watershed best management practices toolbox

4

4 stormwater best management practices toolbox

This section presents a brief illustrated overview of a variety of policy/regulation, site planning, and stormwater/landscaping best management practices (BMPs). Each of the BMPs were integrated into the Dead River W atershed management action items and recommendations presented in Chapter 6. Policies and standards BMPs provide the legal framework for conservation development, while planning process BMPs are on-site strategies that preserve natural features and facilitate conservation stormwater BMPs. Stormwater BMPs are individual practices that achieve on-site stormwater management objectives. Common to many of the techniques is the use of native plants that function not only as a part of an ef fective stormwater management system but also as native landscapes. Following the brief descriptions, more detailed information is provided including guidance on applicable scale and land use, bene f ts & effectiveness, and design considerations. A more detailed toolbox is included in Appendix F.

4.1 POLICIES AND STANDARDS

Policies and Standards serve as the f rst step to establish and then enforce minimum standards for natural resource preservation and stormwater management. Policies express goals for natural resource, water quality , habitat, and open space preservation. Standards (along with zoning described below) are the tools used to implement the policies. Policy actions or standards may include acquisition of Conservation Easements, Stream/Wetland Restoration and Management, and adoption of Watershed Development Ordinances.

Conservation Easement: Legal mechanism for landowners to place voluntary restrictions on the future use of their land, generally requires landowner to sell, permanently relinquish, or donate the rights of development.

Conservation and Floodplain Standards: Standards established to preserve stream corridors and f oodplains from urban development and other encroachments.

Watershed Development Ordinance: Ordinance to regulate development for the purpose of minimizing on-site and off-site impacts to f ooding and water quality.

Wetland/Stream Management and Restoration: Practices that restore and/or create healthy aquatic ecosystems. Activities include stream corridor restoration, hydrologic restoration, and vegetative management. In some cases, creation of wetland banks and fee-in-lieu of wetland mitigation can be used as funding mechansisms for wetland creation and enhancement.

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Bioswales along streets (Portland, OR)

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Filter Strips/ Level Spreaders (Chesterton,IN)

© Conservation Design Forum

Green Roof (Portland, OR)

© Conservation Design Forum

Naturalized Detention (Bolingbrook, IL)

4.2 PLANNING PROCESS BMPS

Planning practices are also used to implement policy goals of maintaining high environmental quality as a watershed develops. Signi f cant natural features and other areas to be preserved are identi fied using environmental planning processes. Many of these areas can then be preserved by open space requirements and other standards. Open Space/Natural Greenway delineation, Riparian Buf fers, and Floodplain Standards are tools used to preserve natural resource areas from development. Conservation Development and Impervious Area Reduction are critical site-level planning and design strategies to create environmentally sensitive developments to achieve stormwater management and watershed goals.

Conservation Development: Site planning and design approaches that preserve existing natural areas and utilize naturalized drainage and detention measures for stormwater management, energy consumption, transportation eff ciency, and habitat enhancement.

Impervious Area Reduction: Impervious area reduction can be achieved in a number of ways, such as: narrower streets; shorter streets in lower density residential neighborhoods; creative driveway design; shared parking facilities; and designing roads, walkways, and trails for multiple uses as an integrated system.

Open Space/Natural Greenway: Designation of open spaces and/ or natural areas as greenways, in order to preserve and connect signif cant natural features and accommodate aesthetic, recreational and/or alternative transportation uses.

Riparian Buffer: A buffer of native vegetation along lakes, streams, and wetlands that provides water quality and habitat benef ts.

4.3 ON-SITE STORMWATER BMPS

On-site stormwater BMPs are site-speci f c practices that can minimize onsite and of fsite hydrologic and water quality impacts derived from stormwater runoff via methods of incorporating and re-establishing natural hydrologic process into an urbanized environment. These measures can be designed and implemented into new development as well as retro f tted into existing development in cost effective ways.

Bioswales: Filtration and inf ltration systems planted with grasses and forbs, and designed to f lter, retain and evapotranspirate stormwater . Vegetation enhances f ltration, cooling, and cleansing of water to improve water quality and prevent sealing of subsoils. The bioswales typically include an in f ltration trench below the vegetated swale to provide temporary storage to increase the volume of runof f water inf ltrated.

Filter Strips/Level Spreaders: Filter strips are an area of dense, preferably native, vegetative cover used to filter and absorb runoff. Level spreaders are often used in conjunction with filter strips and are laid on the contour to distribute runoff over filter strip areas. Filter strips/level spreaders can be used within stream and wetland buffers to diffuse stormwater prior to discharge to streams and wetlands.

Green Roofs: Vegetated roof system designed to capture, temporarily store, and evapotranspirate rainwater on the top of roofs. Typically, green roofs are planted with drought and wind tolerant vegetation. Green roofs can be designed as simple, lightweight systems that provide stormwater benefits, or as more elaborate rooftop gardens that also provide outdoor space.

Naturalized Detention: Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat benefits. Naturalized detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Porous Pavement: Permeable or perforated paving materials with spaces that allow for the infiltration of rainwater and the transmission of water to aggregate base and subsoils. Runoff is temporarily stored in the base for infiltration into the subsoils and/or slow release to a bioswale or stormwater system.

Rain Barrels/Cisterns: A vessel used to capture and temporarily store rainwater for various uses, including landscape irrigation, reuse for graywater purposes, etc.

Rain gardens: A landscaped garden designed to retain, detain, infiltrate and evapotranspirate stormwater runoff from individual lots and roofs.

Vegetated Swales: Vegetated stormwater features that convey, retain, infiltrate and cleanse stormwater. Native vegetation enhances filtration and retention of stormwater.

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Porous Pavement (Elmhurst, IL)

© Conservation Design Forum

Rain Barrel (Chicago, IL)

© Conservation Design Forum

Rain garden (Maplewood, MN)

© Conservation Design Forum

Vegetated Swales (Madison, WI)

© Conservation Design Forum

Native Landscaping (Geneva, IL)

4.4 LANDSCAPING BMPS

Landscaping, as a BMP , stands alone in its own category due to the importance of vegetation in biodiversity , aesthetics, habitat, cooling of ambient air, and stormwater management. Native landscapes, including native prairies and wetlands, can improve water quality through in f ltration and cleansing of stormwater runof f. Properly designed landscapes that incorporate native plants and hydrologically and ecologically appropriate vegetation can not only facilitate effectiveness of stormwater management but also provide wildlife habitat and quality open space.

Native Landscaping: Native vegetation in either large restoration or smaller garden projects. Native vegetation uses plants that are endemic to a specif c geographic region prior to European settlement. Native landscapes can serve a variety of purposes, including habitat, inf ltration, f ltering, and evapotranspiration of stormwater, and wildlife habitat.

Stream/Wetlands Management and Restoration: Landscape restoration practices that maintain existing remnant landscapes and/or restore them to thier natural state.

4.5 FLOOD REDUCTION BMPS

Structural Flood Control: Structural measures control or contain water and are generally designed to preventf oodwaters from reaching buildings. Structural alternatives generally include reservoirs, levees and f oodwalls, diversions, stream channel conveyance improvements and drainage and storm sewer improvements. Because of their size and cost, structural projects are often implemented with help from state or federal f ood control agencies such as the Illinois Department of Natural Resources - Of f ce of W ater Resources, or the U.S. Army Corps of Engineers.

Non-Structural Flood Control: In addition to structural controls for f ood remediation, f ooding problems can also be addressed using non-structural means. Some of the non-structural f ood control techniques include f oodproof ng, acquisition of f oodplain buildings, building elevation and building relocation. More communities and county-wide agencies could get involved in non-structural programs such as acquisition by helping to identify repetitively f ooded properties.

Tables 4.1 and 4.2 summarize the stormwater management tool applicability and effectiveness for each of the best management practices described in this toolbox. Following these tables is a vignette for each of the BMPs that begins with its definition and continues with its range of applicability, associated benefits, and finally some potential design considerations, as described below.

Definition - A brief description of the BMP relative to stormwater management.

Applicability - Where and how each BMP is the most applicable is addressed in three aspects: scale, applicable applications, and effectiveness:

Scale

- **Watershed/County:** Applied at a regional scale in watershed or county-wide.
- **Town/Village:** Applied at municipal or other scale with common zoning authority.
- **Neighborhood:** Applied at development or other sub-municipal scale.
- **Lot:** Applied within individual residential lot or commercial parcel.

Applications

- **Retrofit:** Applied to existing developed areas, infill, and redevelopment.
- **New:** Applied to new development.
- **Roofs:** Applied on roofs or used to treat roof runoff.
- **Streets:** Applied on or used to treat runoff from public/private streets and roads.
- **Driveways:** Applied on or used to treat runoff from driveways.
- **Parking Lots:** Applied on or used to treat runoff from parking lots.
- **Lawns:** Applied on or used to treat runoff from existing open lawns that are generally planted with turfs, such as parks, campuses, individual yards, etc.
- **Sensitive Areas:** Applied on ecologically sensitive areas such as remnant habitats, floodplains, wetlands, steep slopes, and highly erodible soils.

Effectiveness

- **Runoff Rate Control:** Practices that can control or reduce runoff rates.
- **Runoff Volume Control:** Practices that can control or reduce runoff volumes.
- **Physical Habitat Preservation/Creation:** Practices that can preserve, introduce, or provide wildlife habitats.
- **Sediment Pollution Control:** Practices that can remove suspended solids from runoff.
- **Nutrient Control:** Practices that have the ability to reduce or remove nutrients such as nitrogen and phosphorus from runoff.
- **BOD Control:** Practices that can remove constituents that exert a Biological Oxygen Demand (BOD) in runoff.
- **Other Pollutant Control:** Practices that can reduce and remove other pollutants such as heavy metals and petroleum-based hydrocarbons.

Benefits - Other positive effects that the individual or system of practices performs. Benefits can be specific to stormwater management or be more general to various functions and values for the quality of life.

Design Considerations - Design recommendations and suggestions that should be considered when implementing the specific BMP. Drawings are not illustrated for construction, but rather as a general guidance on the components of the practice.

Table 4.1 Stormwater Management Tool Applicability

Tools	Scale				Applications							
	Watershed/ County	Town/ Village	Neighbor- hood	Lot	Retrof t	New	Roofs	Streets	Drive- ways	Parking Lots	Lawns	Sensitive Areas
Policies / Standards												
Conservation Easement	X	X	X	X	X	X						X
Wetland / Stream Management and Restoration	X	X	X	X	X	X						X
Watershed Development Ordinance	X	X			X	X	X	X	X	X	X	X
Planning												
Conservation Development	X	X	X			X		X	X	X	X	X
Conservation and Floodplain Standards	X		X		X	X						X
Impervious Area Reduction		X	X	X		X	X	X	X	X		
Open Space/Natural Greenway	X	X	X		X	X						X
Riparian Buffer	X	X	X		X X	X					X	X
Site Stormwater BMPs												
Bioswale			X	X	X	X		X		X		
Filter Strips/Level Spreader			X	X	X	X			X	X	X	X
Green Roof				X	X	X	X					
Naturalized Detention	X	X	X		X	X	X	X	X	X	X	X
Porous Pavement			X	X	X	X		X	X	X		
Rain Barrels/Cistern				X	X	X	X					
Rainwater Garden				X	X	X	X		X		X	
Vegetated Swale			X	X	X	X	X	X	X	X	X	
Landscaping												
Native Landscaping			X	X	X	X	X	X	X	X	X	X

"X"= practices that are applicable to corresponding scale and applications

Table 4.2 Stormwater Management Tool Effectiveness

Tools	Effectiveness						
	Runoff Rate Control	Runoff Volume Control	Physical Habitat Preservation/ Creation	Sediment Pollution Control	Nutrient Control	BOD Control	Other Pollutant Control
Policies / Standards							
Conservation Easement	- -		H	- -		-	-
Wetlands / Stream Management and Restoration	-	-	H	H	M	-	-
Watershed Development Ordinance		H	H	H	H		H H
Planning Process							
Conservation Development	H	H	H	H	H	H	H
Conservation and Floodplain Standards	H[1]	-	H	-	-	-	-
Impervious Area Reduction	H	H		-H	H	H	H
Open Space/Natural Greenway	-	-	H	-	-	-	-
Riparian Buffer	M	-	H	M M M			M
Site Stormwater BMPs							
Bioswale	H	H	-	H	H	H	H
Filter Strip/Level Spreader	M	M	-	H	H	H	H
Green Roof	H	H	- - - -				-
Naturalized Detention	H		-	MH	H	H	H
Porous Pavement	H	H	-	H	M	M	H
Rain Barrel/Cistern	-	M	- - - -				-
Rainwater Garden	M	M	- - -			-	-
Vegetated Swale	M	M	-	M	M	M	M
Landscaping							
Native Landscaping	-		MM	M	M	M	M

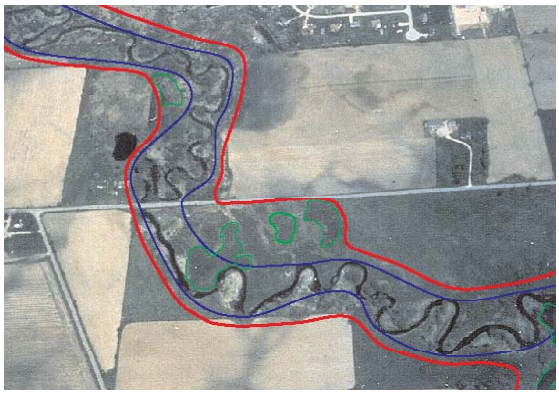
1 Prevents f ood damage as a result of high f ow rates

"H" = High effectiveness; "M" = Moderate effectiveness; " –" = Not Applicable

Conservation Easement

Def nition

- Legal mechanism for landowner to place voluntary restrictions on the future use of their land. Generally requires landowner to sell, permanently relinquish, or donate the rights of development.



conservation easements provide mechanism for long term preservation of morphologically-based corridors

Applicability

➢ Scale	☒	Watershed/County	☒	Town/Village	☒	Neighborhood	☒	Lot
➢ Applications	Retro ☒	f t	☒	New				
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance		
	☐	Roofs	☐	Streets	☐	Driveways		
	☐	Parking Lots	☐	Lawn	☒	Sensitive Areas		
➢ Effectiveness	☐	Runoff Rate Control	☐	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☐	Sediment Pollution Control
	☐	Nutrient Control	☐	BOD Control	☐	Other Pollutant Control		

Benef ts

- Preserves signif cant natural features and open space.
- Preserves created/restored natural areas from development and other disturbances.
- Provides opportunity to preserve morphologically and ecologically-based corridors that may be more dif f cult to preserve with f xed width buf fers in many stormwater
- ordinances.
  Can be used as a tool to create interconnected network of open space to improve ecological functioning of overall system.

Design Considerations

- Conservation easements, along with f oodplain/open space zoning, ordinance buf fer requirements, and conservation design should be used to preserve and create natural resource networks.
- Conservation easements are best suited to areas not subject to land use change and therefore cannot readily be preserved through the development process.
- Conservation easements may also be used to preserve high quality uplands and other areas not readily preserved through zoning and/or stormwater ordinances.

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one's backyard may be wildlife's treasure habitat

Wetland / Stream Management & Restoration Management

Coffee Creek streambank restoration (Chesterton, IN) (Conservation Design Forum)

Def nition

- Practices that maintain a healthy ecosystem and/or restore a deteriorated ecosystem to its natural state.

Applicability

➢ Scale	☒	Watershed/County	☒	Town/Village	☒	Neighborhood	☒ Lot
➢ Applications	Retro ☒	f t	☒	New			
	☐	Preventive	☒	Remedial	☒	Ongoing/ Maintenance	
	☐	Roofs	☐	Streets	☐	Driveways	
	☐	Parking Lots	☐	Lawn	☒	Sensitive Areas	
➢ Effectiveness	☐	Runoff Rate Control	☐	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒	Nutrient Control	☐	BOD Control	☐	Other Pollutant Control	

Benef ts

- Preserves signi f cant natural features and their habitat, runof f moderation, and water quality benef ts.
- Reduces the impact to natural systems by f oods and other natural perturbations and improves recovery from these disturbances by preserving natural processes and functions.

Design Considerations

- Conduct a thorough analysis of existing and historic conditions of the restoration site, surrounding area, and watershed to understand system processes and functions.
- Establish stewardship program with local governments, stakeholders, interest groups, and communities to ensure sustained management and monitoring ef forts on managed/ restored ecosystems.
- Management and stewardship activities should be recognized as ongoing activities. Intensiveness of stewardship activities will decrease as system health and processes are restored.

a successful wetland restoration ensures the healthiness of ecosystems and improves quality of life for both human and wildlife

Watershed Development Ordinance

Def nition

- Ordinance to regulate development for the purpose of minimizing on-site and off-site impacts to f ooding and water quality.

watershed development ordinances are designed to preserve and enhance natural site features and protect downstream areas from stormwater impacts

Applicability

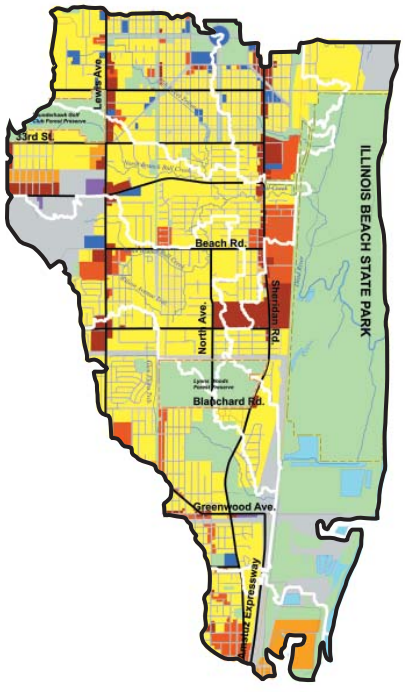
➢ Scale	☒	Watershed/County	☒	Town/Village	☐	Neighborhood	☐	Lot	
➢ Applications	Retro ☒	f t	☒	New					
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance			
	☒	Roofs	☒	Streets	☒	Driveways			
	☒	Parking Lots	☒	Lawn	☒	Sensitive Areas			
➢ Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control	
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control			

Benef ts

- Provides consistent standard throughout watershed.
- Prevents/minimizes degradation of watershed resources.
- Establishes orderly rules and procedures for development activities.

Design Considerations

- Ordinances should comprehensively address stormwater management, f oodplain management, stream and wetland preservation, and soil erosion and sediment control.
- Ordinances should include standards to address runof f volumes, runof f rates, and water quality.
- Ordinances should provide f exibility in methods of meeting standards.
- Ordinances should facilitate watershed resources restoration activities.



comprehensive land use plan

the watershed development ordinance is a critical element of the Dead River Watershed Management Plan (Conservation Design Forum)

Conservation Development

Def nition

- Site planning and design approach that preserves existing natural areas and utilizes naturalized drainage and detention measures for stormwater management, energy consumption, transportation eff ciency, and habitat enhancement.

residential conservation development
(Grayslake, IL)

Applicability

➢ Scale	☒	Watershed/County	☒	Town/Village	☒	Neighborhood	☐	Lot
➢ Applications	Retro ☐	f t	☒	New				
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance		
	☐	Roofs	☒	Streets	☒	Driveways		
	☒	Parking Lots	☒	Lawn	☒	Sensitive Areas		
➢ Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control		

Benef ts

- Preserves signif cant natural features and open space.
- Minimizes changes in runof f volumes, rates, and water quality typically associated with urban development.
- Improves views and site aesthetics, while at the same time providing site drainage and water quality functions.

Design Considerations

- On-site natural areas should be identif ed and preserved.
- Existing natural drainageways should be incorporated into site plan.
- Roadway should generally follow ridge lines.
  Impervious runoff should be routed through naturalized drainage systems integrated into the site plan.
- Use of native vegetation adapted to expected hydrologic conditions will improve runoff reduction and water quality benef ts.
- Naturalized drainage systems should be preserved from construction site runoff during establishment.

conservation moderate density residential site plan
(Conservation Design Forum)

Floodplain Zoning

Definition

- Zoning regulations established to preserve stream corridors and floodplains from urban development and other encroachments.

floodplain zoning prevents development from occurring in floodprone areas

Applicability

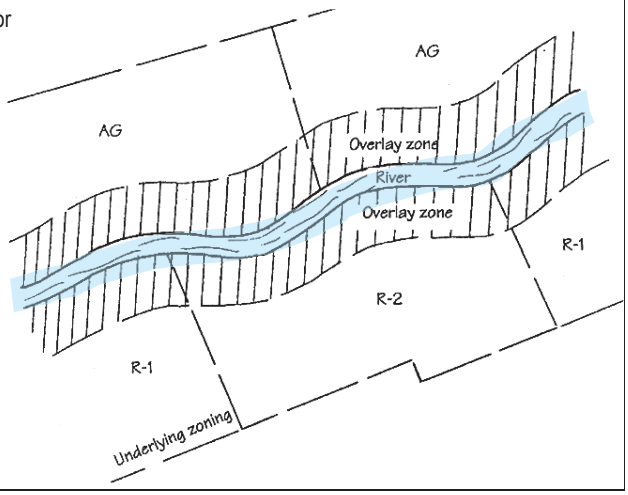
➢ Scale	☒	Watershed/County	☒	Town/Village	☐	Neighborhood	☐	Lot	
➢ Applications	Retro ☒		☒	New					
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance			
	☐	Roofs	☐	Streets	☐	Driveways			
	☐	Parking Lots	☐	Lawn	☒	Sensitive Areas			
➢ Effectiveness	☒	Runoff Rate Control	☐	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☐	Sediment Pollution Control	
	☐	Nutrient Control	☐	BOD Control	☐	Other Pollutant Control			

Benefits

- Preserves stream corridors and riparian wetlands and provides natural buffer.
- Enhances safety and quality of life.
- Protects properties from flood damages.
- Preserves natural floodplain functions.

Design Considerations

- Zoning regulations should allow for and encourage riparian corridor restoration.



floodplain zoning overlays underlying zoning (source: SEMCOG)

Impervious Area Reduction

Def nition

- Impervious area reduction can be achieved by reducing street widths and building setbacks, examining parking lot requirements, and through building design alternatives.

reduce impervious areas by reducing street width (Seattle, WA)

Applicability

➢	Scale	☐	Watershed/County	☒	Town/Village	☒	Neighborhood	☒	Lot
➢	Applications	Retro ☐	f t	☒	New				
		☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance		
		☒	Roofs	☒	Streets	☒	Driveways		
		☒	Parking Lots	☐	Lawn	☐	Sensitive Areas		
➢	Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control
		☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control		

Benef ts

- Reduces runoff volumes and rates and associated pollutants.
- Reduces urban heat island ef fect and thermal impacts to waterbodies.
- Reduces development and maintenance costs.
-

Design Considerations

- Impervious area reductions can be achieved through reduced road widths, shared parking, reduced setbacks, and other measures. These reductions will often require changes in subdivision code.
- Street length can often be reduced by clustering development onto portions of the site.
- Benef ts of impervious area reduction are enhanced when combined with methods to “disconnect” impervious surfaces, e.g. vegetated swales, bioswales, f lter strips/level spreaders, etc.

impervious areas reduced by lessening road length through clustering of development (Plano, IL) (Conservation Design Forum)

Open Space / Natural Greenway

Def nition

- Designation of linear open space and/or natural areas as greenways to preserve and connect signi f cant natural features and to accommodate aesthetic, recreational, and/or transportation uses.

open space greenways can provide recreational as well as habitat and water quality benef ts

Applicability

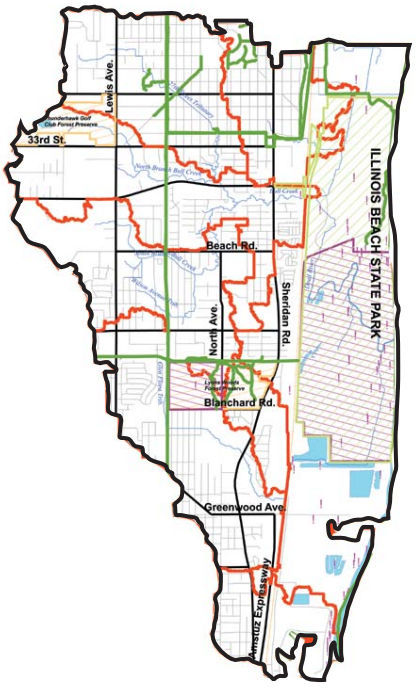
➢ Scale	☒ Watershed/County	☒ Town/Village	☒ Neighborhood	☐ Lot	
➢ Applications Retro	☒ f t	☒ New			
	☒ Preventive	☐ Remedial	☐ Ongoing/ Maintenance		
	☐ Roofs	☐ Streets	☐ Driveways		
	☐ Parking Lots	☐ Lawn	☒ Sensitive Areas		
➢ Effectiveness	☐ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control	
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control		

Benef ts

- Preserves large contiguous natural areas and resources.
- Provides opportunity for wildlife movement and habitat within an ecological network.
- Provides alternative and connected passive recreation and transportation opportunities.

Design Considerations

- A natural resources inventory should be completed to identify signif cant natural features and functioning ecological networks.
- Signif cant cultural features should also be integrated into the network.
- Buffer requirements, open space/ f oodplain zoning, conservation easements, and conservation design should be used together to implement greenway networks.



an open space/natural greenway system is designated to preserve key natural resources in the Dead River W atershed Area (Conservation Design Forum)

Riparian Buffer

Def nition

- A buffer of native vegetation along lakes, streams, and wetlands that provides water quality and habitat benef ts.

© Conservation Design Forum

buffers of native vegetation along streams and wetlands provide natural stabilization and pollutant f ltering

Applicability

➢	Scale	☒	Watershed/County	☒	Town/Village	☒	Neighborhood	☒ Lot
➢	Applications	Retro ☒	f t	☒	New			
		☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance	
		☐	Roofs	☐	Streets	☐	Driveways	
➢		☐	Parking Lots	☒	Lawn	☒	Sensitive Areas	
	Effectiveness	☒	Runoff Rate Control	☐	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
		☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control	

Benef ts

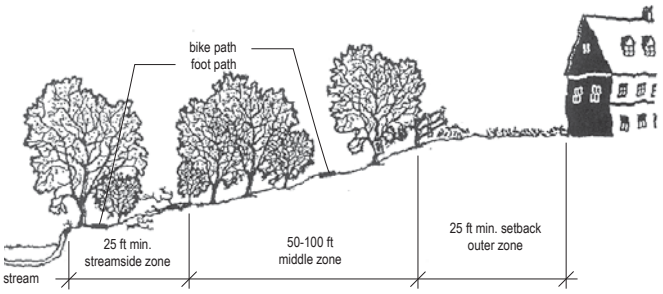
- Preserves natural functions of lakes, streams, and wetlands. Naturally attenuates f ow rates.
- Provides f ltering of lateral surface and groundwater inf ows.
- Helps stabilize streambanks and shorelines against erosion.
-

© Conservation Design Forum

riparian buffers preserve riparian habitat

Design Considerations

- Riparian buf fer width should be dependent on lake, stream, or wetland quality, ground slope, and size of feature.
- Buffer should be planted with native riparian vegetation.
- Buffers are often established/ preserved through a watershed development ordinance.



the three-zone urban stream buffer system (source: Center for Watershed Protection)

Bioswale

Def nition

- Vegetated swale system with an in f ltration trench designed to retain and temporarily store stormwater . Bioswales are planted with native grasses and forbs that enhance f ltration, cooling, and cleansing of water in order to improve water quality and prevent sealing of subsoils.

© Conservation Design Forum

bioswale in a parking lot (Tellabs, Napeville, IL) (Conservation Design Forum)

Applicability

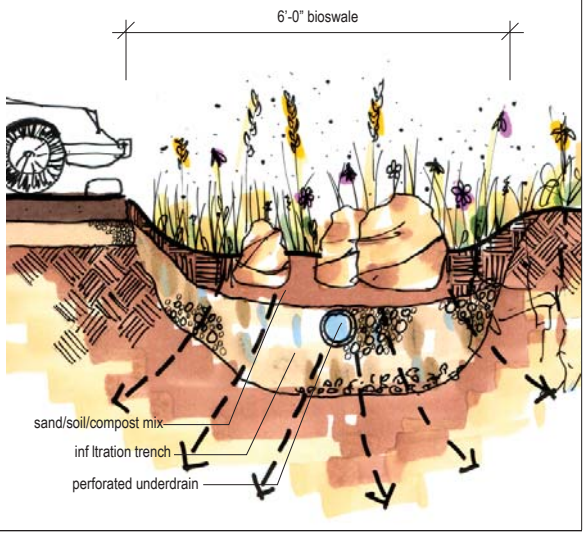
- Scale: ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot
- Applications: ☒ Retro f t ☒ New
  - ☒ Preventive ☒ Remedial ☐ Ongoing/ Maintenance
  - ☐ Roofs ☒ Streets ☐ Driveways
  - ☒ Parking Lots ☐ Lawn ☐ Sensitive Areas
- Effectiveness: ☒ Runoff Rate Control ☒ Runoff Volume Control ☐ Physical Habitat Preservation/ Creation ☒ Sediment Pollution Control
  - ☒ Nutrient Control ☒ BOD Control ☒ Other Pollutant Control

Benef ts

- Reduces impervious runoff volumes and rates.
- Recharges groundwater and sustains base f ows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.

Design Considerations

- Bioswales must be sized and designed to account for drainage area and soils.
- Filtration bene f ts can be improved by planting native deep-rooted vegetation.
- Inf ltration storage should be designed to drain in 24 hours to prevent sealing of subsoils.
- Topsoil should be amended with compost and/or sand to improve organic content for f ltering and to achieve adequate inf ltration rates.
- Bioswales should be protected from construction site runof f to prevent sealing of topsoil and/or subsoils.
- Direct entry of stormwater runof f into in f ltration trench should be prevented to preserve groundwater quality and to prevent sealing of subsoils.
- Underdrain should be suf f ciently low in the trench to provide adequate drainage of aggregate base of adjacent paved areas but suff ciently high to provide inf ltration storage.



© Conservation Design Forum

cross section of bioswale (Conservation Design Forum)

Filter Strip/ Level Spreader

© Conservation Design Forum

Coffee Creek Center level spreader installation (Chesterton, IN) (Conservation Design Forum)

Definition

- A **filter strip** is an area with dense, preferably native, vegetative cover used to filter and absorb runoff from impervious areas. A **level spreader** is a trench laid on the contour to distribute runoff over filter strip areas.

Applicability

➢ Scale	☐	Watershed/County	☐	Town/Village	☒	Neighborhood	☒
➢ Applications	Retro ☒		New ☒				
	☒	Preventive	☒	Remedial	☐	Ongoing/ Maintenance	
	☐	Roofs	☐	Streets	☒	Driveways	
	☒	Parking Lots	☒	Lawn	☒	Sensitive Areas	
➢ Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☒
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control	

Benefits

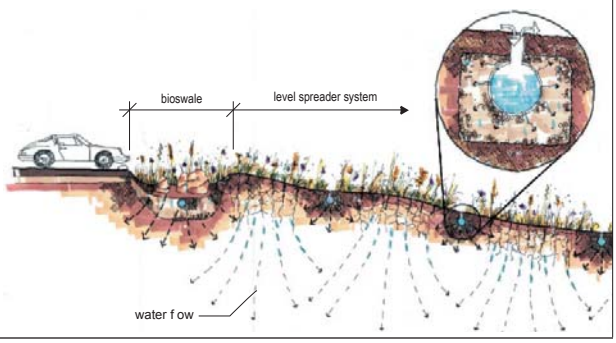
- Reduces runoff volumes and rates by allowing runoff to infiltrate over a large area.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Deconcentrates storm sewer and detention basin discharges to dissipate energy, reduce scour, and better mimic historic runoff patterns to receiving waterbody.
- Can reduce detention needs.

© Conservation Design Forum

filter strip/level spreader

Design Considerations

- Filter strips/level spreaders must be sized and designed to account for drainage area, slope, and soils. Chronic hydraulic overloading of filter strips may cause erosion.
- Filtration benefits can be improved by planting native deep-rooted vegetation and by minimizing the slope.
- Infiltration storage within the level spreader trench should be designed to drain in 24 hours to prevent sealing of subsoils.
- Compaction of filter strips should be avoided and/or topsoil should be amended with leaf compost and coarse sand to improve filtration, infiltration, and plant establishment.
- Runoff should be diverted away from filter strips during construction until vegetation is established.



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cross section of level spreader (Conservation Design Forum)

Green Roof

Def nition

- Vegetated roof system designed to retain and slow rainwater runoff on the top of roofs. Green roofs are generally planted with drought and wind tolerant vegetation.

© Conservation Design Forum

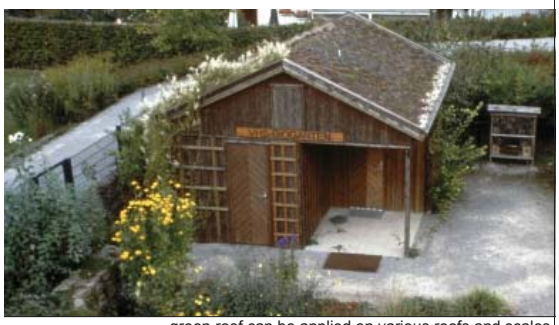
green roof on City Hall (Chicago, IL) (Conservation Design Forum)

Applicability

Scale	☐ Watershed/County	☐ Town/Village	☐ Neighborhood	☒ Lot	
Applications	Retro ☒	New ☒			
	☒ Preventive	☐ Remedial	☐ Ongoing/ Maintenance		
	☒ Roofs	☐ Streets	☐ Driveways		
	☐ Parking Lots	☐ Lawn	☐ Non-Buildable		
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control	
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control		

Benef ts

- Signif cantly reduces runoff volumes and rates as well as thermal impacts (50 - 90% reduction in annual runoff).
- Can reduce detention needs.
- Contributes to reduction in urban heat island effect.
- Can reduce energy requirements associated with heating and cooling.
- Creates opportunities for outdoor space as roof top gardens.

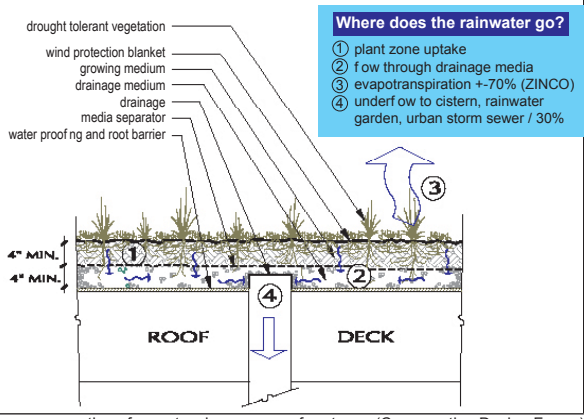


© Conservation Design Forum

green roof can be applied on various roofs and scales

Design Considerations

- Structural load capacity of existing roof system must be evaluated.
- Plant material, such as succulents, that are drought tolerant, should be used on lightweight “extensive” green roof systems.
- A wider range of vegetation may be used on heavier, “intensive” green roof systems with deeper growing medium.
- Use of a granule drainage layer will improve retention and detention benef ts relative to drain boards.



cross section of an extensive green roof systems (Conservation Design Forum)

Naturalized Detention

© Conservation Design Forum

naturalized wetland detention on Tellabs industrial campus (Bolingbrook, IL) (Conservation Design Forum)

Def nition

- Naturalized detention basins are used to temporarily store runof f and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat bene f ts. Naturalized detention may also be used as a retro f t to achieve water quality benef ts.

Applicability

➢ Scale	☒	Watershed/County	☒	Town/Village	☒	Neighborhood	☐	Lot
➢ Applications	Retro ☒	f t	☒	New				
	☐	Preventive	☒	Remedial	☐	Ongoing/ Maintenance		
	☒	Roofs	☒	Streets	☒	Driveways		
	☒	Parking Lots	☒	Lawn	☒	Sensitive Areas		
➢ Effectiveness	☒	Runoff Rate Control	☐	Runoff Volume Control	☒	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control		

Benef ts

- Reduces runoff rates.
- Recognized by virtually all stormwater agencies as approved method of controlling stormwater runoff.
- Very effective at removing sediment and associated pollutants.
- Provides attractive site amenity when properly designed and not used as sole BMP on sites with high pollutant/nutrient runoff.

Design Considerations

- Should be sized to control release to allowable rate.
- Size should ref ect use of upstream BMPs.
- Water level f uctuations should be limited to 3-4 feet (during 100-year storm) to maximize plant diversity.
- Shallow water entry angles will minimize shoreline erosion, improve water quality bene f ts, increase aquatic habitat and plant diversity and provide safety ledge.
- May be used as retro f t along stream corridors to prevent direct discharge of stormwater runoff.

© Conservation Design Forum

a well designed naturalized wet detention pond provides open space and passive recreation opportunities

Porous Pavement

Def nition

- Permeable or perforated paving materials or pavers with spaces that allow transmission of water to aggregate base and subsoils. Runoff is temporarily stored in the base for in f ltration into the subsoils and/or slow release to storm drain system.

© Conservation Design Forum

porous pavement driveway

Applicability

Scale	☐	Watershed/County	☐	Town/Village	☒	Neighborhood	☒	Lot
Applications	☒	Retro f t	☒	New				
	☒	Preventive	☒	Remedial	☐	Ongoing/ Maintenance		
	☐	Roofs	☒	Streets	☒	Driveways		
	☒	Parking Lots	☐	Lawn	☐	Sensitive Areas		
Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control		

Benef ts

- Reduces runoff volumes and rates.
- Recharges groundwater and sustains base f ow.
- Filters sediments and associated pollutants from runoff.
- Can reduce detention needs.

© Conservation Design Forum

porous pavement allows in f ltration through the paving material

Design Considerations

- Base and subbase materials should be coarse aggregate with no f nes to allow adequate drainage and to prevent frost heave.
- Subgrade should be graded at minimum 1% slope to allow drainage when water entry rate exceeds in f ltration capacity of subsoils.
- Subsoils should be compacted to the minimum level necessary to achieve structural stability.
- Geotextiles should be used between base and subgrade to improve structural stability and separate base from subgrade.
- Underdrains should be placed at edge of pavement to provide drainage as necessary to prevent ponding in the base for periods greater than 24 hours.

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porous pavement in parking lot

Rain Barrel/ Cistern

Def nition

- A vessel used to capture and temporarily store rainwater for various uses, including graywater reuse and irrigation.

© Conservation Design Forum

rain barrels in back yard (Conservation Design Forum)

Applicability

➢ Scale	☐	Watershed/County	☐	Town/Village	☐	Neighborhood	☒	Lot	
➢ Applications	Retro ☒	f t	☒	New					
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance			
	☒	Roofs	☐	Streets	☐	Driveways			
	☐	Parking Lots	☐	Lawn	☐	Sensitive Areas			
➢ Effectiveness	☐	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☐	Sediment Pollution Control	
	☐	Nutrient Control	☐	BOD Control	☐	Other Pollutant Control			

Benef ts

- Reduces runoff volumes.
- Conserves water for reuse.
- Provides irrigation water during watering restrictions.

Design Considerations

- At the residential scales, rain barrels located at downspouts will typically be used.
- One inch of rainfall over 1,000 square feet of roof area is equivalent to 625 gallons of rainwater.
- Rain barrels can be used in combination with rainwater gardens, green roofs, and other stormwater BMPs to increase stormwater benef ts.
- Larger cisterns in some settings may be used to provide graywater for use in toilet f ushing and other non-potable uses.

© Conservation Design Forum

a cistern system collects rainwater from Kresge Foundation Headquarters (Toy, MI)
(Photo: Conservation Design Forum)

Rainwater Garden

Def nition

- A landscaped garden designed to retain and detain stormwater runoff from individual lots and roofs.

© Conservation Design Forum

rainwater garden planted with vegetation that attracts butterf ies

Applicability

➢ Scale	☐	Watershed/County	☐	Town/Village	☒	Neighborhood	☒	Lot
➢ Applications	Retro ☒	f t	☒	New				
	☒	Preventive	☒	Remedial	☐	Ongoing/ Maintenance		
	☐	Roofs	☒	Streets	☒	Driveways		
	☒	Parking Lots	☐	Lawn	☐	Sensitive Areas		
➢ Effectiveness	☒	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☒	Sediment Pollution Control
	☒	Nutrient Control	☒	BOD Control	☒	Other Pollutant Control		

Benef ts

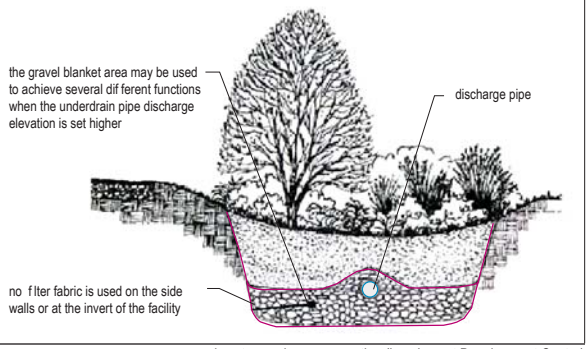
- Reduces runof f volumes and rates from lawns, roofs, and driveways.
- Recharges groundwater and sustains base f ows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.
- Can increase aesthetic value for the properties.
- Can provide wildlife habitat.

© Conservation Design Forum

roof downspout connects to rainwater garden (Glen Ellyn, IL)

Design Considerations

- Rainwater gardens must be sized and designed based on drainage area, soils, and desired runoff volume reduction.
- Filtration and nutrient control benef ts can be improved by planting native vegetation.
- The soils in the top 18" to 24" should be amended with leaf compost and coarse sand to enhance organic content and improve permeability.
- Where subsoil inf ltration rates are low (less than 0.5 to 1.0 in/hr), a gravel trench with underdrains should be used to encourage drainage between events.
- Maximum ponding depths should generally be limited to 6" to 12" unless underdrains are used.



rainwater garden cross section (Low Impact Development Center)

Vegetated Swales

© Conservation Design Forum

vegetated swales planted with native grasses and forbs along the street

Def nition

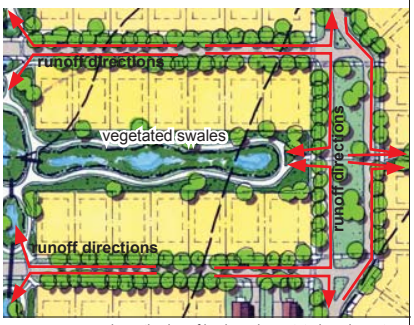
- Vegetated swales are planted stormwater features that convey , retain, inf ltrate, and cleanse stormwater.

Applicability

➢ Scale	☐	Watershed/County	☐	Town/Village	☐	Neighborhood	☒	Lot	
➢ Applications	Retro ☒	f t	☒	New					
	☒	Preventive	☐	Remedial	☐	Ongoing/ Maintenance			
	☒	Roofs	☐	Streets	☐	Driveways			
	☐	Parking Lots	☐	Lawn	☐	Sensitive Areas			
➢ Effectiveness	☐	Runoff Rate Control	☒	Runoff Volume Control	☐	Physical Habitat Preservation/ Creation	☐	Sediment Pollution Control	
	☐	Nutrient Control	☐	BOD Control	☐	Other Pollutant Control			

Benef ts

- Reduces runoff volumes and rates.
- Provides conveyance and water quality benef ts in one stormwater feature.
- Reduces sediment and nutrient runoff.
- With proper design, can reduce detention needs.



© Conservation Design Forum

schematic plan of back yard vegetated swale system (Conservation Design Forum)

Design Considerations

- Vegetated swales must be sized to convey design runof f rate (typically 10-year storm).
- Filtration bene f ts can be substantially improved by planting native deep-rooted grasses and forbs and by minimizing the slope.
- Topsoil may be amended with compost and/or coarse sand to improve organic content for f ltering and to improve in f ltration and retention of runoff.
- Vegetated swales should be protected from construction site runoff to prevent sealing of topsoil and/or subsoils.

© Conservation Design Forum

urban bioswale

Native Landscaping

Def nition

- Establishment of native vegetation in either large restoration projects or smaller gardening projects. Native landscaping is often a component of other BMPs such as detention, f lter strips, bioswales, and rainwater gardens.

© Conservation Design Forum

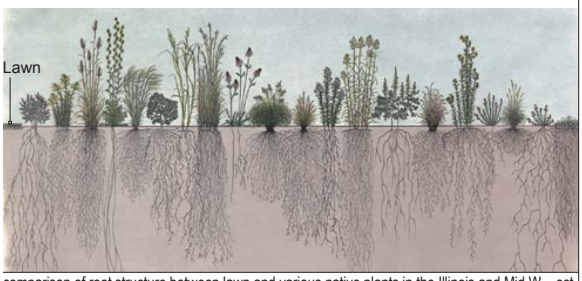
prairie planted in residential development area (Mill Creek, IL)

Applicability

Scale	☐ Watershed/County	☐ Town/Village	☒ Neighborhood	☒ Lot	
Applications	☒ Retro f t	☒ New			
	☒ Preventive	☒ Remedial	☐ Ongoing/ Maintenance		
	☒ Roofs	☒ Streets	☒ Driveways		
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas		
Effectiveness	☐ Runoff Rate Control	☒ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control	
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control		

Benef ts

- Reduces runoff volumes.
- Increases inf ltration rates.
- Increases ability to remove nutrients.
- Increases organic content of soils.
- Increases permeability of compacted soils.
- Reduces irrigation and fertilization requirements.
- Reduces use of fossil fuels and air pollution relative to turf landscapes that require regular mowing and maintenance.
- Provides wildlife habitat.



© Conservation Research Institute

comparison of root structure between lawn and various native plants in the Illinois and Mid W est Region (Conservation Research Institute)

Design Considerations

- Some local “weed” ordinances may need to be amended to allow native and taller vegetation.
- Plant diversity and health is maximized by annual burning. Plots may be mowed and then burned to prevent spread of f re on small sites. Fall burning will select for prairie wildf owers.
- On compacted soils, amendment may be necessary to increase organic content, improving success of establishment.

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Tellabs Bolingbrook (Bolingbrook, IL)