data could be helpful depending on your scope of work.
3. Is written narrative available describing the design intent? If not, can the designer or client explain why the work was undertaken and what the goals were? Knowing this will help assure that subsequent actions will reinforce and not contradict the design intent.

4. Does a maintenance plan already exist?
5. Are there records of past maintenance?
6. What was the approximate project timeline, including design, installation, and previous maintenance?
7. Is this a LEED® or SITES™ project? If so, ample, online documentation will be readily available.
8. Was the project funded by a grant or public agency? If so, documentation will be available and there may be further documentation requirements that need to be met. There may be a stormwater management plan (SWMP), or a Green Area Ratio (GAR) plan (in Washington, D.C.), or a Nutrient Management Plan (NMP) (in Virginia), or other documents vital to the project.
9. Are any plants or products still under warranty? If so, itemize and note time remaining.
10. Who is the client? Who is the primary decision maker? Are they the same person? If not, what is the appropriate communication hierarchy?
11. Is this an historic site? (Historic site checklist items are covered in Section 3.)

Even when documentation is available, existing site conditions must be inventoried, and then assessed. Do not assume that any drawings you obtain are correct. Proprietary tools exist to facilitate this process, making use of handheld GPS devices, phones, or tablets with packages such as DynaSCAPE's Manage360, or the open source Bioretention Inspection app developed by the firm, Stormwater Maintenance & Consulting.

Another online inventory and assessment tool is Seattle's Capital GREEN, developed by ArchEcology, LLC. Whatever you use, be methodical and consistent.

Site Inventory Checklist: Physical Inventory

1. Use software such as Google Earth to view your site online. Some counties offer free downloadable GIS maps as well, with layers for features such as topography, soils, wetlands, historic features, and other important aspects of a site. Zoom out from your site to locate and identify the nearest body of water. Use the online distance tool to learn the approximate distance between that water body and protected resources on or near the site. Most counties and cities offer online tools you can use to identify the watershed in which a given site is located.
2. Determine the parcel size and size of the area or areas to be maintained. Understand the topography and orientation.
3. With or without a set of drawings, during a site visit note BMPs present, both hardscape BMPs, such as permeable pavement and living BMPs, also called Green Infrastructure (GI). For detailed lists of different types of BMPs, see Sections 19 and 20.
4. Understand the aboveground and belowground drainage. Locate any downspouts, area drains, storm drains, culverts, or swales, and mark them on your drawing or online handheld device. Is there a septic system on site? If so, learn where the system elements are.
5. Once you know the items listed above, you will have a sense of the contributing drainage area (CDA) of your site. Note that the CDA may be, and often is, beyond your site's property line. There is nothing as informative as seeing your site during a heavy rain event. Hopefully you will have this opportunity.
6. Is an irrigation system present? If so, locate the control box or boxes, drip lines, and/or sprinkler heads. Locate hose bibs on buildings, if present.
7. Conduct a plant inventory. You may not need to note every perennial, but note trees and shrubs in urban and suburban sites. Rural sites will require a different survey protocol. Note all trees, since it is common for trees below a certain caliper to be ignored by surveyors, even in urban areas.
8. Also inventory the presence of plants that are considered aggressive or unwanted, whether native or non-native. Note areas in which they appear and the degree to which they are established. (For more on this topic, see Section 17.)

1.2 Site Assessment

As you work through the site, alone or with colleagues, use a simple and consistent evaluation method relating to the scope of work your client has requested, or better, the scope of work you feel is needed. Visual Indicator templates for assessing BMPs are available from the Chesapeake Stormwater Network, *Technical Bulletin #10: Bioretention Illustrated: A Visual Guide for Constructing, Inspecting, Maintaining and Verifying the Bioretention Practice*, October 20, 2013. (For more see Section 19, and for tree assessment, see Section 16.) The results of your site assessment will help you determine priorities.

Your clients will also have their own priorities, for example, including seasonally driven issues like snow removal, preparing for hurricane season, or the beginning of school. It is your job to reconcile what the site needs, based on your fact-finding and on-site assessment, and what the client asks of you.

Observing your site during a rainstorm is important to be able to assess its performance.

PHOTO: CHERYL CORSON

1.3 Prioritization

Warranties

If condition issues involving any warranties are expiring soon, whether on plants, hardscape materials, or labor, these are matters to call to the client's immediate attention. In an ideal world, this information will be available and the client stands to benefit greatly by this level of attention on your part. (See Section 10 for a discussion of proprietary products and systems.)

Reporting requirements

If the GI on your site was funded by grants or by a public agency, documentation of continued performance might be required. Your preliminary fact-finding will have determined this. If this is the case, any milestones for demonstrating performance should be noted and incorporated into the project's maintenance priorities. Your client may be an agency or nonprofit organization responsible for tracking the amount of rainwater treated to a public agency as part of its Municipal Separate Storm Sewer (MS4) system reporting requirements. If reporting forms or spreadsheets are already in place, use them. If not, you can offer the service of creating them for your client.

Hazardous conditions

It is possible that, based on your site assessment, GI elements on your site may present a public safety concern of some kind, whether flooding and freezing on a walkway, in the case of a poorly functioning rain garden, or an eroded bank sending sediment into a storm drain or stream. You may have noticed a dead overhanging tree limb over a highly trafficked area. Report any hazardous conditions immediately, preferably in writing, so that the client can choose to make them their top priority. By doing so, you transfer the liability from your company to the client.

Multiple sites

You may be responsible for maintaining multiple sites, for example, several housing developments handled by the same property management firm, or multiple sites within a parks department or school district. When this is the case, use the consistent rating system you've developed to prioritize across all individual locations so that the client will be able to easily see the most pressing items first without having to sift through many pages (or scroll through many computer screens).

Playgrounds and nature play areas

Playground safety should be determined only by a Certified Playground Safety Inspector (CPSI). Do not assume this liability yourself. Owing to the growing movement toward nature play spaces, GI is being incorporated into nature play elements. Constitution Gardens in Gaithersburg, Maryland, and the extensive play space at Burgundy Farm Country Day School in Alexandria, Virginia, are good examples, although there are many others. When this is the case, limit your work only to the GI items and alert the client that they should consult a CPSI to audit or inspect play areas and play equipment (if any) separately, if they have not already done so.

Irrigation

Some sites will have irrigation systems, with or without a separate maintenance contract. Don't assume that a contract is in place. Always ask the client who is responsible for contacting the vendor for winter shutdown and spring start up. Some publicly funded rain gardens, such as those in Washington, D.C., allow for supplemental irrigation for the first year only. Be aware of any stipulations and act accordingly. (See Section 11 for more on irrigation.)

Beyond these issues, establish sustainability goals for each landscape element with input from the designer and client. Establish priorities according to the factors mentioned throughout this manual, creating worksheets particular to each site or area. Project management software, such as those already mentioned, may be used to track work orders and responses. For BMP maintenance, repair, or rehabilitation, remember that your work directly affects the quantity and quality of water headed into the Chesapeake Bay.

This nature place space probably has special sand specifications. Always check with the designer before purchasing replacement sand for any designed play area.

PHOTO: CHERYL CORSON. CONSTITUTION GARDENS, GAITHERSBURG, MD. SENECA CREEK COLLABORATIVE

1.4 References

Chesapeake RiverWise Communities. Chapter 2: Best Management Practices, pp.17–23.

Sustainable Landscapes Certification Manual. Harrisburg, PA: Pennsylvania Landscape and Nursery Association. Chapter 5: Stormwater Best Management Practices for the Sustainable Landscape, pp.43–50; Chapter 9: Construction, Monitoring, and Maintenance, pp.99–103.

Henderson, Elizabeth and Karl North. *Whole-Farm Planning*. Chelsea Green Publishing, 2011.

SECTION 2: LAWS, REGULATIONS, AND PERMITTING

2.1 Regulatory Overview

Some state and local laws and regulations apply to any type of landscape maintenance, whether or not it relates to sustainable practices or BMP maintenance. Examples include local ordinances that regulate the times of day landscape work may occur or work that occurs within public rights of way. You are responsible for compliance with all regulations.

State laws and local regulations also exist specifically to improve Chesapeake Bay water quality and these vary between states. For example, Virginia requires that a Nutrient Management Plan be in place for golf courses and other public lands and also recommends them for many other landscapes. Since 1984, Maryland has designated the entire area within 1,000 feet from the edge of mean high water as the Critical Area and local governments regulate any landscape work conducted within it. Virginia has a Chesapeake Bay Protection Area that includes a 100 feet buffer inland from wetlands streams and shorelines known as the Resource Protection Area (RPA). The District of Columbia's Green Area Ratio program requires that landscape maintenance standards set at project inception be maintained throughout the project's life, even when a property changes hands. Virginia requires all BMPs installed through new development or redevelopment to have a stormwater maintenance plan or maintenance agreement.

As a CBLP, you are responsible for being familiar and complying with any laws, regulations, or ordinances in effect within all jurisdictions in which you work. The larger the geographic range in which you work, the more you need to know.

2.2 Project Approval Framework

Since this manual covers maintenance and not installation, most often your work will not involve permitting. However, certain changes or upgrades may trigger permit requirements and site inspections. Occasionally, you may also find it necessary to engage the support of allied professionals, such as surveyors, arborists, landscape architects, or others. In some cases, they will be responsible for obtaining permits, when needed.

Knowing when to consult allied professionals is a valuable skill in itself. Work on large trees requires a certified arborist.

PHOTO: CHERYL CORSON

The good news is that you will rarely, if ever, interface with federal laws like the Clean Water Act or the Endangered Species Act. Most likely, should a permit have been previously required by the U.S. Army Corps of Engineers (USACE) for projects near water bodies, the Corps would have served as the clearinghouse for all related federal agencies and you will not, for example, need to identify a rare bird living in a wooded area on your site.

Your work will likely relate to state, bicounty (such as MNCPPC), county, and municipal laws, regulations, and ordinances. In addition, public agencies will have their own landscape maintenance policies — for example, school systems or

parks departments. Beyond that, you may work on projects in historic districts (see Section 3), which regulate certain actions and protect certain landscape elements.

Homeowners' associations (HOAs) can present interesting landscape maintenance challenges. It's always important to ask whether a project falls within an HOA's applicable bylaws, guidelines, or project approval requirements. Frequently, out-of-date HOA bylaws may restrict the plant palette to what are now considered to be undesirable species — for example, English ivy, *Vinca minor,* and other non-native trees. In these cases, you might need to educate your client and advocate on behalf of more appropriate native species selection and updating of bylaws.

2.3 Typically Regulated Landscape Maintenance Activities

1. Application of herbicides, pesticides, and/or fertilizer.
2. Disturbing areas above a certain size or installing hardscape larger than a certain area.
3. Work requiring erosion and sediment control (ESC) measures, permits, inspections.
4. Working in or near wetlands, tidal, or nontidal areas.
5. Working within a vegetative buffer zone.
6. Removing trees above a certain caliper.
7. Planting trees on city streets, which may have a master plan regulating species selection.
8. Installing certain plants known to be invasive.
9. Working on historic properties or in historic districts (see Section 3 of this manual).
10. Noise ordinances related to motorized equipment.
11. Worker safety (see Sections 7 and 8).

2.4 Where to Find Information on Laws and Regulations

Chesapeake Bay restoration practices vary greatly across the watershed, so it is important to compile and maintain your own list of relevant public agencies and cultivate good working relationships with key personnel. Nothing is as helpful as a good relationship with a public official or nonprofit sector manager who you can call on the phone for support. And when you reach someone helpful, it's always good to ask, "Who else should I talk to?" The geographic scope of your practice and project types will determine those agencies with which you are most likely to interact. Be sure to sign up for any email lists available from public agencies in whose jurisdictions you work within. This can be the easiest way to remain aware of pending and new laws or regulations and training opportunities.

Also, know your state resources. Laws at higher levels of government supersede those at lower levels. For example, a state fertilizer law remains in effect when there is no county or municipal equivalent. However, some state laws recognize that jurisdictions may implement more stringent standards, in which case those take precedence. For example, a county herbicide and pesticide law, such Montgomery County, Maryland's Healthy Lawns Bill 52, enacted in 2015, may be more stringent than that of the state. Always check to see if the jurisdiction within which you are working has its own maintenance manual, and if so, be sure to follow any directives it sets forth.

Table 1: State Environmental Agencies

Table 1 lists primary state resources related to landscape maintenance issues. It is not intended to be comprehensive, nor are there any comprehensive tables listing all county and municipal agencies. The fluid nature of the Internet and environmental legislation necessitates continuing education and active participation in one's professional community in order to remain informed.

TABLE 1: STATE ENVIRONMENTAL AGENCIES

STATE	DEPARTMENT	URL	PROGRAMS
District of Columbia	Department of Energy & Environment (DOEE)	doee.dc.gov	Stormwater Management, Green Area Ratio (GAR), RiverSmart Homes, others
Maryland	Maryland Department of the Environment (MDE)	mde.maryland.gov	Bay Restoration programs, Erosion & Sediment Control, others
Maryland	Maryland Department of Agriculture (MDA)	mda.maryland.gov	Nutrient Management Program, Invasive Plants Prevention & Control, others
Maryland	Department of Natural Resources (DNR)	dnr.maryland.gov	Maintains natural resources on public lands, Critical Area
Virginia	Department of Environmental Quality (DEQ)	deq.virginia.gov	Stormwater management programs, Erosion & Sediment Control, Chesapeake Bay Preservation Act, etc.
Virginia	Department of Conservation and Recreation (DCR)	dcr.virginia.gov	Soil and Water Conservation, including Nutrient Management Programs, others
Virginia	Virginia Department of Agriculture and Consumer Services (VDACS)	vdacs.virginia.gov	Pesticide certification, grading permits, others

Often the state links listed above will provide county and municipal links to all relevant programs, often with staff directories, so they are a good place to start. The states can be a good starting point, but keep in mind that in many cases, only localities administer certain programs, for example, in Virginia, most erosion and sediment control is handled at the local level.

Since the scope of this manual is limited to landscape maintenance, other state agencies, such as planning departments, or Soil Conservation Service offices, or university extension services (which house Master Gardener programs), have not been listed.

2.5 Selected Nonprofit Sector Resources

The Chesapeake Bay watershed is home to numerous environmental nonprofit sector organizations. Some that specifically support sustainable landscape maintenance activities include:

- Chesapeake Conservation Landscaping Council (CCLC)
  CCLC is a key partner in the CBLP program. It is a membership organization that has disseminated sustainable landscape practices information in the region since 2003.

- Chesapeake Stormwater Network (CSN)
  CSN advocates for sustainable stormwater management throughout the watershed and also creates and disseminates training on caring for stormwater BMPs once they are installed.

- Watershed Stewards Academy (WSA)
  WSA is a consortium of watershed practitioners who are trained to become community leaders and local watershed resources. Five WSAs currently exist in Maryland and the National Capital region. Their deep knowledge of local conditions makes their volunteer efforts quite valuable.

- Sustainable Sites Initiative's SITES™ v2 Rating System and Scorecard
  SITES™ is a voluntary sustainable landscape installation and maintenance rating system whose free online scorecard contains goals and standards. SITES™ Section 8, Operations + Maintenance closely correlates to the structure of this manual and provides a good evaluation framework.

Remember to ask your client for any project-related public agency and/or organizational contacts they may already have. Whenever possible, it's always nice to provide a public official with a name they already know during an initial conversation.

2.6 References

Stormwater Management Guidebook. Center for Watershed Protection, District Department of the Environment, Water Protection Division, District of Columbia, 2013. Appendix L: Maintenance Inspection Checklists; Appendix Q: Pollution Prevention Through Good Housekeeping; Appendix R: Integrated Pest Management.

SECTION 3: WORKING ON HISTORIC SITES

3.1 Historic Sites Overview

Historic landscapes and gardens are cultural artifacts as equally deserving of care as structures. Unlike historic buildings with plaques, historic landscapes or gardens are more difficult to recognize, yet no less important to preserve when performing landscape maintenance. The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation, and is maintained by the National Park Service. However, historic sites may also be designated at state, county, or city levels. A site not listed on the National Register may still be historic, even if it is not listed on any official register.

According to the NPS Preservation Brief 36, *Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes,* "there are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes." The Secretary of the Interior's *Guidelines for the Treatment of Cultural Landscapes* goes into more detail. Historic landscapes evolve, however they each have what is called their "period of significance," which is their most significant time in history.

Historic landscape preservation is a specialty, and you are not expected to become knowledgeable in this field just by reading a few online documents. You are expected to be aware of any properties you may be called to work on that may be historic, research them as appropriate, and render no harm to their historic integrity in the course of your work.

If you are interested in learning more about how to inventory and assess historic cultural landscapes and prepare what is called a cultural landscape report (CLR), the National Park Service's Guide to Cultural Landscape Reports (1998) is an excellent resource and describes the process in great detail.

Preserving character-defining landscape features is crucial when working on historic sites, such as Old Naval Hospital in Washington, D.C.

PHOTO: CHERYL CORSON. HILL CENTER, OLD NAVAL HOSPITAL, WASHINGTON, D.C. OVS, LANDSCAPE ARCHITECTS

3.2 Historic Landscapes in Our Region

Historic sites abound in the Chesapeake region. Washington, D.C. alone has 56 historic districts including 32 historic neighborhoods. The Cultural Landscape Foundation (TCLF) website includes an extensive illustrated searchable database of historic landscapes in each of these categories, including many in the Chesapeake Bay watershed.

Historic designations may be granted to sites 50 years old or older, which includes projects as recent as the 1960s. Some local 20th century examples of nationally designated historic landscapes are the mid-century Hollin Hills Historic District in Fairfax County, Virginia, a 1930s planned community in Greenbelt, Maryland, and the town home community of Arlington Village in Virginia, built between 1939 and 1941. Any historically designated landscape or site will have ample online information available. Always check for maps, plant inventories, and listings of significant features.

The most important task of a CBLP is to recognize that a property is, or might be, historic, and then to act accordingly or seek help from an allied professional. It is beyond the scope of a CBLP to prepare an historic landscape report or National Register application. However, use caution and do necessary research on actual or potential historic sites before adding, removing, or relocating paving, fencing, trees or shrubs, water features, railings, statuary, plant beds, and other landscape elements from job sites.

Learn about historic landscape styles in basic reference field guides like the online *Pennsylvania Architectural Field Guide*, which includes illustrated pages on seven different types of landscapes.

The National Park Service employs a number of "historical landscape architects" in the National Capital region, and there are many excellent professional resources, including the ASLA's Historic Preservation Professional Practice Network) and The Cultural Landscape Foundation, based in Washington, D.C.

The Olmsted Center for Landscape Preservation, run by the National Park Service, supports historic landscape maintenance work in its northeast region, which includes the entire Chesapeake Bay watershed. They offer some public guidance on historic landscape maintenance, including the still-valuable 1998 document, *Guide to Developing a Preservation Maintenance Plan for a Historic Landscape*, which includes useful templates and checklists.

Old Naval Hospital, now the Hill Center, located in the Capitol Hill Historic District, is subject to landscape treatment guidelines promulgated by the Capitol Hill Restoration Society.

PHOTO: CHERYL CORSON. HILL CENTER, OLD NAVAL HOSPITAL, WASHINGTON, D.C. OVS, LANDSCAPE ARCHITECTS

3.3 Selected Public Agency Contacts for Historic Properties

State Historic Preservation Offices (SHPOs) play a critical role in historic preservation. Contact your SHPO for guidance on whether a site meets the National Register criteria, or how the nomination process works in your state. SHPOs offer maps, GIS data, technical assistance, and connections with local government historic preservation commissions. Remember that counties and cities also have their own historic preservation offices.

TABLE 2: STATE HISTORIC PRESERVATION AGENCIES

STATE	DEPARTMENT	URL	PROGRAMS
District of Columbia	D.C. Office of Planning: Historic Preservation Office	planning.dc.gov/page/historic-preservation-office	Permits, design review, maps, review board, laws, regs, more
Maryland	Department of Planning: Maryland Historical Trust	mht.maryland.gov	Grants, GIS data, database, research, library archeology, more
Virginia	Virginia Department of Historic Resources	www.dhr.virginia.gov	Regional offices directory, grants, incentives, historic registers, easements, archeology, more

3.4 Case Study

Historic Mount Auburn Cemetery in Cambridge, Massachusetts is nearly 200 years old. In recent years there has been a conscious shift toward more sustainable management. Noted Pennsylvania landscape designer Larry Weaner participated in the study group that made recommendations, and writes about how the new plan was developed and implemented in his book, *Garden Revolution* (pp.86–91). Practices now in place at the site include chipping and recycling wood from trees pruned on site, creating customized potting soil mixes based on soil testing data, converting part of the mower fleet from gasoline to propane engines, and allowing seed heads to remain in place over winter to provide wildlife habitat. For a month-by-month description of practices now in use at the site, written by the cemetery's assistant greenhouse manager, Paul Kwiatkowski, see *A Year of Sustainability*.

3.5 References

Preservation Brief 36: Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes, Charles A. Birnbaum. National Park Service.

A Year of Sustainability, by Paul Kwiatkowski. Ecological Landscape Alliance website, December 15, 2013.

Guidelines for Evaluating and Documenting Rural Historic Landscapes, by Linda Flint McClelland. National Park Service, 1999.

Guide to Developing a Preservation Maintenance Plan for a Historic Landscape. Olmsted Center for Landscape Preservation, 1998.

Pennsylvania Architectural Field Guide. Pennsylvania Historical & Museum Commission. August 26, 2015. Section: Historic Landscapes.

The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes, by Lauren Meier and Christine Capella Peters. National Park Service, 1992.

Weaner, Larry and Thomas Christopher. *Garden Revolution.* Timber Press, 2016, pp.86–91.

SECTION 4: STRATEGY, SCHEDULING, AND SPECIFICATIONS

4.1 Strategy

One definition of a landscape maintenance plan (LMP) is "a written plan outlining the utilitarian, ecological, and aesthetic objectives for a specific landscape. The plan describes the specific practices and products that will be used to implement the landscape management plan, along with a schedule of annual maintenance practices." —*ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices*. Version 2b, 2014, p.30.

Begin developing an LMP after compiling all available site history documents (section 1); identifying applicable regulations, if any (section 2); and identifying any historic landscape elements that may be present (section 3).

If you are using an online app or project management software, your electronic site history will already have begun. If not, create a cover sheet for your project including:

- project name;
- client and contact information, including organization if any;
- location, including county, local jurisdiction, watershed;
- designer and installer names, dates of work, and contact information, including yourself; and
- any applicable programmatic or regulatory items (GAR, NMP, Critical Area, etc.).

If the site scale and complexity warrant it, break up your site into landscape management areas (LMAs). Record your site inventory within each LMA. You may number the LMAs, but it's also helpful to name them for clarity, for example, "slope above retaining wall," or "entry courtyard."

Create a row for each landscape element as shown in Table 3. Insert a thumbnail photo of each element as an easy visual reference.

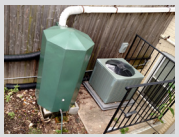
For each element assign a priority, or criticality level on a scale of 1 to 4, in which 1 is most important and 4 is the least important, based on considerations such as:

- visibility or proximity to an entry or gateway;
- relative position in a stormwater management treatment sequence, or possible site damage if it failed;
- habitat value;
- aesthetic or historic value; and
- client priorities, if any.

For each element, also assign an overall existing conditions value on a 1 to 4 scale, where 1 is good, 2 is fair, 3 is poor, and 4 is failing. (See Sections 19 and 20 for more information about rating individual BMPs.) For now, don't break each BMP into component parts with individual rankings for each component (inlet, vegetation, mulch, outfall, stand-up pipe, etc.) You will have space for more detail on the individual BMP worksheet.

TABLE 3: EXAMPLE OF LMA WORKSHEET

LMA #1: Fictional School Building entry

ELEMENT	PHOTO	AREA/QUANTITY	CRITICALITY	INSPECTOR	DATE	EXISTING CONDITION	CURRENT HAZARD?
Rain garden #1: NE corner		200 sq. ft.	2	Dan, Earthwise Landscape	Sep. 1, 2016	1	no
Rain garden #2: West side		300 sq. ft.	3	Jim, Earthwise Landscape	Sep. 2, 2016	2	no
Permeable driveway		600 sq. ft.	1	Dan, Earthwise Landscape	Sep. 1, 2016	1	no
Turf behind gym		5,000 sq. ft.	3	Dan, Earthwise Landscape	Sep. 1, 2016	2	no
Canopy trees above 24" caliper		1	1	Tanya, Earthwise Landscape	Sep. 1, 2016	2	Dead overhanging branch over walkway
Ground Cover area		100 sq. ft.	2	Tanya	Sep. 1, 2016	2	no
Rain barrel		1 @ 150 gallons	3	Liz	Sep. 1, 2016	3	no

Total all the landscape elements across all the LMAs to determine how many BMP practices, turf, trees, and other hardscape elements you must address in your LMP as well as their current conditions. For any public safety issues, or issues outside your scope of expertise, determine which allied professional should be brought in. Your client may have a working relationship with this type of professional, but may be open to your suggestions. Evaluate any access issues as they affect maintenance. Assess any client priorities as mentioned in Section 1. Now you are ready to create your proposal with your own suggested schedule and specifications.

4.2 Scheduling

Regarding BMP maintenance, Chesapeake Stormwater Network *Technical Bulletin No.10: Bioretention Illustrated* states that:

> *It can be tempting to prescribe a specific list of maintenance tasks and a fixed schedule to perform them, but in reality most maintenance tasks are performed on demand based on what the inspector/maintainer actually sees. The maintenance regime for an individual practice depends on the level of service or amenity, visibility, development intensity and owner preferences. Other factors, such as extreme rainfall events, hard winters and extended droughts, can strongly influence maintenance needs from year to year. — CSN Technical Bulletin #10*, Section 5.2.

It is also true that the more you know about how plants grow, reproduce, and die, the less you will need to rely on written instructions because your own site observations will tell you when to perform certain tasks such as deadheading unwanted plants before they go to seed.

Before developing a landscape maintenance schedule, speak with your client or prospective client about their expectations, as well as the designer if it is someone besides you. Understand how a landscape is *intended* to perform seasonally, so that you can be the messenger back to the client and designer if actual conditions differ.

Since you would have created your site history timeline (section 1.1 checklist item 6), and consulted with the designer if it's not you, you should understand whether the landscape you are considering is in the "plant establishment phase," the "landscape establishment phase," or the "post-establishment phase," as fully described in *Planting in a Post-Wild World* (pp.235–241). Understand that designed landscapes require different levels of care depending on their stages of development, so schedule tasks accordingly, in addition to those regularly required tasks (outlined in Table 7).

4.3 Specifications

What are specifications, and how do they differ from a contract proposal or from design drawings? Whether they originate with the client, designer, or contractor, specifications generally consist of "the written requirements for materials, equipment, systems, standards and workmanship… and performance of related services." (*Construction Specifications Writing,* Rosen et al, p.5).

While it is beyond the scope of this manual to review the different types of specifications (or specs), it is important to know that they differ from design drawings, which show the sizes and locations of landscape elements. Specifications outline assembly — or, for our purposes, maintenance — in more detail. While model landscape maintenance specs are commercially available from professional organizations like the Landscape Contractors Association (LCA), there are currently no commercially available sustainable landscape maintenance specs tailored to the Chesapeake Bay watershed. However, two such model documents written by Seattle Public Utilities offer an excellent starting point.

According to Seattle Public Utilities, both the short form *Landscape Maintenance Agreeme*nt (five pages) and long form Landscape Maintenance Standards and Specifications (twelve pages), "are written in specification format, for use in contracting for landscape maintenance services, or guiding in-house staff. They can be adapted to fit a variety of sites: commercial properties, schools and institutions, new developments, or homeowners associations."

Here are some examples from the above-mentioned, *Landscape Maintenance Agreement* to provide an idea of how sustainable landscape maintenance may be articulated as a goal shared by designers, clients, and contractors:

> *The Owner intends that this landscape be maintained using natural landscaping techniques such as soil building, integrated pest management (IPM) and proper pruning and irrigation practices, and that pesticide use and other chemical inputs be minimized or eliminated.* (p.1)

> *Leaves shall be mulch mowed or left in planting areas throughout the winter, spring and summer when leaf fall is not excessive and plant health is not adversely affected.* (p.4)

> *An ISA-certified arborist must be used for pruning on any trees larger than six inches DBH or any branches larger than four inches in diameter. This is additional work outside the scope of this contract.* (p.4)

Though written from the client's perspective, these documents provide useful language that may be adapted by landscape contractors for their written agreements or proposals. Remember, specs are considered to be contractual documents. Always have a qualified attorney review any of your contract documents or templates prior to use.

4.4 References

ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices. Version 2b, 2014, p.25.

CSN Technical Bulletin No.10: Bioretention Illustrated. Chesapeake Stormwater Network, April 2010. Sections 5.2 and 5.3

Rosen, Harold J., Morton Dan. Morris, and John R. Regener. *Construction Specifications Writing: Principles and Procedures.* Hoboken, NJ: Wiley, 2005, p.5.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities. Direct download: www.seattle.gov/util/cs/groups/public/@spu/@conservation/documents/webcontent/02_015543.doc

Rainer, Thomas, and Claudia West. *Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes.* Portland, OR: Timber Press, 2015, pp.235–241.

Cook, T. W., & VanDerZanden, A. M. *Sustainable landscape management: Design, construction, and maintenance.* Hoboken, NJ: Wiley, 2011.

RiverSmart Homes – Maintenance. D.C. Department of Energy & Environment.

Riding mowers should be set to cut grass no less than 3½" high, mulching it in place.

During the growing season, a sharp straight blade is best for turf.

When leaves are falling in autumn, a toothed blade will help chop falling leaves, which should also be mulched in place.

PHOTOS: LEVEL GREEN LANDSCAPING

SECTION 5: LABOR AND COST ESTIMATING

5.1 Training and Skills

Responsible monitoring and maintenance of sustainable landscapes requires a labor force with training and skills beyond those of traditional landscape crews. A growing and largely unmet demand for more highly trained landscape maintenance personnel exists in both private and public sectors.

The voluntary standard, SITES™, includes staff training as a requirement in its Section 8: Operations + Maintenance. Similarly, the federal government's *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes* requires that "site managers and any maintenance contracts commit to educating maintenance personnel on the goals and implementation of the [landscape maintenance] plan." The federal government also requires that those maintaining agency landscapes attend annual training on sustainable practices. (See p.21 of *Guidance for Federal Agencies*.)

The CBLP Program is helping to address the need for training in sustainable practices, which will eventually create a market niche for landscape maintenance professionals, who practice environmental stewardship on all projects in the following ways:

- Know more about all plants and their growth cycles.
- Can "read" a landscape and understand dynamic processes occurring within it.
- Understand how to effect desirable change in soil, water, and nutrient systems.
- Effectively communicate with and help educate a new generation of clients.
- Can participate fully on design teams throughout a project's life cycle.

This will require much earlier and informed involvement during the design and installation process of those who will monitor and maintain a landscape. For instance, designers and crew leaders should conduct a job-site walk-through to train crews on sustainable maintenance practices required for each project. It will also mean that designers remain involved on projects after installation, learning how their designs fail and succeed in the natural and human environment. It must be understood that there are cost implications to this level of training and teamwork. It is our job as landscape professionals to help educate our clients and landscape crews to ensure projects succeed and function as designed.

A well-prepared crew consults a full-size printed drawing during plant installation.

PHOTO: CHERYL CORSON

Trucks equipped with safe equipment ramps indicate a safety conscious company.

PHOTO: JOHN SHORB LANDSCAPING

5.2 Business Models

For design professionals, time and resources devoted to continuing education are part of business overhead and the same must be true on the maintenance side. Hourly pay rates and billing rates for more highly trained personnel must reflect this. In addition, it is necessary to build training and professional development time into overhead for crew leaders and staff. Two types of training are needed:

1. General company-wide sustainable practices having to do with proper use of equipment, turf management, mulching and recycling methods, etc.
2. Specific maintenance of BMPs such as rain gardens, permeable paving, green roofs, hand pruning, etc.

For companies that run multiple crews, owners will choose whether to train some or all members of every crew in BMP maintenance, or develop a specialty crew with those increased capacities. In the first case, a single deployment will be able to handle all maintenance aspects on a site. In the second, multiple deployments may be needed, involving crews with different skill levels. Companies active in the Mid-Atlantic practice both these methods. Each business owner must determine staffing strategies best suited to their existing and aspirational client portfolio.

5.3 Cost Estimating

Over time, the total cost of owning a sustainably designed and maintained landscape will be less than a traditional one. Certain inputs will always be lower, or will decrease over time. These include:

- water;
- fuel for mowers and staff time mowing;
- pesticides;
- fertilizers;
- mulch;
- annuals; and
- replacement trees.

Other previously described costs will be higher. Informal research for this manual revealed that many local landscape maintenance companies use a customized version of a cost estimating spreadsheet developed years ago by a large company. Such a tool can quantify labor rates for a certain type and size mower based, for example, on the area covered per hour. Contractors are known to have difficulty estimating time for labor for BMP maintenance done without machinery. Other companies may provide cost estimates based on the use of inappropriate tools for certain tasks, such as string trimming a green roof.

A better alternative is to use the completed LMA inventories (Table 3), total the areas of each landscape element. Next, use an open source app or proprietary estimating software described in Section 1.1. Alternatively, estimate and quantify the maintenance tasks needed. Test the results after some number of crew deployments, adjust your numbers, and thus develop a custom cost estimating model based on data collected through job experience.

When proposing remedial work or upgrades to a client, with design team input, it may be useful to organize the cost implications as shown in Table 4.

TABLE 4: LANDSCAPE MAINTENANCE COST/BENEFIT MATRIX

DIFFICULTY OF IMPLEMENTATION	COST IMPACT	ENVIRONMENTAL BENEFIT
Low: Relatively simple to do	Low: Little to no cost	Good: Improves performance from baseline
Medium: Requires special coordination	Medium: Cost has 3–8 year payback period	Very Good: Achieves target performance for one element
High: May require specialized expertise to design/implement	High: Payback period over 10 years	Excellent: Demonstrates leadership, improves more than one element

Adapted from Green Gardening Workshop, Barbara DeCaro, Senior Environmental Analyst, City of Seattle.

When taking on new work on landscapes with many sustainable features and goals, and BMPs, it may be advisable to notify your client that the first year will be used as data to assess true cost and that you and the client (with designer) will review your cost findings prior to contract renewal.

In fact, this practice may become an intentional part of what is called an adaptive management strategy, which involves conducting a performance evaluation on a regular basis and determining how the system might more positively adapt going forward. This can refer as much to the human system as the natural systems at the site. As for any important assessment, the integrated design team should participate in any adaptive management strategy.

5.4 References

Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes. Council on Environmental Quality, 2011.

Landscape Management Plans, Green Gardening Workshop PPT file, Barbara DeCaro, October 16, 2012.

SECTION 6: PROJECT DOCUMENTATION AND TEMPLATES

6.1 Overall Site Inspection Rationale and Templates

You will find sample maintenance worksheet templates for individual BMPs in Sections 19 and 20 of this manual. Depending on the site's scale and complexity and on the size of your maintenance staff, these will be important to use. However, it is also a good idea to first monitor the landscape site as a whole for its general appearance, performance, and any public safety issues. This step can help detect patterns that identify conditions that may be responsible for individual BMP performance issues site wide.

One way to quickly record an overall site inspection is to simply add a set of columns to the LMA worksheet from Table 3 in this manual. This will create a quick and easy basis for comparison, after which you can move onto individual condition worksheets for each BMP that allow you the opportunity to go into more detail. Prioritization you will already have done (see Section 1.3) and established as a "Criticality" factor of 1 though 4 in your initial LMA worksheet (Table 3) will not normally change.

This task is not intended to create a lot of paperwork. It is to document your process so that you can communicate effectively with your clients, designers, or any allied professionals when needed. Remember, there are online apps and software tools that may be adapted for this purpose. This step is valuable even if your entire site is composed of a single BMP, like a large rain garden. One way to maximize the benefit of this step would be to upload or somehow share this worksheet with your client after each monthly site inspection. In the long run, this could save time since you and the client would be sharing information all along the way.

TABLE 5: EXPANDED LMA WORKSHEET WITH NEW SITE INSPECTION

ELEMENT	PHOTO	AREA/ QUAN.	CRITICALITY	INSPECTOR	DATE	EXISTING CONDITION	CURRENT HAZARD?	INSPECTOR	DATE	EXISTING CONDITIONS	HAZARD?
Rain garden #1 NE corner		200 sq. ft.	2	Dan, Earthwise Landscape	Sep. 1, 2016	1	no	Dan	Oct. 3, 2016	1	no
Rain garden #2 West side		300 sq. ft.	3	Jim, Earthwise Landscape	Sep. 2, 2016	2	no	Dan	Oct. 4, 2016	1	no
Permeable driveway		600 sq. ft.	1	Dan, Earthwise Landscape	Sep. 1, 2016	1	no	Dan	Oct. 3, 2016	2	no
Turf behind gym		5,000 sq. ft.	3	Inspector	Sep. 1, 2016	2	no	Dan	Oct. 3, 2016	2	no

Table 6 is another overall site worksheet on which to record site-wide observations. This worksheet presents a way to using one sheet to group different landscape elements together in a single report. Again, you can break this down further in individual BMP condition worksheets as needed (Sections 19 and 20).

TABLE 6: SITE-WIDE GENERAL LANDSCAPE MAINTENANCE ASSESSMENT

(Adapted from *Field Guide: Maintaining Rain Gardens, Swales, and Stormwater Planters* (2013), Oregon State University.)

NAME OF SITE	CLIENT NAME	ADDRESS	
Date of Last Visit	**Date of This Visit**	**Date of last rain over 1"**	**Inspector Name**
General Appearance and Level of Care	**LMA #__(s) Landscape Feature(s)**	**What Did You See?**	**What Did you Do?**
Safety issues?			
Trash/debris			
Vandalism			
Breaks in fences			
Walkway condition			
Site furniture condition			
Signage condition			
Wildlife evidence (wanted, unwanted)			
Oil or chemical presence			
Other			
Vegetation	**LMA #__(s) Landscape Feature(s)**	**What Did You See?**	**What Did you Do?**
Turf condition, height			
Bare Soil?			
Mulch condition			
Stressed (trees, shrubs, perennials, ground cover)			
Dead (trees, shrubs, perennials, ground cover)			
Storm damage to trees			
Unwanted plants?			
Unwanted plants about to go to seed?			
Desirable plants emerging?			
Tree stake issues			
Other			
Erosion and Sediment	**LMA #__(s) Landscape Feature(s)**	**What Did You See?**	**What Did you Do?**
Eroded areas (inlet, side slope, outfall, etc.)			
Sedimentation			
Standing Water			
Clogged stand-up pipes, drains, inlets			
If irrigated, evidence of over-spray			
Sediment from snow melt			
Structural footers exposed by erosion			
Other			

6.2 Annual Maintenance Task Outline and Template

The Chesapeake Bay watershed is so large that first and last frost dates vary greatly and cannot be used as a regional metric. Even microclimate conditions within a small area, including urban versus suburban or rural areas, will mean that certain landscape maintenance actions occur a week or more earlier or later, depending on location. Table 7 may be adjusted to suit your specific site requirements. The seasons are grouped by the vegetation cycle rather than by calendar year.

TABLE 7: ANNUAL TASK SCHEDULE TEMPLATE

TASK AND/OR INSPECTION	DORMANT SEASON			LATE WINTER/ EARLY SPRING			VIGOROUS GROWING SEASON			PLANT MATURITY SEASON		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Staff Training (most time available)												
Soil Testing												
Irrigation on/off												
Tree Inspection												
Tree Pruning**												
Shrub Pruning***												
Cut Back Perennials												
Cut Back Grasses												
IPM****												
Turf Renewal												

* if site requires

** unless storm damage

*** **depends on species, generally only after blooming, right plant, right place will require little or no pruning except for storm damage or minor aesthetic adjustment**

**** **customize for species to be released**

6.3 References

Field Guide: Maintaining Rain Gardens, Swales, and Stormwater Planters. Oregon State University, 2013.

TOOLS AND WORKING METHODS

SECTION 7: TOOLS AND EQUIPMENT

7.1 Choosing Tools and Equipment

Sustainable tools and equipment reduce environmental impact and cause no physical harm to landscape maintenance workers or site inhabitants. To accomplish this, vehicles and equipment should be selected or phased in that

- reduce fossil fuel use by increasing fuel efficiency;
- use hybrid or electric power;
- are water-efficient, when applicable;
- rely more on hand tools than power tools; and
- mulch grass clippings in place, rather than bag and remove them.

The document, *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes,* Section XII, Operations and Maintenance (items e, f, and g), contains a detailed list of energy efficient qualities to select for in tools and equipment. A more concise list may be found in the SITES™ v2, rating system checklist, Section 8.1 Operations + Maintenance, item 6, Landscape maintenance equipment. In fact, SITES™ v2 offers extra credit for projects maintained with no power equipment at all (Credit 8.7).

One example of a specification for mulching mowers may be found in the Seattle Public Utilities template document, *Landscape Maintenance Standards and Specifications,* section 4.1.1.

> "All turf will be mowed with professional quality mulching mower equipment. Pricing assumes that bagging and removing clippings will be required only when excessive leaf debris is present, turf is too long to mulch, or when moisture conditions are too high to allow effective mulching without substantial clumping of turf debris. (No more than a total of 8 times per year.)"

Avoid using power equipment that is too large or heavy for the task at hand, because it causes soil compaction on-site. Consider the tire treads necessary for various types of work and use turf treads to avoid damage and unnecessary soil disturbance when appropriate.

7.2 When to Use Equipment

As discussed in Section 2 of this manual, jurisdictions in which you work will specify acceptable days and hours for landscape maintenance. It is more sustainable to exceed minimum standards by exercising choice about when certain noisy operations are conducted. As stated in the *Guidance for Federal Agencies,* Section XII, item g, "Work periods should be specified for use of power equipment to reflect impact on human health and if possible, maintenance equipment such as mowers, leaf blower, trimmers, should operate during hours that have the least impact on building occupants and neighboring communities."

7.3 Maintaining Tools and Equipment

Your maintenance schedule will depend on what equipment you operate and how often it is used. Establish routine periodic equipment monitoring and documentation that include the following:

- Keep tires properly inflated.
- Lubricate moving parts.
- Keep blades sharp.
- Keep combustion engines tuned up.
- Maintain combustion engine fluid levels.

7.4 References

Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes. Council on Environmental Quality, 2011. Section XII, Operations and Maintenance, subsections e, f, and g.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities. Section 4.1.1.

SITES™ v2 rating system checklist, Section 8.1.

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013,Section 8. Management.

Sustainable Landscapes Certification Manual. Harrisburg, PA: Pennsylvania Landscape and Nursery Association, pp.99–103.

SECTION 8: SAFETY AND TEAMWORK

8.1 General Safety Resources

Avoid toxic landscape products or materials whenever possible. Crew leaders should carry documentation on emergency contacts for all crewmembers, including themselves, in the event of a medical emergency, including any known drug allergies.

Worker Safety
Every landscape maintenance worker, whether a full-time or temporary worker, has the federally protected right to a safe work environment. The agency that sets and enforces safety standards is the U.S. Occupational Safety and Health Administration (OSHA), which has specific standards for landscape and horticultural services. Here you will find personal safety standards for things like ear, hand, and foot protection; power tools; respiratory protection; and more. OSHA stipulates that training must be conducted in the language spoken by workers, which means Spanish for a large segment of our local workforce.

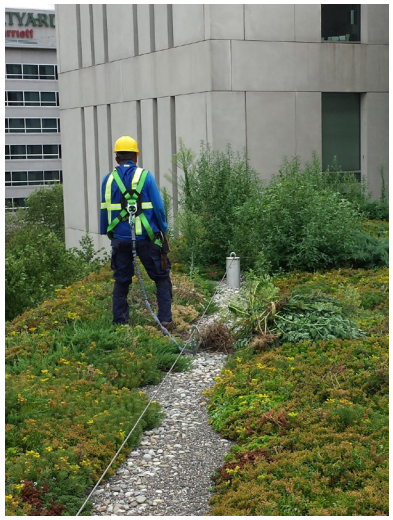
Some states have their own OSHA-approved plans, which may have different or more stringent requirements. As of September 2016, three states in the Chesapeake Bay watershed had state OSHA-approved plans.

Digging Safety
The three-digit hotline, *811: Know what's below. Call before you dig,* was created to provide a nationwide, easily accessible resource for contractors, homeowners, and farmers. The 811 call center manages requests in all 50 states.

Safety Data Sheets
Until 2012, Safety Data Sheets (SDS's) were called Material Safety Data Sheets (MSDS's). In any event, these documents are designed to provide workers and emergency personal with the proper procedures for handling or working with a particular substance. Any chemical used in the landscape industry will have an online searchable SDS. A brief by the Occupational and Safety and Health Administration (OSHA), *Hazard Communication Standard: Safety Data Sheets*, explains how to read an SDS.

8.2 Specific Landscape Safety Concerns

Green Roofs
OSHA has a set of requirements relating to green roofs, including topics like fall protection, cranes, heat stress, and more. See *Green Job Hazards: Green Roofs* for details. OSHA has been known to enforce green roof safety violations in the District of Columbia, and significant fines may be imposed.



OSHA-required safety features for maintaining green roofs are functional design elements. For example, this worker is wearing a safety harness and tether to prevent a fall off the roof.

PHOTO: JOHN SHORB LANDSCAPING

Poisonous Plants
Train staff to recognize and take proper precautions when working around toxic plants like poison ivy. OSHA has an online resource on this topic, *Health Hazards: Poisonous Plants*. Giant hogweed is a highly toxic Asian native now present in the Chesapeake Bay watershed. Contact with this plant may cause severe burns and eye contact may cause permanent blindness. Helpful state resources about invasives available within the Chesapeake Bay watershed as of September 2016 include:

- Delaware: *Dangerous Aliens: Have You Seen Them?*
- Maryland: *Giant Hogweed*
- New York: *Giant Hogweed: Do Not Touch This Plant!*
- Pennsylvania: *Invasive Plants in Pennsylvania: Giant Hogweed*

Using Harvested Rainwater
Local regulations will stipulate whether water from cisterns and/or rain barrels may, or may not be used to irrigate crops, used in children's sand play areas, or for other purposes. Always check your local jurisdiction before watering with harvested roof water.

Safe Refuse Disposal
Be aware of regulations in your jurisdiction for the safe disposal of any materials that may be hazardous. These may include pressure treated lumber, pet waste, chipped wood from diseased woody plants, or needles or syringes (also called "sharps").

Safety and Access around Vegetation
Seattle's *Green Stormwater Operations and Maintenance Manual* (p.23) offers this list of five qualities of excellent vegetation safety:

- Vegetation causes no visibility (line of sight) or driver safety issues.
- Infrastructure is always accessible and has clear access path.
- Vegetation around infrastructure is maintained at height to prevent damage during routine maintenance.
- Fire hydrant access is clearly visible and accessible.
- Vegetation does not impede pedestrian access.

8.3 The Importance of Teamwork

Working together across disciplines throughout the design, installation, and maintenance phases is a requirement for projects seeking SITES™ Certification. The SITES™ checklist for this prerequisite (Section 2, number 2.1) includes the following seven items:

- Form an integrated design team.
- Develop a collaborative communication process.
- Identify project sustainability principles and performance goals.
- Incorporate the sustainability principles and performance goals into a program plan.
- Identify stakeholders and site user groups.
- Plan for construction oversight.
- Develop a strategy for preparing a site maintenance plan, including all team members.

The Clean Green Team of Potomac Gardens in Washington, D.C. is a youth green jobs training program offered through Little Lights Urban Ministries.

PHOTO: CHERYL CORSON

Although it is easier said than done, teamwork will undoubtedly lead to a better, more sustainable landscape with lower inputs and happier clients. Sometimes the simple things like arranging efficient email communication will take the burden off team members, making teamwork more appealing. Early notification of site maintenance concerns may prevent substantial problems. Often it is the contractor who is in the best position to monitor and report problems. Creating a system for two-way communication is crucial for teamwork to become a benefit not a chore.

8.4 References

ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices, Version 2b, 2014, p.26 & p.30.

Green Stormwater Operations and Maintenance Manual. Seattle Public Utilities, 2009. Table VII: Safety, Spill Prevention and Response, and Pest Control, p.23.

SITES™ v2 Rating System checklist, 2014. Section 2, Prerequisite 2.1: Use an integrative design process: Site Safety, Section 8.1, Item 4.

Sustainable Landscapes Certification Manual. Harrisburg, PA: Pennsylvania Landscape and Nursery Association, pp.28–29, p.102

SECTION 9: USING AND PROCURING MATERIALS SUSTAINABLY

9.1 Selecting Materials for Sustainability

During the maintenance phase, SITES™ v2 recommends that the LMP include a "list of preferred characteristics for replacement materials," such as:

- Materials from local and regional sources
- Recycled content materials
- Certified wood products
- Energy-efficient lighting

Develop your own list in consultation with the integrated design team and identify local sources most aligned with your procurement goals.

9.2 Using Fertilizers

In the Chesapeake Bay watershed, fertilizers are considered a major source of pollution. Conservation landscapes and stormwater BMPs are designed to minimize the use of fertilizers and capture and treat any stormwater runoff carrying dissolved nitrogen and phosphorus. The Urban Nutrient Management BMP approved by the Chesapeake Bay Program is a series of turf-related activities that minimize fertilizer use. Conservation landscapes, according to the CCLC, reduce or eliminate the use of pesticides and fertilizers.

Larry Weaner, in *Garden Revolution,* comes down against fertilizers entirely, saying, "If you've chosen plants that are adapted to the soil, site, and climate, once rooted in the plantings [they] won't need such artificial assistance (except perhaps in the rare case of an extreme and prolonged drought). Dumping extra and unnecessary resources into a garden ecosystem invites invasion by those garden opportunists, weeds." (p.17)

The SITES™ v2 Rating System checklist offers a credit (Credit 8.4, pp.106–107) for minimizing pesticide and fertilizer use. Among the many excellent suggestions are the following:

- Ban all "weed and feed" type fertilizers.
- Set and enforce buffer zones where fertilizers and pesticides may not be applied (such as near drains, near curbs or driveways).
- Develop a list of organic or slow-release fertilizer products that are approved for use on the site.
- Ban the application of all fertilizers during any rainy seasons, before predicted heavy rainfall events, and during summer.
- Ban the use of all fertilizers after the establishment period (with some exceptions; see full text).

Washington State's ecoPRO *Guiding Principles and Sustainable Best Practices* advises avoiding the use of synthetic fertilizers. (p.21) Maryland has a statewide lawn fertilizer law with a great deal of online information. The website states that, "lawn care professionals hired to apply fertilizer to lawns must be certified by the Maryland Department of Agriculture or work under the direct supervision of an individual who is certified." For other jurisdictions, know when an applicator license or certification is required, and comply with any state and local laws. Avoid using combination pesticide and fertilizer products, and follow fertilizer label rates and schedules.

9.3 Procuring Mulch

Larry Weaner, in *Garden Revolution,* comes down against mulch as well as fertilizers, saying, “Broad seas of mulch, a too common feature of contemporary North American landscapes, are an invitation to trouble.” (p.155) He means that mulch may suppress certain weeds but not more aggressive ones like Japanese knotweed. Weed seeds, or even pests like emerald ash borer may be brought onto a site in costly mulch. Furthermore, mulch may inhibit germination of seeds of desirable plants. A better solution, and one also endorsed in the book, *Planting in a Post-Wild World,* is to create a dense ground cover plant layer, and more dense plantings in general, as a weed suppression strategy. University of Maryland Professor Emeritus, Frank R. Gouin, is a frequent area lecturer on the downsides of mulch. Dr. Gouin advocates keeping older mulch on site rather than paying to haul it away, advising that it be raked and reapplied.

If your site does require mulch, follow any design specifications or drawings regarding its application. Purchase mulch from sources known to be free of toxins and pests (like emerald ash borer). For mulch application methods, see Section 15 of this manual. If you are asked to apply mulch to play areas with elevated play equipment, notify your client that engineered wood fiber (EWF) and not landscape mulch, is the correct material to apply within equipment use zones. When in doubt, consult a Certified Playground Safety Inspector (CPSI).

9.4 References

ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices, Version 2b, 2014, p.21.

Ranier, Thomas and Claudia West. *Planting in a Post-Wild World.* Timber Press, 2015, pp.50–54, pp.205–206, p.233.

SITES™ v2 Rating System checklist, 2014. Section 8.1, topic 4 and Credit 8.4.

Weaner, Larry and Thomas Christopher. *Garden Revolution.* Timber Press, 2016, p.17 & p.155.

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013, Section 8. Management.

U-5 Urban Nutrient Management Fact Sheet. Chesapeake Stormwater Network, 2015.

SECTION 10: PROPRIETARY PRODUCTS AND SYSTEMS

10.1 Identifying Proprietary Products

New proprietary products and systems related to stormwater management regularly appear on the marketplace. Frequently, manufacturers require or advise special training or even certification prior to their installation. Maintenance workers often do not have the same training and may not even realize that a proprietary product is in use. Examples include certain green roof systems, living wall systems, and even permeable pavers. This is an important issue because by taking or failing to take certain actions during maintenance could compromise the system's performance or void the owner's warranty.

The site inventory you have compiled (Section 1) will have revealed the presence of any proprietary products or systems, and made you aware of their warranty, manufacturer's representative, and contact information. Make crews aware of any proprietary systems and check with the manufacturers if information on maintenance is missing from the drawings and/or specifications.

Leak detection for this green roof is clearly indicated with a permanent marker for the benefit of clients and landscape maintenance crews.

PHOTO: CHERYL CORSON

NATURAL SYSTEMS

SECTION 11: WATER

It is a frequent misconception that sustainably designed landscapes, or native plants in general, require little or no water. Managing rain or snowfall as well as supplemental water taken from municipal systems, wells, or rainwater harvesting devices requires awareness of some basic concepts, such as:

11.1 Water Use Considerations

1. Understand that not permanently relying on irrigation is a goal of sustainable landscape maintenance.
2. Be familiar with plants on-site and their hydric preferences.
3. Understand current water needs with respect to the landscape's establishment phase and adopt a water budget accordingly (in consultation with designer, installer, and client).
4. Know when plants were installed and be aware of any warranty expiration dates.
5. Understand that greater planting density and less exposed soil surface (even mulched) reduces evapotranspiration and water needs.
6. Be aware of any chemical additives that may be present in municipal water that could affect plant health.
7. Know that harvested rainwater is considered non-potable (not for drinking) and comply with local regulations regarding its use.
8. Plan optimal areas for stockpiling snow "in ways that limit degradation of water quality and surrounding plants and soil health."(SITES™ v2, Section 8.1, topic 7).

11.2 Watering Recommendations

1. Be aware of rainfall quantity (or lack thereof) on your site between maintenance visits.
2. Understand that less frequent yet deep watering encourages stronger root systems and discourages weeds.
3. Ideally, after plant establishment, only water during periods of extended drought.
4. When watering during drought, prioritize trees and shrubs over perennials and turf.
5. If watering manually, use proper equipment that delivers water to where it is specifically needed.
6. Direct water to the base of plants, not the leaves (which wastes water through evaporation).
7. Maximize infiltration by aerating soil or breaking up caked mulch (see Section 12).
8. If using slow release watering bags, fill them regularly and remove them from trees after the growing season.

Snow stockpile locations should be determined in advance to protect nearby planting areas and downstream water quality.

PHOTO: LEVEL GREEN LANDSCAPING

11.3 Irrigation Recommendations

Note that the following recommendations relate to maximizing sustainability in irrigation and are no substitute for more thorough training, including certification, in irrigation system operations and maintenance, including knowledge of public safety features like backflow prevention.

1. If an irrigation system was installed by a separate contractor, determine the maintenance responsibility that contractor currently has and coordinate as needed as part of the overall LMP.
2. Even if a separate irrigation company is on contract, monitor the effectiveness of the irrigation system and report any performance issues to the client as soon as they appear.
3. Assure that irrigation heads only direct water where desired, preventing water runoff onto walkways and other hardscape areas.
4. If you are the responsible party, schedule watering for early morning to reduce evaporation, and adjust water frequency on a monthly basis during the growing season to respond to seasonal water needs.
5. “Run times shall be sufficient to allow for saturation of the root zone without runoff. Allow adequate run times in drip irrigation zones.” (Seattle Public Utilities, Landscape Maintenance Standards and Specifications, page 11.)
6. In coordination with the integrated design team, remove or disable any temporary irrigation system put in place during the landscape establishment phase when no longer essential.
7. Use a manual soil moisture sensor to monitor existing conditions, and as practicable, add soil moisture sensors and rain shut-off sensors to existing irrigation systems to conserve water.
8. Perform timely seasonal system start-up and shut-off in coordination with the client and integrated design team.

Landscape maintenance staff should alert the client and designer of this inappropriate 360 degree spray head and arrange with the irrigation contractor to replace it.

PHOTO: CHERYL CORSON

11.4 References

Water-Wise Gardening, by Cheryl Corson. Capital Community News: Hill Rag, June 2016.

ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices, Version 2b, August 4, 2014. p.12.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities, 2009, Section 7.1.3, pp.10–11

SITES™ v2 rating system checklist, Section 8.1, Topic 1: Water, p.100.

Virginia Rainwater Harvesting Manual, by Adrienne LaBranche et al. Compiled by The Cabell Brand Center, Salem, VA. 2007.

Sustainable Landscape Management: Standards of Care in the Desert Southwest. Janet Waibel. Tempe, AZ: GBG Publishers, LLC, 2009, p.32.

SECTION 12: SOIL

12.1 Soil Specifications

Background
Landscape maintenance requires ongoing soil monitoring, soil testing, and providing site specific, organic responses using soil amendments, but only when needed. Ongoing monitoring of soil protects the Chesapeake Bay by helping manage nitrogen (N) and phosphorous (P), the two key nutrient pollutants of waterways feeding the Bay. When specified soil media, mulches, or composts are not used, a BMP may no longer be eligible for nutrient and sediment reduction credits.

Soil scientist Dr. Phillip J. Craul writes that soil scientists and allied professionals "are concerned with the physical, chemical, and biological properties of soil that lead to the characteristics of water-holding capacity, drainage and aeration, fertility, and mechanical support for plants." For more on this broad topic, refer to the CBLP design curriculum. For information on fertilizers, refer to Section 9.2 of this manual.

Soil Specifications
The jurisdiction in which you work likely has its own soil testing and soil amendment protocol. While these may pertain to installations on public projects only, you are responsible for determining their applicability to your site. Here are some examples:

- Montgomery County, Maryland's *Standard Specification 723, Landscape Soil (Topsoil),* is an excellent resource if you've never read a soil specification. This seven-page document says how and when to test, how many tests in a given area to perform, what to test for, acceptable pH levels, acceptable levels of minerals, acceptable soil amendments, and their application methods.

- Arlington, Virginia's Landscape Standards provide another useful example.

- In the District of Columbia, the *Green Area Ratio (GAR) Guidebook's* soil requirements coordinate with the City's *Stormwater Management Guidebook* so that both programs remain consistent (see links in section 12.4 References).

- Virginia has what is called a Nutrient Management Program, which will be discussed more in Section 18 of this manual. This program uses "various strategies to encourage proper land application of fertilizer, manure and sewage sludge for agricultural and urban purposes."

In all cases, the level of detail and the soil specifications themselves vary greatly. Keep in mind that your client and designer may have preferences regarding soil amendments and mulch that may be more stringent than the jurisdiction in which you are working, or your own customary protocol. For example, not all designers or clients find biosolids, also known as sewage sludge, acceptable as a soil amendment.

12.2 Soil Testing

Test the soils in each main planting area (or as required depending on area size) once a year in spring or fall according to the protocol provided by the testing lab you plan to use and your site's needs. Include this annual task in your LMP, including reporting on the results and making recommendations to your client, so that this often neglected aspect of landscape maintenance is sure to occur and that you are adequately compensated.

The University of Maryland Extension offers a list of regional soil test labs (updated 10/8/2015).

Note that most labs will ask if your test is for homeowner or commercial soil testing. Some states, like Delaware include lead in its basic requirement for "Home Lawn and Garden Soil Test," while for others, lead and other heavy metals may be added as options.

Throughout the growing season, also observe soils on site by picking up a sample, squeezing it, checking its plasticity, moisture, smell, etc. You don't always need a laboratory to know how your soil is doing.

12.3 Soil Amendments

As determined by soil test results and plant performance, select the appropriate soil amendment and quantity. Typical organic soil amendments include:

Mycorrhizal Inoculants
These fungi form a network of fine filaments that associate with plant roots and draw nutrients and water from the soil that the root system would not otherwise be able to access. Mycorrhizae are commercially available from specialty suppliers.

Compost

- Create on site:
  Finding a location on your site to compost yard waste in place, if possible, will reduce material entering the waste stream and offer free organic matter back to the soil. Chip small branches and compost larger organic seasonal garden waste. Always mulch grass clippings in place (more on turf in Section 18). Compost tea can be made using worm castings, molasses, and water. If feasible on your site, consider this guide to making compost tea as an additional tool in your toolkit.

- Purchase from reliable source:
  If you purchase compost, organic commercial compost suppliers are now available, such as Chesapeake Compost Works in Maryland. Composted leaves in products such as LeafGro are also available in bulk. Proprietary compost or soil amendments come with manufacturer's application recommendations, which must be followed to achieve the desired results.

- Apply compost appropriately:
  Depending on your native soil, it may be preferable to top dress compost rather than till it in, which destroys soil structure.

Leaves
Provided you have a way to mow or chop leaves so they do not smother ornamental landscape beds, leaves are an excellent soil amendment. If the landscape situation allows, leaves may be left in place. Otherwise, they can be gathered, chopped, and then re-applied to landscape beds and natural areas in the fall. Do not burn them. The Chesapeake Bay Foundation has a webpage about working with autumn leaves.

12.4 References

An APLD Guide to Sustainable Soils. Association of Professional Landscape Designers (APLD).

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013, pp.28–32.

Craul, Phillip J. *Urban Soil in Landscape Design.* John Wiley & Sons, Inc., 1992, p.6.

Green Area Ratio Guidebook. District of Columbia DOEE, March 3, 2015, pp.27–34.

Stormwater Manual, Section 3.6, Bioretention. District of Columbia, DOEE, pp.107–110; Appendix J, *Soil Compost Amendment Requirements .*

Selecting and Using a Soil Testing Laboratory. University of Maryland Extension, 2013.

SECTION 13: EROSION AND SEDIMENT CONTROL

13.1 State Regulations

Refer to the CBLP certification curriculum, which addresses erosion and sediment control (ESC) during landscape installation. Should your site need any modifications or upgrades disturbing more than a certain area, or is triggering ESC requirements for any reason, be aware of what the local requirements are. Here is a list of state level ESC regulations, certifications, and guidebooks:

- District of Columbia
  Soil Erosion and Sediment Control Overview
- Maryland
  Responsible Personnel online training
- Virginia
  Erosion and Sediment Control and Stormwater Management Certification Regulations (2014)

Products needed for ESC, such as silt fencing, ESC blankets, coir mats, and inlet protection devices, are readily available from local landscape and specialty suppliers, including ACF Environmental, a company active in the Chesapeake Bay watershed.

13.2 Monitoring for Sedimentation

Sediment buildup can prevent stormwater runoff from entering a BMP, and it can impede or prevent water from infiltrating into the soil. Even when BMPs function well, regular removal of sediment will be required. See Section 19 of this manual for specific instances.

Your site may exhibit unwanted erosion and/or sedimentation even if no new upgrades are being planned. Stormwater BMPs may not perform as expected. Underplanted or newly planted areas may not adequately hold soil in place. Slope subsidence from adjacent properties may cause sedimentation onto your site. Parts of your site left unchanged after installation may exhibit erosion and sedimentation from previously unaddressed issues.

Take responsibility for noticing and reporting any such instances and engage your design team in arriving at solutions. Always check and clear area drains and storm drains for accumulation of sediment or debris during routine maintenance visits, both for ESC diagnostic reasons, and to keep these devices functioning optimally.

Landscape maintenance staff seeing this eroded area should call it to the client and designer's attention and coordinate a work order for raising the soil to design levels.

PHOTO: CHERYL CORSON. CITY OF LANCASTER, PA. PUBLIC WORKS

13.3 Sediment Removal and Disposal

Chesapeake, Virginia's *BMP Maintenance Guide* states, "Sediment removal is usually the largest single cost of BMP maintenance; therefore, it is best to plan ahead to allow for contractual negotiations, as well as adequate funding." This statement is also made by many other manuals.

The Oregon *Field Guide: Maintaining Rain Gardens, Swales and Stormwater Planters,* advises, "Always visually inspect sediment before determining the appropriate disposal method. Note any on-site activities that may contaminate sediment (i.e., fueling, hazardous material storage/handling/disposal, auto maintenance). If sediment is off color, has an odor or sheen, have it tested to determine if it is hazardous. Contaminated sediment must be disposed of at a hazardous waste facility." (p.16) The same field guide has excellent photos showing sediment removal methods in rain gardens and bioretention forebays. (pp.13–15)

In our region, the science regarding the chemical composition of BMP sediment is still evolving. Testing and disposal protocols do not exist in all jurisdictions. Your local jurisdiction may have regulations about proper disposal, whether or not the sediment in question is considered hazardous. If in doubt, have it tested. If your jurisdiction specifies a disposal protocol such as bagging BMP sediment as household waste to be taken to a landfill, do that. Otherwise, examine the sediment and if you feel it can be composted, proceed, taking care to monitor its effect on the compost or soil mix you are creating.

For the purposes of this manual, sediment removal refers to dry sediment. Dredging and removal of wet sediment (as for ponds and wetlands) is beyond the scope of the CBLP program and requires assistance from a professional engineer (PE).

13.4 References

BMP Maintenance Guide. City of Chesapeake, Virginia, p.4.

Field Guide: Maintaining Rain Gardens, Swales and Stormwater Planters. Oregon State University Extension, 2013, pp.13–16.

SECTION 14: INTEGRATED PEST MANAGEMENT

14.1 What is IPM?

There is no single official definition of Integrated Pest Management, or IPM. It has mistakenly been thought to refer only to insects or only to invasive plants. Broadly speaking, IPM is a natural systems approach to seeking the least harmful methods of managing all types of landscape pests, including insects, weeds, plant pathogens, or vertebrates. IPM refers to protecting biodiversity and habitat by minimizing the use of pesticides. A good discussion and short history may be found at the Virginia IPM website, *The IPM Concept*.

General IPM resources may be found on these regional websites:

- District of Columbia: *Integrated Pest Management.* Department of Energy & Environment.
- Maryland: *Integrated Pest Management.* University of Maryland Extension
- Pennsylvania: *Pennsylvania Integrated Pest Management.* PennState Extension.
- Virginia: *Pesticide Programs: IPM*. Virginia Tech.

IPM protects biodiversity and habitat by minimizing the use of pesticides.

PHOTO: CHERYL CORSON. HILL CENTER, OLD NAVAL HOSPITAL, WASHINGTON, D.C. OVS, LANDSCAPE ARCHITECTS

Due to the particularly adverse effects of pesticides on young children, many states in the Chesapeake Bay watershed also have IPM laws, plans, or guidelines for school grounds and child care centers. You are responsible for compliance with IPM laws in jurisdictions in which you practice. The following resources will help you understand your responsibilities when practicing IPM in or near areas where children play:

- District of Columbia: *Prevention Protocol: Integrated Pest Management*. D.C. Public Schools.
- Maryland: *Integrated Pest Management (IPM) in Schools*. Maryland Department of Agriculture.
- Pennsylvania: *PA School IPM Manual.* PennState Extension.
- Virginia: *Integrated Pest Management Guidelines for Virginia Schools (K-12)*. Virginia Cooperative Extension.

The federal government recommends IPM for sustainable landscaping (see page 28 of *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes)*. Also, the SITES™ v2 Rating System offers a credit for minimizing pesticide and fertilizer use.

Rather than eliminate pests from the ecosystem, IPM seeks to find acceptable levels. Rather than use pesticides which indiscriminately kill all insects or weeds, including beneficial insects like honey bees or praying mantis, IPM seeks to target pests with the least toxic intervention possible.

14.2 IPM Methods

IPM has four types of controls:

1. **Cultural**
   Educating the human population on the benefits of certain insects and mammals for managing pet populations.

2. **Physical**
   Mowing, lopping, or hand-pulling pests (insects and unwanted plants).

3. **Biological**
   Timed release of beneficial insects, parasites, and pathogens to reduce the numbers of pests.

4. **Chemical**
   Judicious and targeted pesticide use as a last resort for controlling pests.

The PLNA's *Sustainable Landscapes Certification Manual* offers four main steps to an IPM plan as outlined by the U.S. EPA (p.101):

1. **Set action thresholds**
   Establish a threshold at which a pest control action must be taken. Sighting a single pest does not necessarily mean control measures are necessary.

2. **Monitor and identify pests**
   Monitor frequently to quickly identify any new pest problems, which are much easier to address in the early stages than once a pest has become established. Correctly identify the pest and establish whether it requires control. Not all insects and weeds cause negative impacts. Some are actually beneficial. Research the biology and life cycle of the pest to help determine the best way to control it, if controls are warranted.

3. **Prevention and exclusion**
   Prevent the pest from establishing and prevent further colonization by eliminating the conditions that the pest needs to survive.

4. **Control**
   Once monitoring, identification, and action thresholds indicate that pest control is required, and preventative methods are no longer effective or available, IPM programs then evaluate the proper control method for effectiveness and risk.

14.3 Specifying IPM

The SITES™ credit 8.4 includes a credit component for specifying "the use of third-party certified IPM service providers when pest control services are contracted out." (p.107)

The Seattle Public Utilities Commission's *Landscape Maintenance Standards and Specifications* offers the following template language regarding IPM, which may be adopted in your proposals and contracts:

3. INTEGRATED PEST MANAGEMENT (IPM)

3.1.1 Owner strongly encourages environmentally sensitive maintenance practices. The principles of integrated pest management (IPM) shall be employed. The intent is to limit any pesticide (including herbicide) applications through healthy landscape management practices.

3.1.2. IPM is an approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological, and educational tactics to keep pest numbers low enough to prevent unacceptable damage or annoyance. Additional treatments, such as pesticide applications, are made only when and where monitoring has indicated that the pest will cause unacceptable economic, medical, or aesthetic damage. Treatments are not

made according to a predetermined schedule. Treatments are chosen and timed to be most effective and least hazardous to non-target organisms and the general environment. (Adapted from Bio-Integral Resource Center)

3.1.3 Contractor shall consider pesticide applications only as a last resort and only after other methods of control are proven ineffective. (p.4)

For more specific recommendations on pesticides, see Section 17 of this manual.

14.4 References

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013.

Ellis, Barbara W. and Fern Marshall Bradley eds. *The Organic Gardener's Handbook of Natural Insect and Disease Control.* Rodale Press,1996.

Sustainable Landscapes Certification Manual. Pennsylvania Landscape and Nursery Association, p.101.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities. Direct download: www.seattle.gov/util/cs/groups/public/@spu/@conservation/documents/webcontent/02_015543.doc

SITES™ v2 rating system checklist, Section 8.1, Credit 8.4, Minimize pesticide and fertilizer user, pp.106–108.

Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes. Council on Environmental Quality, 2011, p.28.

IPM: A Common Sense Approach to Managing Problems in Your Landscape (HG62). University of Maryland Extension, 2013.

Pest Management Guide: Home Grounds and Animals (456-018). Virginia Cooperative Extension, 2016.

Reducing Pesticide Use in the Home Lawn and Garden (450-725), by Elizabeth Bush. Virginia Cooperative Extension, 2015.

PLANT MATERIALS

SECTION 15: PLANTS AND VEGETATED AREAS

15.1 Plant Health Care

Plant health care (PHC) is a proactive approach to maintaining tree, shrub, and perennial health by providing the proper growing environment for the plant. It may seem obvious, but the goal of PHC is to do whatever possible for the plant not to become stressed in the first place. Stressed plants have lower immune systems and are therefore more susceptible to disease. Think of PHC as preventive health care for plants.

PHC is an important aspect of the SITES™ v2 Rating System's Section 8, Topic 3: Vegetation.

Refer to Natural Systems (pp.37–45) of this manual for discussion of many aspects of PHC — water, soil, ESC, and IPM, which will not be repeated here. Refer to Sections 16, 17, 18, and 19 for management of trees, invasive plants, turf, and living BMPs. This section will cover universally applicable PHC basics for any plant environment you are maintaining.

This sedge buffer not only protects trees from mowers and string trimmers; its long foliage helps maintain soil moisture, and creates habitat for beneficial insects.

PHOTO: CHERYL CORSON

PHC Goals:

1. Understand the natural behavior of on-site plants: their hydric and pH preferences, how they reproduce, how aggressive they are in optimal environments, how long, or short-lived they tend to be.
2. Understand the natural behavior of plant communities and how they interact (or compete) reproductively and seasonally.
3. Understand and apply maintenance techniques that foster biodiversity and wildlife habitat.

15.2 PHC Best Practices

In consultation with the designer and client:

1. Manage all landscapes to be healthy and functioning ecosystems that maximize plant health and diversity. (*ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices*, version 2b, 2014)
2. Report any plant health issues observed on each site visit to the client.
3. Be able to recognize native plant species in the designed landscape and tell them apart from unwanted plants.
4. Thin or transplant overplanted material at the appropriate time of year.
5. Locate thinned or overplanted material so as to provide room for grown and air circulation.
6. Divide suitable herbaceous perennials every third year or so. Consult with designer and client on location and spacing of divisions.
7. Know how to divide the different species of plants on the planting plan.
8. Determine the cause of dead or diseased plants and if necessary, replace them with more appropriate selections.
9. Minimize disturbance of naturally occurring beneficial organisms, such as biological predators.
10. Allow most herbaceous perennials, *including grasses,* to overwinter, providing shelter and wildlife habitat. Only cut back in early spring. Compost or recycle cuttings, keeping material out of waste stream.
11. As appropriate for the site and location within the site, allow dead wood to remain, creating wildlife habitat (called “snags”).
12. Time all interventions optimally according to the plant’s cycle of growth, flowering, and seed production.

Grasses provide winter landscape interest for humans and shelter and habitat for birds. This grass planting will be cut down in early spring before new growth appears.

PHOTO: CHERYL CORSON

15.3 Mulch Best Practices

1. Rely on mulch as little as possible in favor of greater plant density and ground covers.
2. Always obtain landscape mulch from reliable sources who can verify it is free of harmful chemicals, inorganic debris, or known pathogens such as emerald ash borer.
3. Do not use inorganic mulch materials such as rubber, or materials that will not break down into the soil like brick fragments.
4. Do not use synthetic weed barriers such as plastic or landscape cloth.
5. Do not use dyed mulch, which is made of construction wood waste such as pallets. Possibly toxic waste contaminants and the dye leach into the soil harming or killing beneficial soil bacteria, and immobilizing nitrogen in the soil, making it unavailable to plants.
6. Never place mulch in direct contact with trunks or stems of woody plants.
7. Mulch should not exceed a depth of two to three inches, though shallow-rooted plants should receive no more than an inch.
8. Mulch should be placed around woody plants so as to collect, not shed water.
9. Rake, aerate, and reposition old mulch on site rather than removing and sending it into the waste stream.
10. Apply no mulch to established beds where plant foliage or groundcover completely covers the soil surface.

Properly mulched trees have a much higher survival rate. Always keep mulch several inches away from trunks of woody plants.

PHOTO: MONTGOMERY COUNTY, MARYLAND. DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). RAINSCAPES PROGRAM

This perennial bed relies on evergreen groundcovers more than on mulch to retain soil moisture and discourage weeds.

PHOTO: CHERYL CORSON

15.4 Pruning Best Practices

CCLC's *Conservation Landscaping Guidelines* say, "Maintenance such as pruning requires knowledge of specific plant species and their habits and requirements… If you are used to regularly scheduled cutting, shearing …and so on, you will find this approach very different." (p.37) Once the ornamental woody plant palette in designed landscapes further evolves to include predominantly native shrubs, the need for most pruning will disappear.

Work with designers and clients to strategically replace rows of burning bush *(Euonymous alatus),* Autumn olive *(Eleagnus umbellata),* barberry *(Berberis vulgaris),* and the like with looser, more naturalistic arrangements of native shrubs whose genetically programmed mature size is in proportion to its design setting. Tons of hedge clippings will then never reach the waste stream, and labor savings can be redirected to maintaining more highly functioning green infrastructure BMPs. Here are six sustainable pruning best practices for shrubs:

1. Only prune plants as needed for health and vigor, but never more often than every two or three years.
2. Establish a pruning schedule in writing based on the specific plant species on your site. Discuss it with designer and client.
3. Never shear shrubs into neat geometric shapes.
4. Prune flowering shrubs only after they flower but before they set buds.
5. When you do prune, chip clippings for use in compost on site whenever possible or if removed, recycle clippings.
6. Communicate with clients about pruning operations and keep records of what you prune and when.

15.5 Plant Removal, Disposal, and Replacement

Federal sustainable landscaping guidelines say, "The site maintenance plan should incorporate composting and/or recycling 100% of vegetation trimmings and appropriate compostable organics on-site, where feasible." (p.21) The SITES™ v2 Rating System offers a credit for recycling organic matter on site or within 50 miles, with the intention to, "support nutrient cycling, improve soil health, and reduce transportation costs and materials going to landfills." (p.105) Be sure your LMP includes the strategy for dealing with organic waste sustainably.

One exception to organic matter recycling is diseased or toxic plants, which, depending on the disease, should be bagged separately as trash; if they are regulated, like emerald ash borer, diseased plants should be taken to the appropriate facility. Giant hogweed disposal may also be regulated by your state or jurisdiction. Be sure to check. Poison ivy should never be composted so as to pose a health risk to humans. Some toxic plant materials may need to be treated as hazardous waste. Always check for guidance from local public officials.

15.6 References

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013, pp.11, 24, 37.

Using Mulches in Managed Landscapes. Iowa State University Extension, 2001.

ecoPRO Certified Sustainable Landscape Professional: Guiding Principles and Sustainable Best Practices, version 2b, 2014, p.12.

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Direct download: www.seattle.gov/util/cs/groups/public/@spu/@conservation/documents/webcontent/02_015543.doc

SITES™ v2 rating system checklist, Section 8.1, Topic 3: Vegetation, p.100, Credit 8.3: Recycle organic matter, p.105.

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SECTION 16: TREES

16.1 Trees Need Our Help

It often seems that generations of new trees are not getting the start in life they deserve due to failures in the simplest planting and maintenance tasks. In fact, street tree mortality is quite high, with some studies suggesting a mere seven-year life span after planting. We must do better. Sustainably speaking, trees are at the apex of the plant world in terms of habitat, biodiversity, oxygen production, water uptake, cooling hot urban places, soil stabilization, longevity, and beauty. Failing to mention them except under the umbrella term “vegetation,” as in the SITES™ v2 Rating System, does not do them justice.

New technologies for continuous urban tree planter boxes, structural soils, and more, give trees in developing urban areas much better chances for survival. These are beyond the scope of this manual. However, a set of open source tree planting details and specifications have been available since 2010, created in part by Maryland landscape architect James Urban, with public funding and peer review. Download any drawing or spec in .dwg or .pdf format from www.jamesurban.net/specifications. There are also drawings and specs for tree protection during construction, which is a situation in which landscape maintenance contractors may easily find themselves.

Some jurisdictions, like Washington, D.C., have laws protecting trees greater than a certain size. Do not remove a tree without first checking whether a permit (and fee) is required. It is also possible that it may not legally be removed at all.

Mature trees are ecosystem superstars deserving the utmost care.

PHOTO: CHERYL CORSON

16.2 Simple, Effective Tree Maintenance

Although the sustainability literature does not usually focus on tree maintenance, the International Society of Arboriculture (ISA) offers many helpful brochures on its website relative to tree planting, mulching, and watering. Washington, D.C.'s Casey Trees also offers many helpful free online resources, including How To Care for Trees. Here is a short list of routine tree care tasks that will reduce street tree mortality:

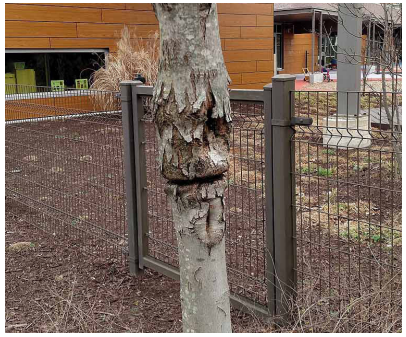
1. Remove stakes from newly planted trees after one season, or no later than one year after planting. If not removed in time, wires on new fast growing trees will girdle and kill young trees. In fact, most new urban trees do not need staking at all. See *Trees, Like Vampires, Must Be Staked*.
2. Mulch properly. Never practice "volcano mulching" and keep mulch at least three inches from the trunk. Mulch so water is sent to the tree, not shed away from it. Casey Trees of Washington, D.C. provides a useful guide to proper mulching.
3. Check for girdling roots at the base of the tree and remove them before they harm the tree, taking care not to damage the trunk.
4. Fill slow release watering bags regularly during the growing season, and remove them after the growing season. This is because the warm damp space between the bag and the tree trunk can attract damaging insects.
5. Keep mowers and string trimmers away from all tree trunks, no matter how large the tree.
6. Be sure that newly planted trees receive at least 25 gallons of water per week for the first two growing seasons. For more information, see *How To Water Your Trees This Summer.*

"Volcano mulching" is the fastest way to kill a tree.

PHOTO: CHERYL CORSON

Properly mulched trees expose the root flare at the base of the trunk. Mulch is no more than 2" deep, providing needed air and water to tree roots.

PHOTO: CHERYL CORSON



Landscape maintenance crews must be empowered to remove tree stakes to avoid girdling and killing newly planted trees like this one.

PHOTO: CHERYL CORSON

16.3 Tree Pruning Basics

You may wish to become an ISA-certified arborist as part of your professional development. For anyone performing sustainable landscape maintenance this is a valuable skill set to offer your clients. Meanwhile, here is some basic pruning advice:

1. If trees must be pruned, do so in the dormant winter months.
2. Use clean and sharp blades for pruning.
3. Prune clean and just outside the branch collar in accordance with accepted horticultural practices.
4. Know when to contact an ISA-certified arborist. Typically they should be called for pruning trees larger than six inches DBH (diameter at breast height), and any branches larger than four inches in diameter.

Certified arborists know how to work safely in large trees. Many participate in annual ISA-sponsored competitions, like this one at the U.S. National Arboretum.

PHOTO: CHERYL CORSON

16.4 When to Call an ISA-Certified Arborist

Virginia landscape architect and ISA-certified arborist Lindsay Burleigh offers this list of situations in which you should contact a professional arborist:

1. trunk lean
2. cavities in roots, trunk and/or branches
3. visible fungus on roots, trunk and/or branches
4. excessive deadwood in canopy
5. lack of root buttressing
6. excessive branch diameter as compared to trunk diameter
7. infestation
8. liquid oozing from trunk
9. stunted growth
10. leaves that are wilted, discolored, spotted or contain bumps or holes
11. indications of mechanical damage (i.e. from guying material such as wire, turnbuckle and hose, etc.), mechanized lawn equipment (trimmers and mowers, etc.), heavy equipment (loaders and excavators, etc.), and weather related damage (lightning and storm, etc.)
12. soil compaction that could benefit from mechanical aeration
13. sudden change in soil moisture, soil depth, topography, and/or exposure to wind and sun

The ISA website offers an online search tool for finding a certified arborist and an online lookup for verifying the credential of tree care professionals you are considering hiring. Always verify before allowing anyone to work on trees under your care.

16.5 References

Roddick, Christopher, with Beth Hanson. *The Tree Care Primer.* Brooklyn Botanic Garden. 2007.

Roman, Lara A. *How Many Trees are Enough? Tree Death and the Urban Canopy*. Scenario Journal 04: Building the Urban Forest, Spring 2014.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities, 2009. Section 5, p.9.

Tallamy, Douglas W. *Bringing Nature Home: How You Can Sustain Wildlife with Native Plants, Updated and Expanded.* Timber Press, 2007.

Urban, James, with Dr. Ed Gilman, Brian Kemph, Tyson Carroll. *Tree Planting Details and Specifications*. 74 open source CAD and PDF drawings and four specifications on Planting, Planting soil, Irrigation, and Tree Protection.

SECTION 17: INVASIVE SPECIES IDENTIFICATION, REMOVAL, AND CONTROL

17.1 Invasive Plant Definition, Recognition, and Reproduction

Definition

"Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." (*Plant Invaders of Mid-Atlantic Natural Areas,* p.8) Although this definition considers only human impacts, proliferation of invasive plants can affect entire ecosystems in numerous ways:

- reducing biodiversity
- altering soil chemistry and erosion rates
- degrading or changing wildlife habitat, food quality and availability
- displacing native plants through competition for water, nutrients, light, or space
- altering native populations through breeding or hybridization

Source: *Sustainable Landscapes Certification Manual*. Pennsylvania Landscape and Nursery Association.

As previously discussed in Section 14 of this manual, an integrated systems approach to non-native invasive plants would be to find acceptable population levels rather than seek complete eradication. This level will vary for each species and ecosystem, but greater harm is possible when taking extreme measures to eradicate any single invasive species without consideration of the larger ecosystem whole.

Recognition and Reproduction

Learning how the most common invasive plants look at different times in their growth cycle and during different seasons of the year is a process. The books listed below are great places to start. Many "weed ID" phone apps are also available, often at no cost. The most regionally specific reference book is *Plant Invaders of Mid-Atlantic Natural Areas*, available as a free pdf download.

In addition to knowing what invasive plants look like at various stages of development, you will need to know how they reproduce in order to understand how best to time control methods most effective for that species. It's always good to work with nature so you're not fighting harder than necessary to achieve your goals.

Over 60 Grounds and landscape services staff enjoying plant identification training at the University of California, Davis.

PHOTO: PROFESSIONAL GROUNDS MANAGEMENT SOCIETY, BALTIMORE, MD

Not surprisingly, given their successful establishment, invasive plants reproduce and spread in many ways. *Plant Invaders of the Mid-Atlantic* says:

> *Invasive plants can spread by seed and by vegetative means including rhizomes, runners, shoots, tubers and bulbs. Seeds and plant fragments may be dispersed by wind, water, wildlife and people. Some animals spread invasive plants by consuming the fruits and depositing seeds later or by transporting seeds or fruits on their fur and feet. People can spread invasive plants by carrying seeds and other plant parts on their shoes, clothing and equipment, or by using contaminated fill dirt and mulch. A common pathway for dispersal of invasive aquatic plants is through attachment to anchors, propellers, and wheel wells.*

Don't try to learn every invasive plant at once. Focus on three that are most common in a particular landscape you care for. Learn as much as you can about them, both from books and in the field. Test recommended control methods and keep detailed notes. After you gain confidence with a few species, learn three more. Slowly you will develop an invasive plant knowledge base with control methods that work for you.

17.2 Public Agency Assistance and Regulation

Your state, county, or city may maintain an invasive plant list with recommended control and disposal measures. Your local extension agency, Master Gardener, riverkeeper, or watershed stewards, native plant society, or "weed warriors" group may offer technical assistance or organize work days for invasive plant control on public lands. Here are state-level invasive plant websites from which to start your research:

- District of Columbia: doee.dc.gov/page/invasive-plants-district
- Maryland: dnr2.maryland.gov/invasives
- Pennsylvania: www.dcnr.state.pa.us/forestry/plants/invasiveplants
- Virginia: www.dcr.virginia.gov/natural-heritage/invspinfo

Be aware that certain states pass legislation against the planting or sale of certain invasive species. Always check online before planning a purchase. For example, Maryland has such a law to regulate invasive plants. This is a dynamic field so check often and register for any email updates you can.

17.3 Control Methods

The following seven invasive plant control method categories appear here in a sequential list. However, throughout the landscape different plants will be at different stages of the process simultaneously, most of the time. It is beyond the scope of this manual to do what the excellent books in the References section below have already done: present plant specific growth and reproduction habits and control measures for dozens of local invasive plants. But it is important to know what control measures are available. They are as follows:

1. **Prevention**
   Don't plant invasive non-native plants in the first place. Consult local lists and don't purchase, even if those plants are sold in local nurseries.

2. **Regular monitoring**
   On every routine site visit, have a knowledgeable crew member scout for emerging invasive plants. Make notes, keep records, and notify the client of what you find. Also monitor for re-emergence of previously treated areas.

3. **Early intervention**
   Don't wait until an area is overrun with a particular invasive plant before taking action. You may have one area that is completely covered with English ivy, for example. But keep the big picture in mind and be sure to treat the area with a small emergent invasive population before it gets well established and treatment is more difficult, time consuming, and costly.

4. **Manual controls**
   Thinking on this is evolving. New ideas advanced by professionals like Larry Weaner advise against pulling most weeds out by the roots, which exposes bare soil and brings viable weed seeds to the surface. Cut the plants to the

ground leaving the roots in place, and repeat the procedure until the root system becomes so weak the plant eventually fails to re-emerge. There are exceptions however, such as Oriental bittersweet, which should be pulled.

5. **Mechanical controls**
   Mechanical methods include cutting (see above), mowing (timed to when desired plants are shorter than the height of those being mowed), and burning (only as required and with permits).

6. **Biological controls**
   Grazing animals (goats and sheep) or timed release of host-specific insects. Customize biological controls to the plant being managed, the site, and the season. There are companies that will bring a small herd of goats to your site for targeted deployments.

7. **Chemical controls**
   Herbicide use is regulated and should be done with care and by certified individuals. Two of the most common herbicides are glyphosate and triclopyr (sold under a variety of brand names). For a thorough discussion of chemical controls, see *Plant Invaders of Mid-Atlantic Natural Areas,* pp.75–77. Application of chemicals on woody plants is done in various ways depending on the plant. Three methods are: 1) the basal bark method, 2) the cut stem method, and 3) the foliar spraying method. Herbicide and pesticide certifications and permits may be required depending on the situation. Always check.

Always read directions. Understand that more (of a chemical) is not better. And attempt controls without chemical use whenever possible.

17.4 Common Regional Invasive Plants

The Mid-Atlantic Invasive Plant Council (MAIPC) coordinates regional efforts to gather and share information on the identification, management and prevention of invasive species, provide training and volunteer opportunities and to identify research needs. This website is a tremendous resource for plant ID and training: www.maipc.org.

Table 8 includes a small subset of all regional invasive plants intended to show the different plant categories and some of the most common ones. Note that some of these plants are still sold in plant nurseries.

TABLE 8: SELECTED COMMON CHESAPEAKE BAY WATERSHED NON-NATIVE INVASIVE PLANTS

Aquatics	Grasses	Herbaceous Plants	Shrubs	Trees	Vines
Eurasian watermilfoil *Myriophyllum spicatum*	Common reed *Phragmites australis*	Garlic mustard *Alliaria petiolata*	Autumn olive *Elaeagnus umbellata*	Bradford pear *Pyrus calleryana*	Oriental bittersweet *Celastrus orbiculatus*
Hydrilla *Hydrilla verticillata*	Japanese stiltgrass *Microstegium vimineum*	Japanese knotweed *Fallopia japonica*	Multi-flora rose *Rosa multiflora*	Norway maple *Acer platanoides*	English ivy *Hedera helix*
		Purple loosestrife *Lythrum salicaria*	Burning bush *Euonymous alatus*	Princess tree *Paulownia tomentosa*	Japanese honeysuckle *Lonicera japonica*
			Japanese barberry *Berberis thunbergii*	Tree of heaven *Ailanthus altissima*	Periwinkle *Vinca minor*

17.5 References

Kaufman, Sylvan Ramsey and Wallace Kaufman. *Invasive Plants: Guide to Identification and the Impacts and Control of Common North American Species.* Mechanicsburg, PA: Stackpole Books, 2007.

CCLC. *Conservation Landscaping Guidelines. The Eight Essential Elements of Conservation Landscaping.* 2013. pp.10–16, pp.34–35.

Mertz, Tawna, and Adkins Arboretum. *The Green Book for the Bay.* December 2008. Downloadable pdf book.

Sustainable Landscapes Certification Manual. Harrisburg, PA: Pennsylvania Landscape and Nursery Association, p.27, pp.102–103.

Ranier, Thomas, and Claudia West. *Planting in a Post-Wild World.* Timber Press, Portland, Oregon. 2015.

SITES™ v2 rating system checklist, Section 8.1, Topic 3B, Vegetation.

Plant Invaders of Mid-Atlantic Natural Areas, 4th edition, by Swearingen, J.B. Slattery, K. Reshetiloff, and S. Zwicker. Washington, D.C.: National Park Service and U.S. Fish and Wildlife Service.

SECTION 18: LAWN CARE

18.1 Lawns and the Chesapeake Bay Watershed

If the lack of adequate tree care is out of proportion with the environmental benefit of trees, the reverse is true for lawns. Enormous amounts of time, resources, and harmful chemicals are directed at lawn care with scant environmental benefit. Excessive nutrients from fertilizers cause algae overgrowth and "dead zones" in the Bay, and are increasingly regulated. There are 3 million acres of turf in the Chesapeake Bay watershed, 1.2 million of them in Virginia alone, so this issue has enormous importance.

Much is written about lawns reducing biodiversity, but not enough about the perception of lawns by most wildlife as a spatial barrier preventing safe passage. Reducing the size of lawn areas and interconnecting conservation landscaping and buffer plantings can greatly improve wildlife habitat connectivity. In addition, properly timed mowing can prevent harm to ground-nesting birds. More client education is needed on this, more than probably any other landscape maintenance issue. Clients need your help to see beauty and value in grass that is not a monoculture, not so short, and not green all the time.

This section assumes basic knowledge of environmental harm caused by lawns and of design alternatives. See previous sections of this manual for information regarding water, soil, IPM, tools, and regulations, all of which contain lawn-related information.

Include servicing pet waste stations in sustainable landscape maintenance proposals. Fecal bacteria and parasites and nutrients have a significant negative impact on the Chesapeake Bay.

PHOTO: CHERYL CORSON

18.2 Legislation and Regulation

Many states and local jurisdictions address the nutrient loading of traditional lawn care practices by statute or regulation. Maryland and Virginia are two examples with state fertilizer legislation. In addition, Virginia has an Urban Nutrient Management Program for farmland and urban areas. In Virginia, a Nutrient Management Plan may be required depending on the landscape type (for example, golf courses require them). Nutrient Management Plans, when required, must be written by state certified planners, training for which is available twice a year. Training items included are site analysis, hydrology, soil testing, quantities, components, and application dates for fertilizers when needed, for both warm and cool season grasses. Pennsylvania also has a Nutrient Management Program.

As with any application of pesticides or fertilizers, be sure it is only done by appropriately certified staff. Be sure landscape specifications clearly state lawn care protocol. See the *Seattle Public Utilities Landscape Specifications*, Section 4, Turf Maintenance, for boiler plate language you can adapt.

18.3 Lawn Care Methods

The following principles of effective and environmentally sensitive lawn care have been adapted largely from the Chesapeake Bay Foundation's publication, Steps for Healthy Lawns and a Healthy Bay among other sources:

1. Test soil areas every one to three years, taking samples in mid-late spring or early fall.
2. The target soil pH for soil is slightly acidic (between 5.8 and 6.5).
    a. Do not use synthetic fertilizers.
    b. Use organic fertilizers or natural (animal or plant based) slow-release fertilizers.
    c. Apply after spring green and not during dormancy.
    d. Do not use quick release fertilizers.
    e. Keep nitrogen applications to 1 lb per 1,000 square feet or less.
    f. Apply lime to raise soil pH.
    g. Apply iron sulphate or sulphur to lower pH.
    h. Apply compost as a top dressing if needed.
    i. Use compost tea if needed.
    j. Do not apply fertilizer just before it rains, when windy, or within 15 feet of any water feature.
3. Allow grass clippings to remain on the surface to decompose as fertilizer.
4. Sweep any grass clippings that land on a paved surface and return them to the soil.
5. Sharpen mower blades approximately after every ten hours of use.
6. Mow grass taller, ideally 3.5 inches tall or no more than one-third of the length of the leaf blade, to maximize roots and shade the soil, preventing weed seed germination.
7. When watering during lawn establishment, do so in the morning to avoid mildew and other fungal diseases. Allow grass to go dormant during summer droughts, which will not harm its roots. Never allow water to run off the surface onto pavement or into water bodies.

Allow grass clippings and leaves to mulch in place.

PHOTO: JOHN SHORB LANDSCAPING

Do not mow bare dirt or mow into tree trunks and over surface tree roots, as this worker is doing.

PHOTO: CHERYL CORSON

Top dress compost over lawn areas as shown here, rather than tilling, which destroys soil structure.

PHOTO: LEVEL GREEN LANDSCAPING

Compost tea is an easily made, non-toxic brew helpful for lawns and planting beds.

PHOTO: CHERYL CORSON

8. Consider using a natural deep root grass seed whose roots are twice as deep as traditional grass, which holds more water. Two examples are Eco-Lawn™ and Pearl's Premium Lawn Seed™. Always follow instructions, which will differ from traditional seed establishment methods.
9. Overseed in early fall as needed (September to October).
10. Aerate and dethatch as needed in early spring or early fall.
11. Together with the designer and client, annually evaluate existing lawn areas for possible conversion into other types of vegetation.

18.4 References

Lawn Care: The Easiest Steps To An Attractive Environmental Asset, by Lori Brewer. Cornell University Turfgrass Program, 2014.

Steps for Healthy Lawns and a Healthy Bay. Chesapeake Bay Foundation.

Urban Nutrient Management. Chesapeake Stormwater Network.

Conservation Landscaping Guidelines: The 8 Essential Elements of Conservation Landscaping. Ridgely: Chesapeake Conservation Landscaping Council, 2013, p.24

IPM Series: Turf (HG63, 2012), by David Clement and Mary Kay Malinoski. University of Maryland Extension.

Landscape Maintenance Standards and Specifications. Seattle Public Utilities, 2009, Section 4, Turf Maintenance, pp.5–8.

Tukey, Paul. *The Organic Lawn Care Manual*. Storey Publishing, 2007.

SECTION 19: VEGETATED BMP MAINTENANCE

19.1 Topic Organization and Primary Sources

For the purposes of this manual, BMPs with vegetation are organized into five categories:

1. Rain gardens (also called bioretention basins or cells) and open channels (also called bioswales, grass swales, or vegetated swales).
2. Conservation landscaping, riparian buffers, and vegetated filter strips.
3. Green roofs.
4. Living walls (also called green walls), and vegetated retaining walls (also called living, or green retaining walls).
5. Wetlands and wet ponds.

This manual assumes a working knowledge of the functions, design, and installation of these landscape features, which are not repeated here. Refer to the CBLP curriculum for more information on these topics. Except when otherwise noted, the following maintenance recommendations are primarily from:

- D.C. Department of Energy & Environment's *2013 Stormwater Management Guidebook.*
- Chesapeake Stormwater Network's Technical Bulletin #10: *Bioretention Illustrated.*
- Watershed Stewards Academy's *WSA Rainscaping Field Guide.*

To remain consistent with previous sections of this manual, certain terminology, tasks, and their recommended frequency may differ slightly from the above-referenced source documents. Always check the jurisdiction in which you are working for possible recommended or required evaluation and/or reporting forms and procedures. For example, the D.C. Department of Energy & Environment requires use of their own maintenance inspection checklists, found in Appendix L of their *Stormwater Management Guidebook.*

19.2 Rain Gardens and Open Channels

Though definitive statistics are unavailable, we know that rain garden failure rates within the first five years are very high due to insufficient maintenance. Since rain garden function is an important component of every jurisdiction's watershed improvement plan, or WIP, more frequent and higher quality maintenance is sorely needed.

Make the best use of the following tables and inspection forms by using your LMA Worksheet(s) from Table 3 in this manual, which summarize the inventory of landscape features on your site with specific names, numbers, locations, sizes, and priority levels. Use Table 9 to identify typical necessary maintenance tasks and their recommended frequency.

TABLE 9: TYPICAL MAINTENANCE TASKS FOR BIORETENTION PRACTICES

Typical Maintenance Tasks for Bioretention Practices	
Frequency	Maintenance Tasks
Upon establishment	• During the first 6 months after installation, inspect at least twice after storm events greater than ½" of rainfall. Conduct any needed repairs or stabilization. • Consult Appendix A, Chesapeake Stormwater Network's Bulletin #10, *Visual Indicators Profile Sheets for Bioretention Inspections,* to identify problems. • Record inspection results in Table 11 in this manual. • Water as needed during plant establishment phase in consultation with designer and owner. • Remove and replace dead plants, checking warranty periods.
At least 4 times a year	• Mow grass filter strips and bioretention with turf cover. • Check curb cuts and inlets for accumulated grit, trash, leaves, and debris that may impede or prevent infiltration. • Weed by hand as needed. • Remove trash and/or debris.
2 times during growing season	• Rake mulch.
Annually	• Conduct a maintenance inspection. • Cut back herbaceous vegetation only in early spring (March–April, depending on location). • Supplement mulch to maintain a 3" layer. • Prune shrubs only as needed. • Remove sediment in pretreatment cells, inlets, and outlets.
Once every 3 years	• Remove sediment from planting area, replace with new media to design levels, and replace mulch.
As needed	• Divide perennials and relocate in consultation with designer and client. • Add plants to maintain vegetation density (can be plant divisions). • Remove dead, diseased, and/or invasive plants. • Stabilize the CDA to prevent erosion.

Table 10 establishes a standard for evaluating rain gardens in the field. This table is intended to clearly define performance ranges so that, with some training, multiple staff members can assign consistent values from place to place. After this table, selected images from the Chesapeake Stormwater Network's *Bulletin #10, Bioretention Illustrated,* are shown. These visual indicators will help you match the rating with a typical reference image. For the complete set of photographic illustrations, refer to Appendix A in *Bulletin #10.*

TABLE 10: BIORETENTION CONDITION STANDARD DEFINITIONS

Adapted from Chesapeake Stormwater Network's *Bulletin #10* and Seattle Public Utilities's *Green Stormwater Operations and Maintenance Manual.*

BIORETENTION CONDITION STANDARD DEFINITIONS				
	Excellent – Very Good	**Good – Acceptable**	**Fair**	**Poor – Failing**
Inlet Features: • stone swale • grass channel • level spreader • curb cut • subsurface conveyance • sediment forebay	• No erosion, channelization, or scouring. • No significant sediment, trash, or debris. • Curb cut or other hardscape inlet in very good condition.	• Some erosion, channelization, or scouring. • Some sediment or debris, but does not affect function. • Some wear on curb cut, but does not affect function.	• Erosion, channelization, and/or scouring present. • Sediment/debris affect water quality function but do not affect conveyance. • Some cracking, heaving of curb cut.	• Erosion, channelization, or scouring and bypassing inlet present. • Sediment/debris inhibit or prevent water entering system. • Cracking/heaving of curb cut or other hardscape preventing water from entering system.
Side Slopes	• No erosion or scouring. • No evidence of ponding.	• Some erosion or scouring. • Some evidence of ponding.	• Erosion of side slopes affecting performance. • Ponding above expected levels.	• Erosion of side slopes inhibiting performance. • Evidence of ponding higher than system design level.
Vegetation	• At least 90% of planting zone covered with healthy plants per design. <10% weeds. • Mulch 2"–4", clean edges, limited compaction. No caking. • Soil is well aerated. • No erosion, channelization, or scouring. • No bare spots. • No to minimal sediment or debris. • Drains within 24 hours.	• At least 75% of planting zone covered with healthy plants per design. • Mulch below 2", loose edges, some compaction. • Some soil compaction. • Some erosion, channelization, or scouring. • Sediment or debris present, does not affect function. • Drains within 36 hours.	• At least 60% of planting zone covered with healthy plants. • 20–30% weeds. • Little mulch, no defined edge, shoulder compaction. • Compacted soil. • Erosion, channelization or scouring noticeable. • Sediment or debris inhibits water quality. • Evidence of long-term ponding (over 72 hours).	• Less than 50% of planting zone covered with healthy plants. • >30% weeds. • No mulch present. • Compacted soils. • Sediment and debris inhibit water quality and conveyance. • Presence of standing water.
Outlet Features • stand-up pipe, overflow structure • Clean-out • Berm • Weirs, rock walls, check dams, rock swale • Grates, debris screens • Catch basins, nearest storm drain(s)	• <10% sediment or debris around grates or structures. • limited build-up of sediment behind check dams or weirs. • rockery stable and secure. • berm firm and level. • no sediment or debris around nearby storm drains.	• sediment blocking up to 30% of grates or structures, swales, check dams or weirs, nearby storm drains. • berm shows evidence of breaching. • some trash or debris in outlet channel.	• sediment blocking 30–50% of grates or structures, swales, check dams or weirs, nearby storm drains. • berm structure needs reinforcement. • trash or debris in outlet channel impedes water flow.	• sediment over 50% blocks grates or structures, swales, check dams or weirs, nearby storm drains. • berm not functioning due to blowout in one or more places. • trash or debris in outlet prevents water flow.

Attentive care during the establishment phase is critical for rain garden success.

PHOTO: MONTGOMERY COUNTY, MARYLAND. DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). RAINSCAPES PROGRAM

Teamwork makes the work seem to go faster.

PHOTO: MONTGOMERY COUNTY, MARYLAND. DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). RAINSCAPES PROGRAM

Applying mulch as specified in design drawings helps infiltration.

PHOTO: MONTGOMERY COUNTY, MARYLAND. DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). RAINSCAPES PROGRAM

Observing a rain garden during a rainstorm is the best way to assess performance.

PHOTO AND LANDSCAPE ARCHITECTURE: CHERYL CORSON, RLA.
CONTRACTOR: LEVEL GREEN LANDSCAPING

This water will infiltrate into the ground within 24 hours.

PHOTO AND LANDSCAPE ARCHITECTURE: CHERYL CORSON, RLA.
CONTRACTOR: LEVEL GREEN LANDSCAPING

The slide slopes of this rain garden consist of mowable grass, large rocks, and gabion walls that double as seating.

PHOTO: CHERYL CORSON.
PIERCE'S PARK, BALTIMORE, MD.
MAHAN RYKIEL ASSOCIATES

This rain garden, shown in May, will soon grow in to cover all exposed soil, helping the system function optimally.

PHOTO AND LANDSCAPE ARCHITECTURE:
CHERYL CORSON, RLA. CONTRACTORS:
DEEP ROOTS LANDSCAPE COMPANY

Debris has collected long enough for sediment to be deposited around the outside of this rain garden. Water is prevented from entering, indicating a "Poor–Failing" rating.

PHOTO: CHERYL CORSON. CITY OF
LANCASTER, PA. PUBLIC WORKS

As autumn leaves begin to drop, more regular cleaning of rain garden inlets is needed.

PHOTO: CHERYL CORSON

Kids used loose gutter sections as bike ramps into this rain garden. Public education and signage will help keep BMPs in good shape.

PHOTO: CHERYL CORSON. CITY OF
LANCASTER, PA. PUBLIC WORKS

Use Table 11 for each rain garden to be evaluated, using the performance ranges defined in Table 10.

TABLE 11: BIORETENTION EVALUATION WORKSHEET

BIORETENTION EVALUATION WORKSHEET					
Location:	Installed (mm/yy):	Inspection (dd/mm/yy):		Inspector:	
		Excellent – Very Good	Good – Acceptable	Fair	Poor – Failing
approx. length x approx. width: image:	**Inlet Features** *check all that apply* ____ stone swale ____ grass channel ____ level spreader ____ curb cut ____ subsurface conveyance ____ sediment forebay				
approx. perimeter: image:	**Side Slopes**				
approx. shape and area: image:	**Vegetation** approx. % perennials: approx. no. of shrubs: approx. no. of trees:				
approx. length x approx. width: image:	**Outlet Features** *check all that apply* ____ stand-up pipe ____ overflow structure ____ clean-out ____ berm ____ weirs, rock walls, check dams, rock swale ____ grates, debris screens ____ catch basins, nearest storm drain(s)				

For rain garden rankings better than “poor-failing,” levels of routine maintenance as outlined in Table 9 should be sufficient to keep the system functioning at design level goals. If the system is poor or failing, consult with the designer and client and allied professionals as appropriate, to determine the contributing causes of failure and possible remedies, plus an implementation plan, budget, and schedule.

19.3 Conservation Landscaping, Riparian Buffers, and Vegetated Filter Strips

These practices may be in place because rain gardens were not possible at the site, or due to buffer requirements for sites adjacent to water bodies, or as pre-treatment for other BMPs. Tables 12 and 13 show typical maintenance tasks and their recommended frequency.

TABLE 12: TYPICAL MAINTENANCE ACTIVITIES FOR CONSERVATION LANDSCAPES

TYPICAL MAINTENANCE FOR CONSERVATION LANDSCAPES	
Frequency	**Maintenance Tasks**
Upon installation	• Water once every three days (first month), then weekly, during first growing season, depending on rainfall. • Anticipate approximately 10% of plant material to fail during first year and replace accordingly, checking warranties. • Inspect inlets and overflow areas for debris impeding or blocking flow at least twice during first three months, after storm events greater than ½" of rainfall.
Monthly during first growing season, 4 times a year afterward	• Remove weeds by hand.
Annually in March or April	• For meadows, mow in early spring. • For other types of landscapes, check for winter damage and add mulch to bare spots as needed. • Cut back herbaceous perennials and remove dead growth. • Divide established perennials and plant with proper spacing for mature size.
Annually in fall	• Add reinforcement woody plants to maintain desired vegetation density.
Annually in winter	• Prune trees and shrubs once dormant (in consultation with designer and owner, and considering species specific pruning specifications.
As needed	• Remove invasive plants using species specific control methods. • Remove dead or diseased plants. • Stabilize any eroded or bare areas. • Remove trash.

TABLE 13: TYPICAL MAINTENANCE ACTIVITIES FOR VEGETATED FILTER STRIPS

TYPICAL MAINTENANCE ACTIVITIES FOR VEGETATED FILTER STRIPS (also called bioswales, open channels, or grass channels)	
Frequency	**Maintenance Tasks**
As needed	• Mow grass channels and dry swales during growing season to maintain grass heights between 4"–6". • Look for and stabilize any bare soil or sediment sources in the CDA.
4 times a year	• Keep the CDA, inlets, and facility surface are clear of debris. • Keep the CDA stabilized. Spot seed where needed. • Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. • Repair undercut and eroded areas at inflow and outflow structures.
Annually	• Add reinforcement planting to maintain 90% turf cover. Reseed any salt-killed vegetation. • Remove accumulated sand or sediment deposits behind check dams. • Inspect upstream and downstream check dams for undercutting or erosion. Remove trash or blockages at weep holes. • Inspect channel bottom for erosion, braiding, excessive ponding or dead grass. • Inspect inflow points for clogging and remove any sediment. • Inspect side slopes and grass filter strips for evidence of any rill or gully erosion and repair as needed.

19.4 Green Roofs

Since green roof planting plans vary greatly depending on the depth of the filter media, and some systems are irrigated and others are not, it is necessary to craft a site-specific maintenance plan for any green roof in concert with the designer. Furthermore, many green roofs are proprietary systems and may have separate maintenance contracts. It is important to establish full knowledge of any green roof system you care for as part of the inventory phase outlined in Section 1 of this manual.

Refer to Section 8 of this manual for safety information and remember that maintenance activities on green roofs require precautions such as a harness and tieback system if working outside areas enclosed by railings. Be sure ladders are well secured and drink plenty of water on hot days.

Table 14 is generic in nature and must be customized for the type of roof, irrigation system, and planting media depth present.

TABLE 14: TYPICAL MAINTENANCE ACTIVITIES FOR GREEN ROOFS

GREEN ROOF MAINTENANCE ACTIVITIES	
Frequency	**Activity**
As needed or as required by manufacturer	• Water to promote growth and survival. • Inspect regularly and replace any dead or dying vegetation.
Twice a year	• Inspect the waterproof membrane for leaks and cracks. • Weed to remove invasive plants. Do not dig or use pointed tools. Do not use a string trimmer. • Inspect roof drains, scupper, and gutter to ensure they are not overgrown and have not accumulated organic matter deposits. Remove any organic matter or debris. • Irrigation system start-up and shut down in spring and fall, if system is present.
Annually	• Inspect for dead, dying, or invasive vegetation. Plant replacement vegetation as needed. • Test soil in early spring. • Fertilize with compost, compost tea, or similar as needed depending on soil test results.

Extensive green roofs — those with shallow filter media — will be less susceptible to broad-leafed weed infestation. Intensive green roofs — those with deeper filter media — will be more susceptible to weed infestations. Depending on the severity of weed infestation and type of weeds present, controls will vary. If you are not a certified green roof expert, contact an allied green roof professional with questions regarding moderate to severe weed infestations.

Extensive green roofs, such as this one, have shallow growing media and shallow rooted plants.

PHOTO: CHERYL CORSON.
CANAL PARK, WASHINGTON, D.C.
OLIN, LANDSCAPE ARCHITECTS

Intensive green roofs, such as this one, have deeper growing media and can accommodate taller plants.

PHOTO: CHERYL CORSON

This urban green roof is maintained with the use of a crane.

PHOTO: JOHN SHORB LANDSCAPING

Landscape maintenance crew members on this green roof are belted in, as required by OSHA, to prevent falls.

PHOTO: JOHN SHORB LANDSCAPING

19.5 Living Walls

There are three broad categories of living walls, virtually all of which are proprietary systems:

1. **Vertical gardens**
   There are either free-standing or attached to an interior or exterior building facade, consisting of narrow cells containing growing media. This type of living wall is always irrigated, usually by a top-down drip system.

2. **Living segmental paver retaining walls**
   An open-celled segmental paver retaining wall system, stepped back to create planting pockets on its facade, which cover the hardscape material in vegetation upon grow-out.

3. **Living compost filled fabric or coir log retaining walls**
   Mechanically stabilized earthen systems comprised of compost filled fabric tubes or coir logs, which are planted from within to form a permeable and water holding living system that either decomposes after plants become rooted into the substrate or gradually settles into place without decomposing, depending on the tube material. This type of living wall can be used for streambank stabilization or as a living shoreline. They can also be used to retain soils, usually at lower heights than segmental paver retaining walls.

Since these are specialized proprietary systems, in all cases consult with the manufacturer before performing any maintenance.

This living wall is a Pittsburgh icon.

PHOTO: CHERYL CORSON

19.6 Wetlands and Wet Ponds

Wetlands

Unlike many BMPs, constructed wetlands are designed to be wet most of the time. Constructed wetlands that are maintained regularly can remain healthy and functional for many years. Table 15 indicates the typical maintenance tasks for constructed wetlands. It is adapted from the *Virginia Stormwater Design Specification No.13*.

TABLE 15: TYPICAL CONSTRUCTED WETLANDS MAINTENANCE ACTIVITIES

TYPICAL CONSTRUCTED WETLANDS MAINTENANCE ACTIVITIES	
Frequency	**Maintenance Tasks**
During first year	• During first 6 months inspect site twice after storm events greater than ½" of rainfall. • Stabilize bare or eroding areas in the CDA or around the wetland buffer with grass cover (or other vegetation in coordination with designer). • Depending on the site, vegetation, and rainfall, water every 3 days for the first month, then weekly during the first growing season. • Replant dead or diseased plants.
Annually or more frequently as needed	• Measure sediment accumulation in forebays and micropools. • Remove sediment deposits annually. • Monitor growth and survival of emergent wetland, tree and shrub species and note the presence of any invasive plant species. • Inspect stormwater inlets for damage, erosion or undercutting. • Inspect upstream and downstream banks for sloughing, erosion, or any conditions undermining embankment integrity. • Inspect outfall channel for erosion, undercutting, etc. • Inspect principal spillway and riser for evidence of spalling, joint failure, leakage, etc. • Ensure maintenance access if free of woody vegetation and that manholes and locks can be opened or operated. • Inspect side slopes for evidence of sparse vegetation, erosion, or slumping. • Remove large stands of reeds and seek professional outside assistance to eradicate other undesirable invasives. • Remove trash, debris, and floatables.

This constructed wetland and pond is part of the Phipps Conservatory's LEED Platinum® Center for Sustainable Landscapes (CSL).

PHOTOS: CHERYL CORSON. PHIPPS CONSERVATORY, PITTSBURGH, PA. THE DESIGN ALLIANCE

Wet Ponds

Generally pond maintenance includes aquatic weed and algae control, dam inspection, fish stocking (depending on pond size), shoreline erosion control, and water quality testing.

TABLE 16: TYPICAL WET POND MAINTENANCE ACTIVITIES

TYPICAL WET POND MAINTENANCE ACTIVITIES	
Frequency	**Maintenance Tasks**
During first year as needed	• Inspect at least twice after storm events greater than ½" of rainfall. • Plant the aquatic benches with emergent wetland species, following landscape plan. • Stabilize any bare or eroding areas in the CDA or pond buffer. • Water during growing season as needed during plant establishment phase, in coordination with designer and client.
4 times a year (more frequently after major storms)	• Remove debris and blockages. • Repair undercut, eroded, and bare soil areas.
Twice a year	• Mow buffer and pond embankment.
Annually	• Shoreline cleanup to remove trash, debris, and floating items. • Complete maintenance inspection. • Open the riser to access and test valves. • Repair broken mechanical components, if needed.
Once during second year after construction	• Add pond buffer and aquatic bench reinforcement plantings.
Every 5–7 years	• Remove forebay sediment.
Between 5–25 years as needed	• Repair pipes, riser, and spillway.

19.7 References

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HARDSCAPES

SECTION 20: HARDSCAPE BMP MAINTENANCE

20.1 Hardscape BMP Overview

Hardscape BMPs form an important subset of stormwater management, often intercepting and slowing water flow before it reaches vegetated BMPs. This set of practices does not involve plant health care, yet it can greatly affect the performance of vegetated BMPs by reducing the volume and velocity of stormwater, trapping sediment, and filtering oils and chemicals upstream in the stormwater treatment train.

For the purposes of this manual, hardscape BMPs are organized into three categories:

1. Rainwater harvesting systems, including rain barrels and cisterns.
2. Infiltration systems:
    a. subsurface infiltration such as dry wells or modular underground storage tanks
    b. surface infiltration such as gravel filter strips
3. Permeable paving systems:
    a. unitary pavers such as brick or paver systems allowing water to infiltrate between solid paving units
    b. unitary paving systems employing pavers with gravel or grass-filled voids
    c. monolithic paving systems such as permeable asphalt or permeable concrete

This manual does not address industrial, large-volume, sub-surface water harvesting systems such as those used below parking lots.

20.2 Rainwater Harvesting Systems

Regular monitoring of rain barrels and cisterns includes not only the water storage unit, but also the gutters, downspouts, diverters, and filters coming from the building to the barrel or cistern; the filter screen (if any) on top of the rain barrel; and the spigots and hoses exiting the water storage device. It is also important to monitor the foundation beneath the device, making sure it remains stable and level.

It is common for rain barrels to have hoses attached to rain barrel spigots and a solid hose exiting the device, transitioning to soaker hoses for plant bed irrigation. Monitor any soaker hoses employed in the system to determine if sufficient water pressure is present for them to function. If not, discuss with the designer and client the option of replacing soaker hoses with special high output soaker hoses intended for rain barrels, such as those sold by Mr. Drip. After the growing season, either divert stormwater away from rain barrels into storm drains or, if no storm drain is present, be sure stormwater flow stays off walkways where it could freeze.

Large volume cisterns will have manufacturer's specifications. Be sure to obtain and follow them so as not to void any warranty.

The concrete runnel overflow for this cistern must be kept free of debris for optimal functioning, especially beneath the decorative metal covers.

PHOTO: CHERYL CORSON.
BURGUNDY FARM COUNTRY DAY SCHOOL, ALEXANDRIA, VA.
OCULUS, LANDSCAPE ARCHITECTS

Rain barrels must be connected in spring and disconnected before winter to avoid cracking.

PHOTO: CHERYL CORSON

Landscape maintenance workers must be trained to understand how more complicated rain barrel systems like this function.

PHOTO: CHERYL CORSON.
THE ENVIRO CENTER, JESSUP, MD

TABLE 17: TYPICAL MAINTENANCE TASKS FOR RAINWATER HARVESTING SYSTEMS

TYPICAL MAINTENANCE TASKS FOR RAINWATER HARVESTING SYSTEMS		
Inspector	**Frequency**	**Activity**
Owner's representative (contractor)	Monthly during the growing season	• Inspect and clean prescreening devices and first flush diverters. • Keep gutters and downspouts free of leaves and other debris. • Monitor for mosquitoes by checking mosquito screens and patch holes or gaps. • Use mosquito dunks or similar for short-term control, and repair any openings allowing mosquitoes to enter and breed.
	Once in spring and fall	• Inspect and clean storage cistern lids, paying special attention to vents and screens on inflow and outflow spigots. • Inspect condition of overflow pipes, overflow filter path, and/or secondary stormwater treatment practices. • Drain tank after growing season if used for seasonal irrigation only. • Inspect for cracks before spring hookup. • Inspect foundation for structural integrity and levelness. • Add empty plastic soda bottles (with tops affixed) to the water if some winter use is desired, so that if the tank freezes, it will not crack.
	Every third year	• Clear overhanging vegetation and trees over roof surface using a certified arborist as needed. • Inspect cistern for sediment buildup. • Check integrity of backflow preventer. • Inspect structural integrity of cistern, pump, pipe, and electrical system. • Replace damaged or defective system components.
Qualified third party inspector	According to manufacturer	• Inspect water quality devices.
	As required by jurisdiction	• Provide water quality analysis.
Owner or contractor (as specified in contract)	As needed throughout growing season	• Empty water storage device before next storm.

20.3 Infiltration Basins and Trenches

Water detention, rather than retention, is the purpose of above and below-grade infiltration systems. Below grade systems include gravel-filled dry wells and proprietary systems in which plastic frames, stacked within impervious rubber liners, offer water storage intended to be pumped to the surface. One out of several proprietary examples is Aquablox®. Check with manufacturer for annual and season maintenance of these systems, including electric pumps and overflow devices. Note that these systems may be located below driveways or patios. Consulting design drawings will be necessary.

Traditional, standalone gravel-filled dry wells tend to clog, and their locations may to become lost as landscapes mature. Providing markers for dry well locations is recommended. Newer aggregate filled infiltration trenches may also be part of a suite of connected stormwater management practices, and may include stand-up pipes with capped observation wells, perforated overflow collection pipes, or large diameter perforated pipes for additional water storage. Before attempting to perform maintenance on below grade infiltration trenches, be sure to obtain design drawings, as the number, location, and function of system components vary. Virginia's design specification for infiltration practices shows many of the possible variations.

Gravel-filled surface infiltration trenches may also be called level spreaders. These consist of a level (0% slope) trench adjacent to a hardscape surface such as a parking lot. They may include a geotextile wrapped perforated pipe. Their purpose is to reduce the erosive energy of concentrated water flow by distributing runoff as sheet flow to stabilized vegetative surfaces adjacent to and below the practice.

According to the *Pennsylvania Stormwater BMP Manual*, "compared with other BMPs, level spreaders require only minimal maintenance efforts." However, sediment will often accumulate between the hardscape surface and the level spreader. If it not regularly removed, vegetation will grow in it, impeding or preventing water flow into the practice.

TABLE 18: TYPICAL MAINTENANCE ACTIVITIES FOR INFILTRATION PRACTICES

TYPICAL MAINTENANCE ACTIVITIES FOR INFILTRATION PRACTICES	
Frequency	**Maintenance Tasks**
4 times a year	• Keep the CDA, inlets, and facility surface are clear of debris. • Keep the CDA stabilized. Spot seed where needed. • Remove sediment and oil/grease from inlets, pretreatment devices, flow diversion structures, and overflow structures. • Repair undercut and eroded areas at inflow and outflow structures.
2 times a year	• Check observation wells 3 days after a storm event greater than ½" of rainfall. (Standing water in the well after 3 days is an indication of clogging.) • If no observation wells are included, but the practice is very shallow, observe ponding by removing some gravel at the surface of the trench. • Inspect pretreatment devices and diversion structures for sediment buildup and structural damage. • Remove sediment and debris. • Maintain vegetative cover at 85% and replace if damage greater than 50% is observed.
Annually	• Clean out accumulated sediment from the pretreatment cell.
As needed	• Replace gravel/topsoil and top surface geotextile fabric when clogged. • Mow vegetated filter strips as necessary and remove the clippings. • If dry well does not drain properly, dig down to check inflow points for excessive leaves or debris. • If practice accumulates standing water then reconstruct with assistance from allied professionals as needed. • Regrade and/or reseed areas below the level spreader. • Maintain a vigorous vegetative cover on the areas below a level spreader.

This stone infiltration trench works together with vegetation. Sediment must periodically be removed for optimal functioning.

PHOTO: CHERYL CORSON.
LONG BRIDGE PARK, ALEXANDRIA, VA.
LSG LANDSCAPE ARCHITECTURE

Sediment will accumulate in this infiltration trench and must be periodically be removed to keep the storm drain clear.

PHOTO: CHERYL CORSON.
CITY OF LANCASTER, PA. PUBLIC WORKS

Grass clippings should be swept from paved surfaced and returned to lawn areas to prevent the storm drain blockage and nutrient loading as seen here.

PHOTO: CHERYL CORSON

20.4 Permeable Paving Systems

This segment of the industry is frequently introducing new products and applications, so checking with the manufacturer of a proprietary system regarding maintenance is always recommended. Porous concrete, asphalt, and interlocking pavers require that the surface be kept clean of organic materials, such as grass clippings. Periodic vacuuming and low-pressure washing should be used to clear out voids and extend the pavers' functional life. Conventional street sweepers should be used with brushes and water, ideally four times a year, depending on the area and use. However, permeability will decrease over time, which is why Washington, D.C.'s Green Area Ratio program offers a lower credit score for permeable paving than for vegetative BMP practices.

Understand sub-base installation conditions of any permeable pavement system. It is often the below-grade condition in which water detention and system failures occur. Pavement may subside, crack, fill with sediment, or accumulate standing water. Grass-pave systems may need irrigation during establishment, and will require regular, if infrequent, mowing. The client may have stored extra pavers following construction to be used for replacing damaged ones. Ask if this is the case if replacement units are needed.

TABLE 19: TYPICAL MAINTENANCE TASKS FOR PERMEABLE PAVEMENT PRACTICES

TYPICAL MAINTENANCE TASKS FOR PERMEABLE PAVEMENT PRACTICES	
Frequency	**Maintenance Tasks**
After installation	• During the first 6 months following installation, permeable paving and the contributing drainage area (CDA) should be inspected at least twice after storm events greater than ½" of rainfall. Conduct any needed repairs or stabilization.
Every 1 – 2 months during the growing season	• Mow grass in grid paver applications.
As needed	• Stabilize the CDA to prevent erosion. • Remove any soil or sediment deposited on pavement. • Replace or repair any cracked or damaged pavement surfaces.
2 to 4 times a year (depending on use)	• Conduct a maintenance inspection. • Mechanically sweep pavement with a standard street sweeper to prevent clogging. • Weed as needed in grass-pave applications. • Check downspouts and channels leading to permeable pavement and remove any accumulated debris.
Once a year	• Remove any accumulated sediment in pretreatment cells and inflow points.
Once every 2–3 years (more frequently as needed)	• Use a vacuum sweeper (per manufacturer's recommendation). • Replace any necessary joint material.
In winter	• Do not spread sand or ash which will clog voids in pavement. • Do not use salt and deicing products which will cause pollution and adversely affect all concrete and turf materials. • Keep snowplow blades ½" off turf systems. • Plow paver systems as for unpaved roads.

Gravel-filled permeable pavers with a stone reservoir below filter pollutants from this driveway.

PHOTO AND LANDSCAPE ARCHITECTURE:
CHERYL CORSON, RLA.
CONTRACTORS: DEEP ROOTS
LANDSCAPE COMPANY

Sediment must be periodically removed from paver cells for optimal functioning.

PHOTO AND LANDSCAPE ARCHITECTURE:
CHERYL CORSON, RLA.
CONTRACTORS: DEEP ROOTS
LANDSCAPE COMPANY

Permeable pavers with a large stone drainage basin below may look like regular pavers. Always ask for design drawings to understand what BMPs are in use.

PHOTO AND LANDSCAPE ARCHITECTURE:
CHERYL CORSON, RLA.
CONTRACTORS: DEEP ROOTS
LANDSCAPE COMPANY

This public alley has been retrofitted with permeable pavers to absorb stormwater. They will need to be periodically vacuumed in order to remain fully functional.

PHOTO: CHERYL CORSON.
CITY OF LANCASTER, PA. PUBLIC WORKS

An impervious concrete and stone apron is used only at the building's entry. Beyond that is an aggregate parking court with grass filled pavers as overflow parking.

PHOTO AND LANDSCAPE ARCHITECTURE:
CHERYL CORSON, RLA.
CONTRACTORS: DEEP ROOTS
LANDSCAPE COMPANY

Pervious concrete is shown to the left of impervious concrete on this public street. The pervious concrete will need periodic vacuuming in order to remain fully functional.

PHOTO: CHERYL CORSON

20.5 References

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ABOUT THE AUTHOR

PHOTO: KAT FORDER

Cheryl Corson, RLA, ASLA, is a landscape architect and writer in private practice in the greater D.C. metro area. She also instructs landscape architecture licensure candidates in preparing for the design, stormwater management, and construction sections of the LARE exam. Cheryl holds a bachelor's degree in Public Administration, and she received her master's degree in Landscape Architecture from the Harvard Graduate School of Design.

ABOUT THE CHESAPEAKE BAY LANDSCAPE PROFESSIONAL PROGRAM

The Chesapeake Bay Landscape Profession (CBLP) certification is a voluntary credentialing system for professionals who design, install, and maintain sustainable landscapes, with a special emphasis on stormwater retrofits and conservation landscaping with native species to benefit the environment. Across the Bay region, local government and nongovernmental organizations are asking property owners to increase the use of these small-scale, residential stewardship practices for a healthier Chesapeake Bay. The CBLP credential will help connect consistently trained professionals with potential employers, and will ultimately ensure that these practices function properly, in order to meet runoff, nutrient, and sediment reduction goals.

The CBLP pilot program will run from October 2016 to January 2017 in Maryland, Virginia, and the District of Columbia. Following program assessment and refinement, the certification will launch in the pilot states and Pennsylvania in early 2017, with expansion to Delaware, West Virginia, and New York later in the year.

Please visit cblpro.org for more information.

CHESAPEAKE BAY
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P.O. Box 3399
Silver Spring, MD 20918