

Urban Green Practices

Indiana Watershed Webinar Series
January 25, 2012



Agenda

1. Low Impact Development (LID) & Green Infrastructure (GI) defined
2. Benefits of LID/GI
3. Common Drivers
4. How does it Work?
5. Examples
6. Tools & Resources Available

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1. **LID/GI Defined**
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Low Impact Development is...

- ▶ The management of stormwater runoff at the site through the use of conservation, planning or engineered methods that mimic natural systems to reduce drainage problems and treat polluted runoff.



Conventional Approach



LID Approach

Major Components of LID

1. Conservation Design

- Preserve open space
- Preserving vegetated buffers along stream

2. Better Site Design

- Minimize impact of development
- Changes codes/rules

3. Green Infrastructure

- Mitigate the impact of development using onsite practices

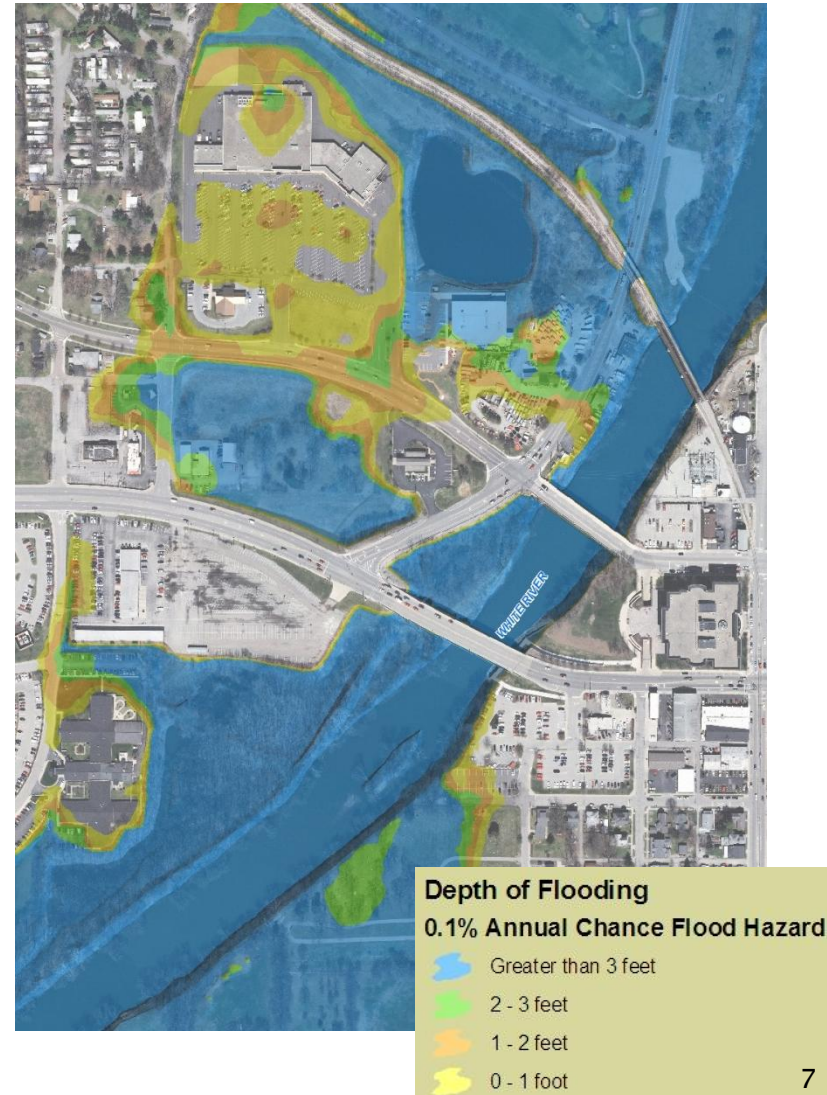
Green Infrastructure is...

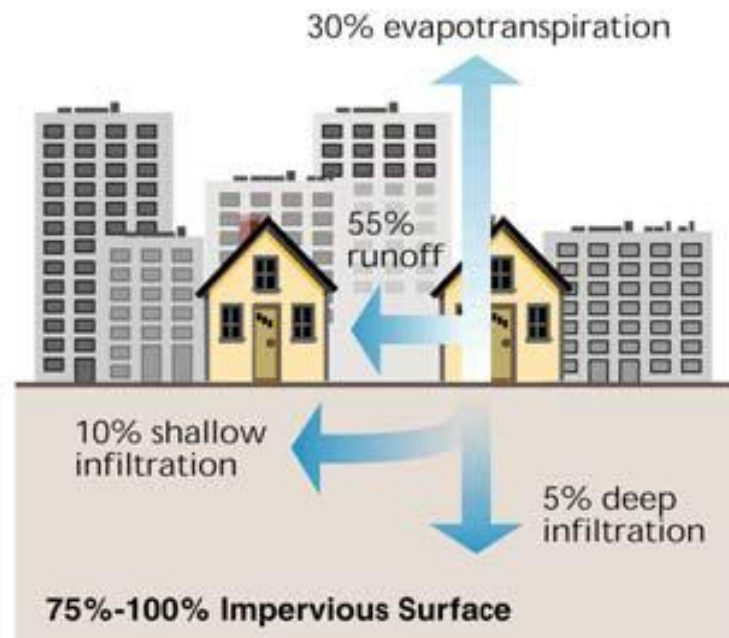
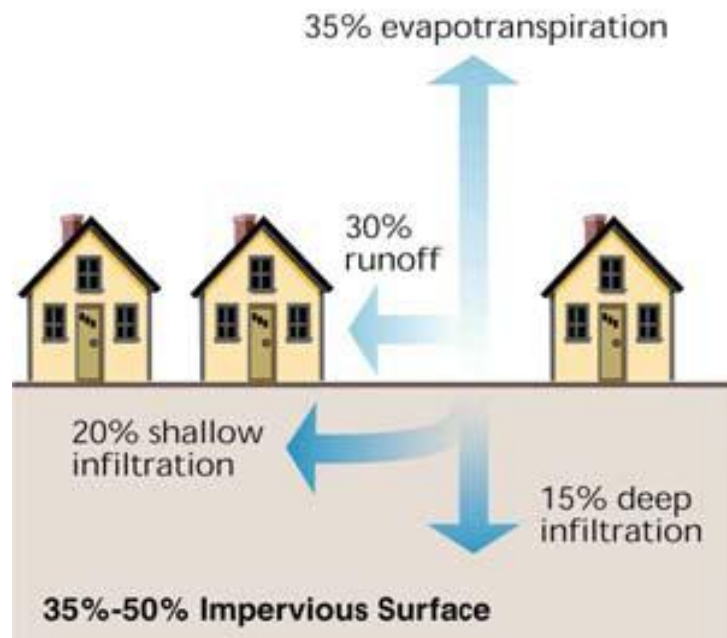
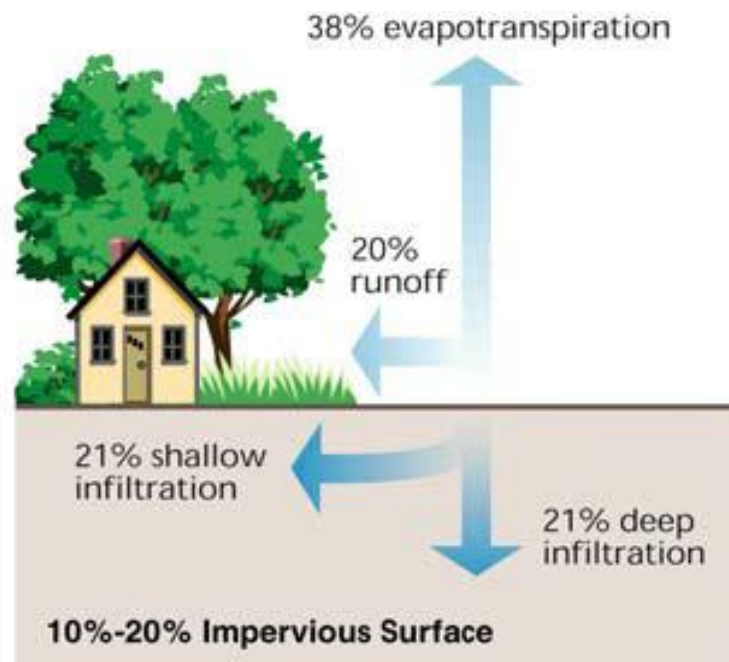
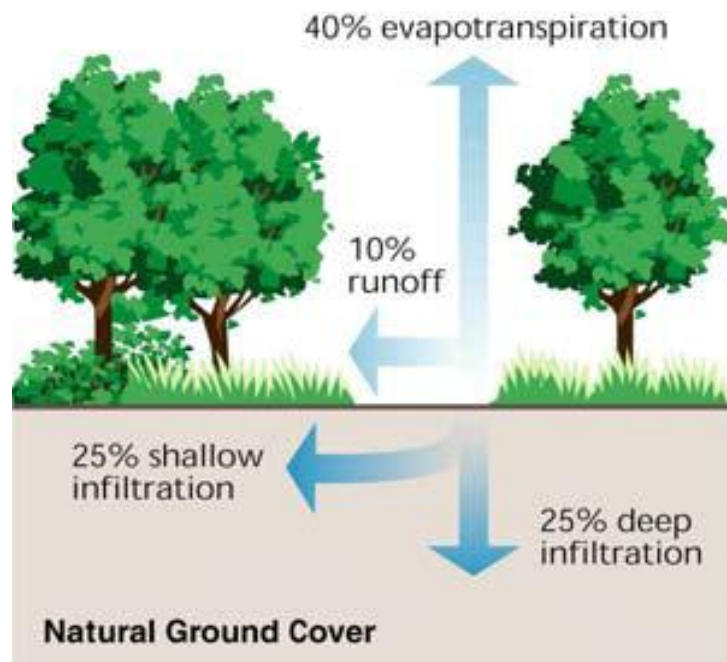
- ▶ Engineered systems that mimic natural processes and characteristics of soil and vegetation to enhance water quality and reduce runoff.

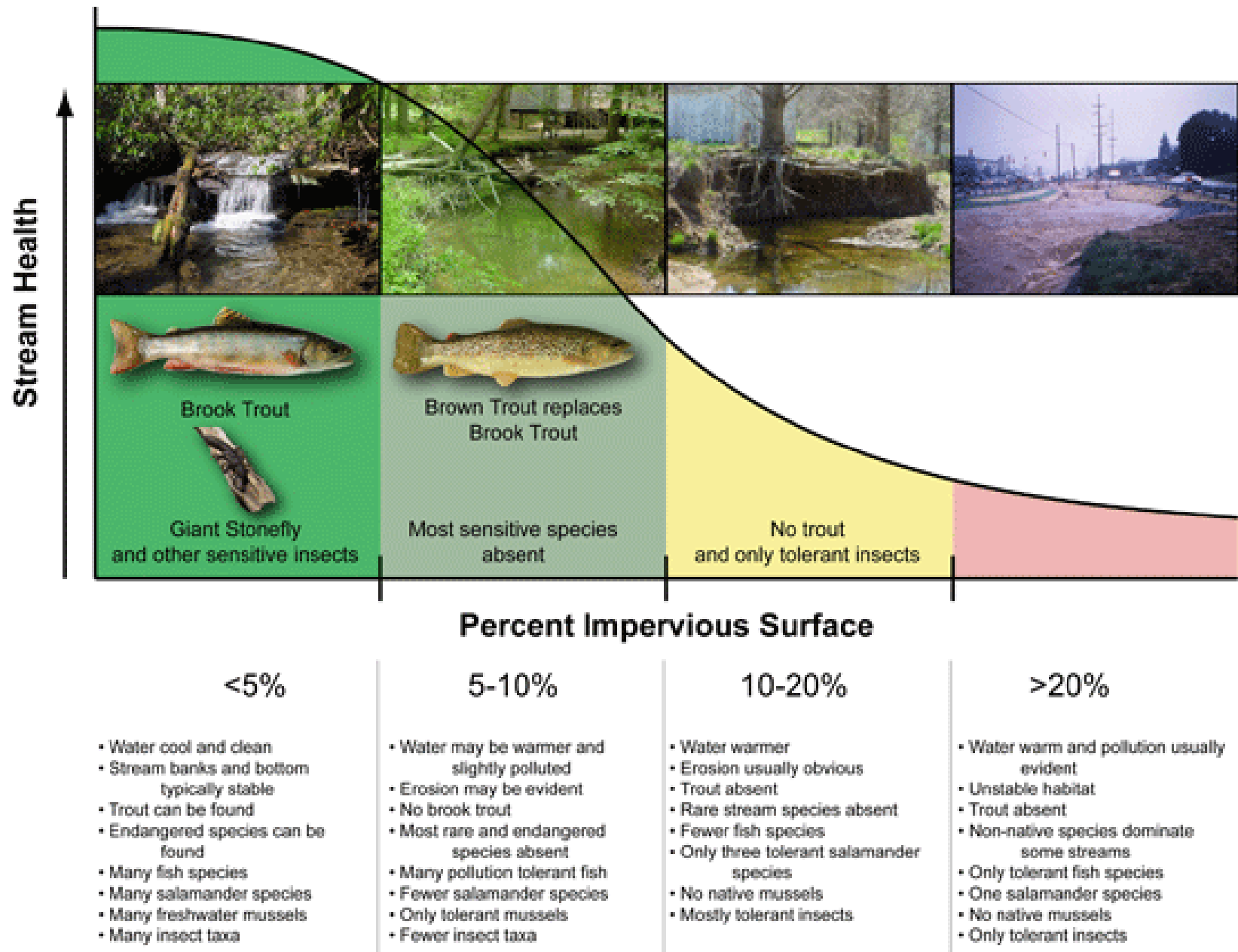


Green Infrastructure is...

- ▶ **NOT** meant to replace flood control structures
- ▶ **NOT** meant to provide storage for more than 1 to 2 inches of runoff







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Benefits of LID/GI

- ▶ People (Social)
 - Human Health
 - Sense of Place
- ▶ Planet (Environment)
 - Water Quality & Quantity
 - Air Quality
 - Habitat
- ▶ Profit (Economic)
 - Capital & Life Cycle Costs
 - Property Value



Benefits of GI Practices

| Benefit | Reduces Stormwater Runoff | | | | Increases Available Water Supply | Increases Groundwater Recharge | Reduces Salt Use | Reduces Energy Use | Improves Air Quality | Reduces Atmospheric CO ₂ | Reduces Urban Heat Island | Improves Community Livability | | | | | Improves Habitat | Cultivates Public Education Opportunities |
|-----------------------------|---|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|---|---|
| | Reduces Water Treatment Needs | Improves Water Quality | Reduces Grey Infrastructure Needs | Reduces Flooding | | | | | | | | Improves Aesthetics | Increases Recreational Opportunity | Reduces Noise Pollution | Improves Community Cohesion | Urban Agriculture | | |
| Practice |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Green Roofs | ● | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● | ○ | ● | ○ | ○ | ● | ● |
| Tree Planting | ● | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● | ● | ● | ● | ○ | ● | ● |
| Bioretention & Infiltration | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ● | ● |
| Permeable Pavement | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ● | ● | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● |
| Water Harvesting | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |



Yes



Maybe



No

Triple Bottom Line

- ▶ An expanded baseline for measuring performance, adding social and environmental dimensions to the traditional monetary benchmark

1. Cost Metric

- Capital Cost (CSO, TSS reduction)
- Lifecycle Cost
- Funding Opportunities/Shared Resources

Triple Bottom Line

2. Social Metric

- Revitalization/Streetscape Improvements
- Reduction in Flooding (basement, street)
- Job Creation on Capital Projects
- Open Space/Recreational Areas
- Public Health

3. Environmental Metric

- Streambank Erosion
- Flood Protection
- Water Quality
- Biological Diversity/Connectivity/Habitat

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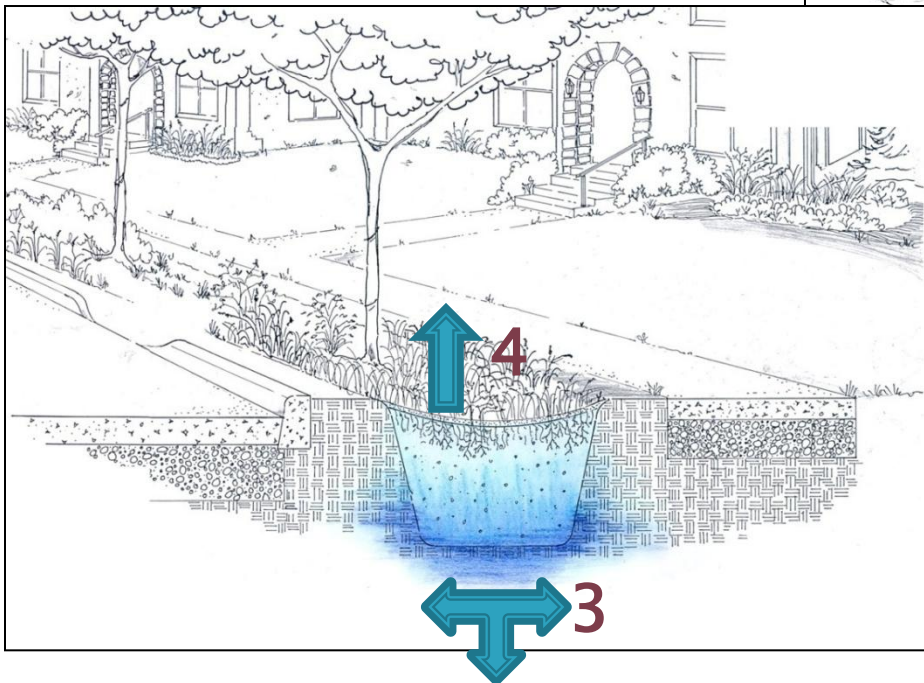
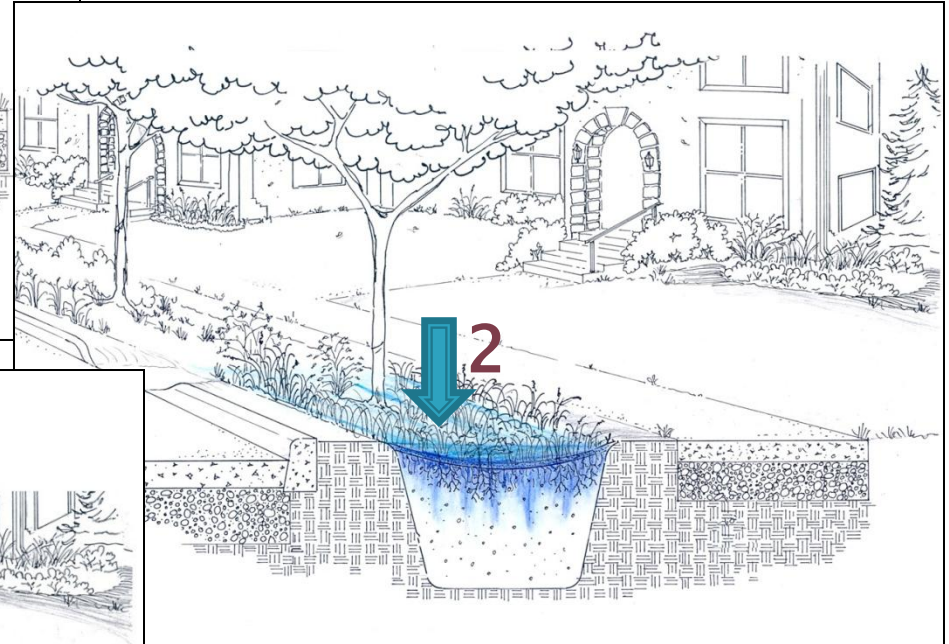
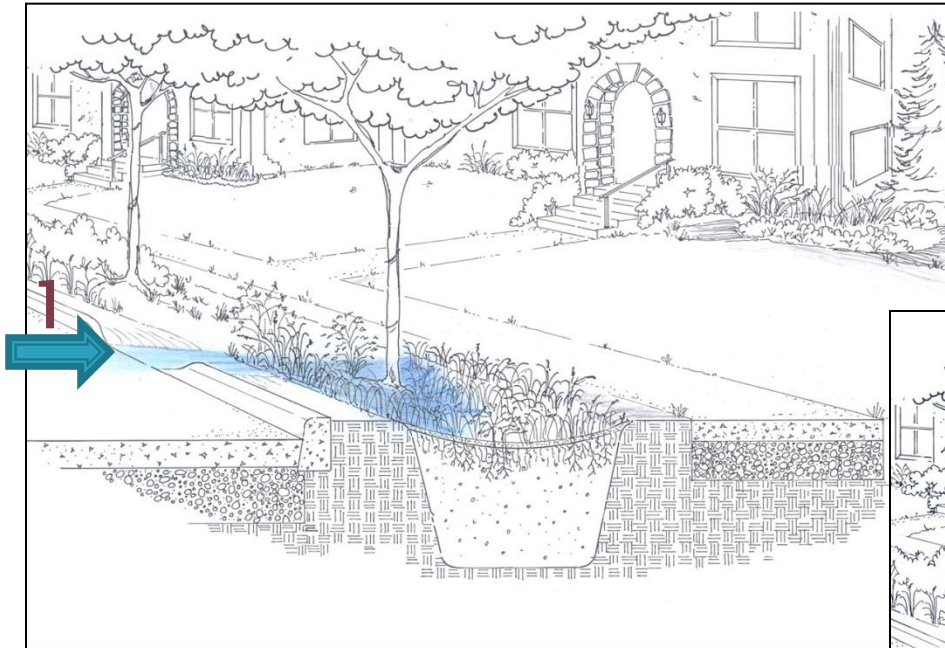
Common Drivers

- ▶ Regulatory Requirements – able to meet MS4 water quality treatment requirements
- ▶ Infrastructure – able to reduce size, operation and maintenance of grey infrastructure
- ▶ **Drainage Problems** – able to reduce peak flow volume and velocity, frequency and severity of nuisance flooding
- ▶ Quality of Life – able to provide social, economic, and environmental benefits

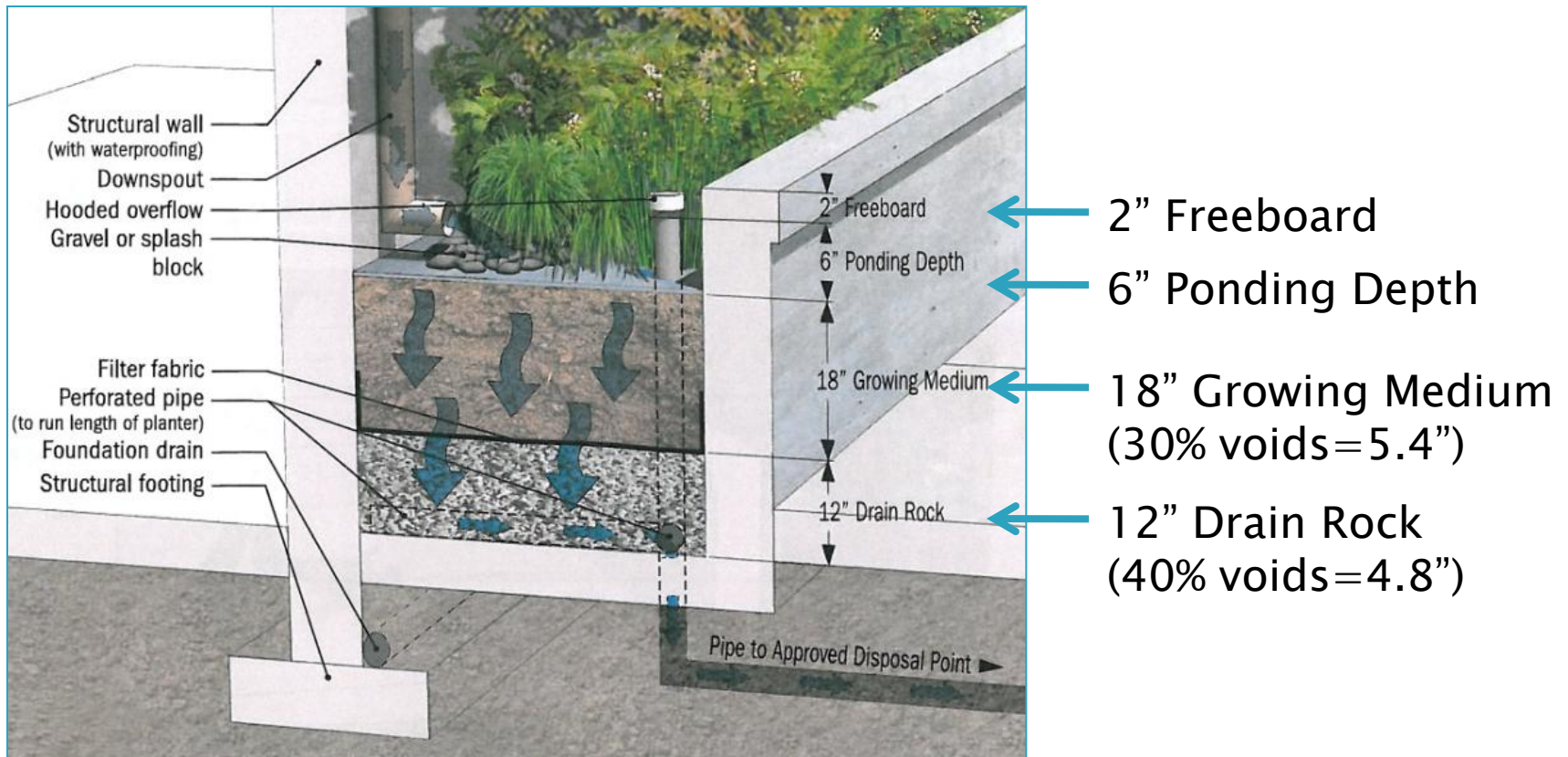
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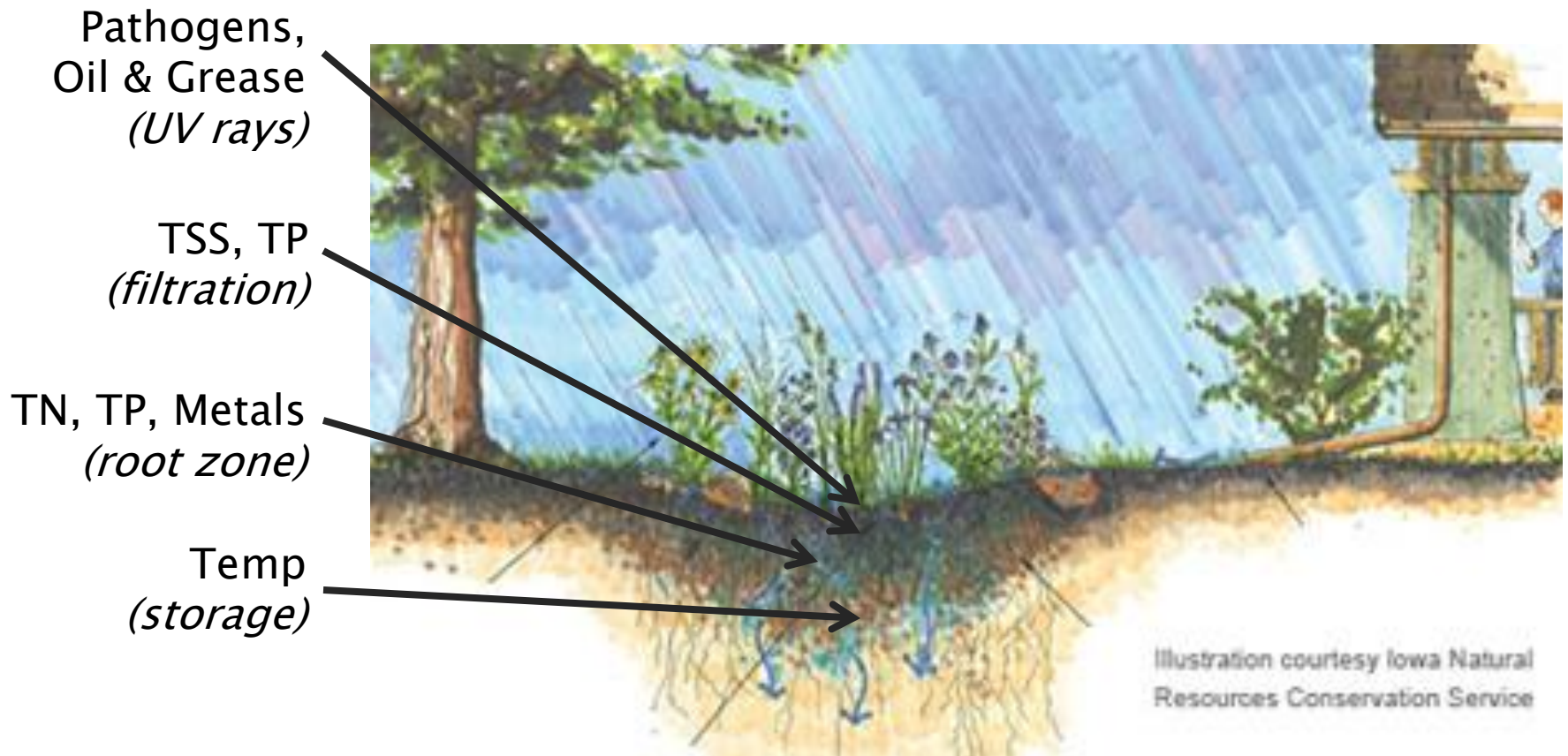
How does it work?



Storage Potential



Pollutant Removal



Storage & Pollutant Removal

| Practice | Storage | Pollutant Removal |
|--|--|-----------------------------------|
| Bioinfiltration/ Bioretention/ Rain Garden | 6" on surface and 12" washed stone (40% voids) | TP = 55% TN = 64% TSS = 70% |
| Rainwater Harvesting | 1" rainfall | TP = 75% TN = 75% TSS = 75% |
| Green Roof/ Blue Roof | 1.5" | TP = 45% TN = 40% TSS = 70% |
| Permeable Pavement | 24" washed stone (40% voids) | TP = 59% TN = 59% TSS = 80% |
| Tree Boxes | 6" on surface and 12" washed stone (40% voids) | TP = 55% TN = 64% TSS = 70% |

Need for Maintenance

- ▶ Critical to performance of GI practices
- ▶ No longer does “mow, blow and go” or “spray and pray” approach work
- ▶ Basic elements O&M:
 - Requirements to inspect and maintain practices
 - Easements or covenants for maintenance
 - Identify party responsible for maintenance
 - Authority to inspect
- ▶ Requires trained staff and good resource materials

Factors Affecting Performance

| | Sediment Buildup | Litter & Debris | Pipe Clogging | Invasive Vegetation |
|------------------------------|------------------|-----------------|---------------|---------------------|
| Surface Sand or Soil Filter | 50% | 30% | 10% | 0% |
| Infiltration Basin or Trench | 36% | 21% | 10% | 5% |
| Wet Pond | 26% | 19% | 21% | 10% |
| Underground Sediment Device | 58% | 21% | 11% | 0% |
| Rain Garden | 33% | 22% | 7% | 26% |
| Filter Strips or Swales | 21% | 26% | 5% | 26% |

Maintenance Considerations

- ▶ Design with maintenance in mind
- ▶ Be aware of material substitutions, compaction, and siltation during construction
- ▶ Inspect and track progress
- ▶ Focus on prevention maintenance efforts

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The Nature Conservancy – Indianapolis



Green Alleys Program – Chicago



Connect planters for greater capacity and/or to convey overflows to receiving drainage system

Locate planters at end of parking aisles
Overflow inlet
Curb cuts

LIDA swales
Porous paving drains to planters or LIDA swales
Porous pavement

LIDA Handbook – Tualatin Basin, OR



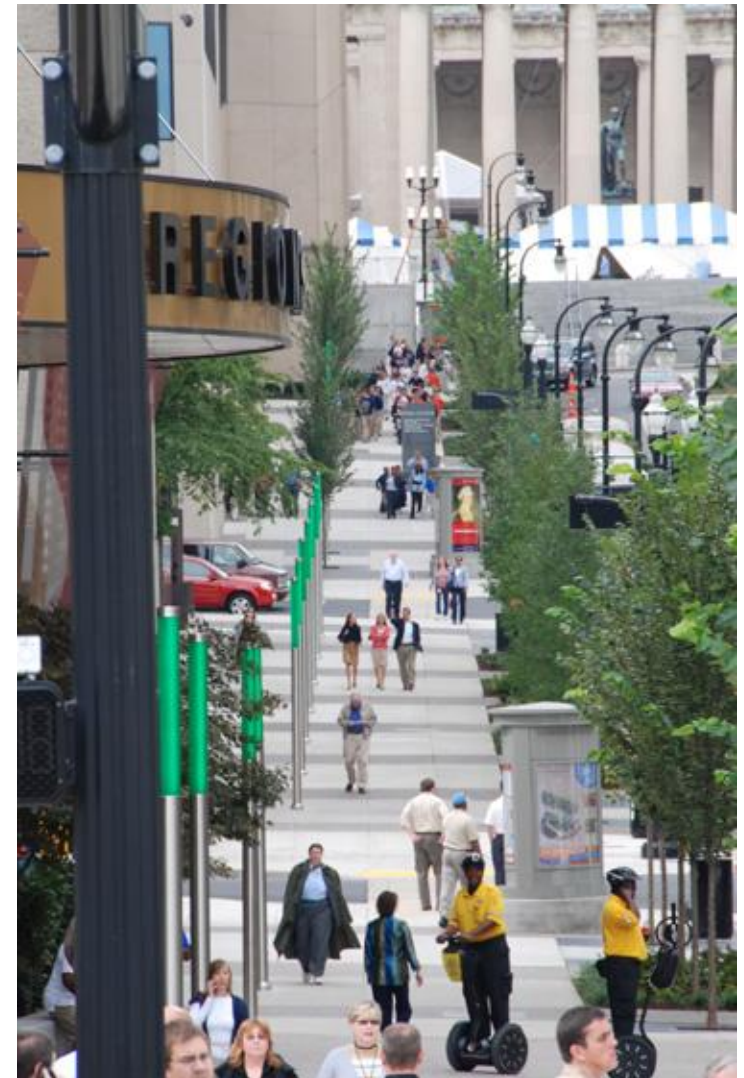
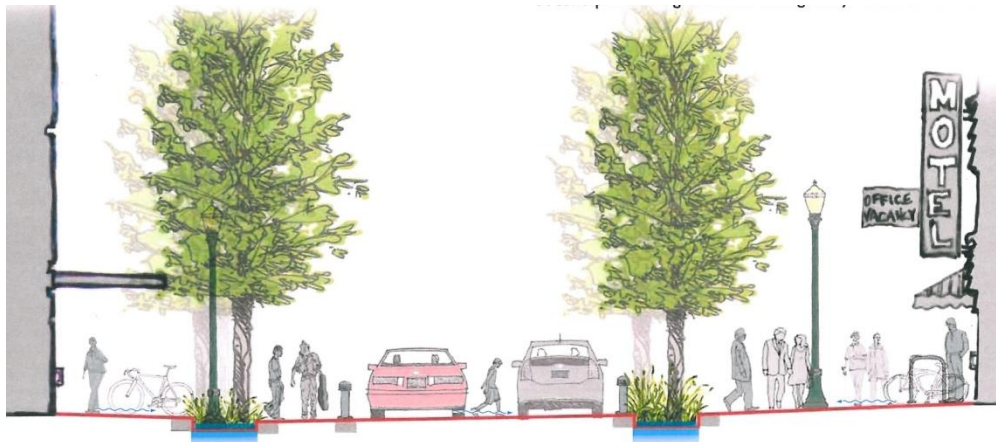
Cultural Trail – Indianapolis



Green Streets – Vancouver, BC



McCormick Street – Portland, OR



Deaderick Street – Nashville, TN









Clarian Cancer
Center
– Indianapolis

Indianapolis Museum of Art
– Indianapolis



City Hall – Chicago



3 Mass Ave –
Indianapolis



Contech Urban Green – Examples of LID Application

Nickel &
Nickel's Winery –
Napa Valley,
CA



Fire Station –
Denton, TX



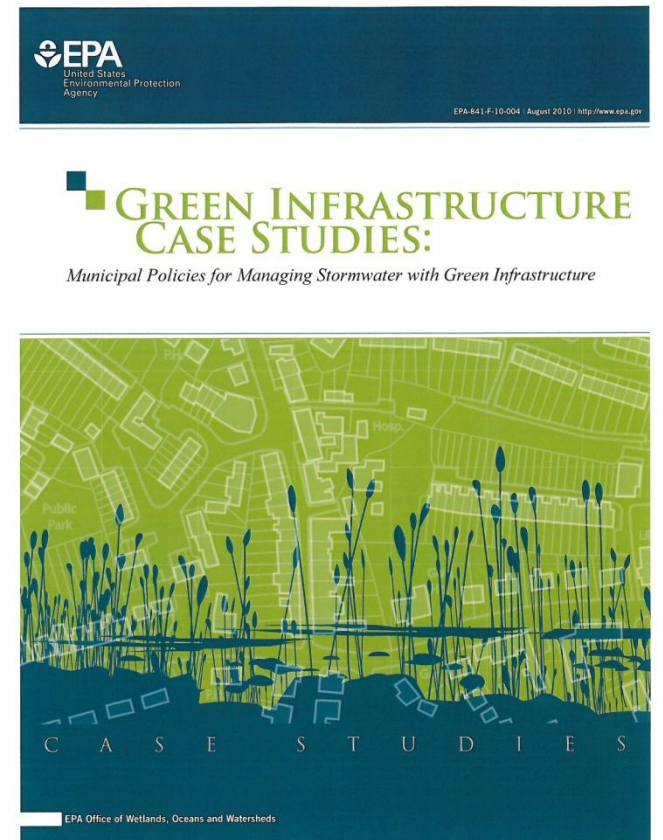
Keep Indianapolis
Beautiful –
Indianapolis

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Policies for Implementation

- ▶ First Step:
 - Stormwater Regulation
 - Development Codes
- ▶ Second Step:
 - Demonstration Projects
 - Education & Outreach
 - Incentives
- ▶ Third Step:
 - Capital Projects

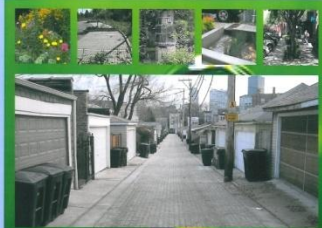


[www.epa.gov/owow/NPS/
lid/gi_case_studies_2010](http://www.epa.gov/owow/NPS/lid/gi_case_studies_2010)

Policies for Implementation

- ▶ EPA Municipal Handbook Series: Managing Wet Weather with Green Infrastructure

*www.cfpub.epa.gov/npdes/greeninfrastructure
munichandbook.cfm*



MANAGING WET WEATHER WITH
GREEN INFRASTRUCTURE

MUNICIPAL HANDBOOK
GREEN STREETS

Green
Streets



MANAGING WET WEATHER WITH
GREEN INFRASTRUCTURE

MUNICIPAL HANDBOOK
GREEN INFRASTRUCTURE
RETROFIT POLICIES

Retrofit
Policies



MANAGING WET WEATHER WITH
GREEN INFRASTRUCTURE

MUNICIPAL HANDBOOK
RAINWATER HARVESTING POLICIES

Rainwater
Harvesting
Policies



MANAGING WET WEATHER WITH
GREEN INFRASTRUCTURE

MUNICIPAL HANDBOOK
INCENTIVE MECHANISMS

Incentive
Mechanisms



MANAGING WET WEATHER WITH
GREEN INFRASTRUCTURE

MUNICIPAL HANDBOOK
FUNDING OPTIONS

Funding
Options

Tools & Resources



Types, Applications, &
Design Approaches

Case Studies

News

Green Infrastructure
Partnership

Regulatory Integration

Research

Models & Calculators

Municipal Handbook

Funding Opportunities

Links

Training & Conferences

Contacts

Green Infrastructure
Home

Integrated Municipal
Plans

U.S. ENVIRONMENTAL PROTECTION AGENCY

Managing Wet Weather with Green Infrastructure

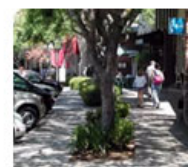
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Green Infrastructure



Managing Wet Weather with Green Infrastructure

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies. See [examples of green infrastructure and design approaches](#).

At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green stormwater infrastructure. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

On a smaller scale, green infrastructure practices include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

- [Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure \(PDF\)](#) (76 pp, 8.23MB)
- [Green Infrastructure in Arid and Semi-Arid Climates \(PDF\)](#) (9 pp, 1.3MB)
- [Green Jobs Training: A Catalog of Training Opportunities for Green Infrastructure Technologies \(PDF\)](#) (52 pp, 536K) - September 2010 edition

Updating Local Codes to Cultivate Green Infrastructure and Foster Sustainable Stormwater Management:

This 2 hour webcast was presented by EPA Region 5 on December 13, 2011. The webcast describes the interaction of zoning and building codes with water quality; presents several examples of code audits conducted in Illinois, Ohio, and Minnesota; and highlights the top ten obstacles to green



Hot Topics

[Green Jobs
Training Catalog
\(PDF\)](#)

[Green
Infrastructure
Training](#)

New Bulletins



The documents on this site
are best viewed
with Acrobat 8.0

http://cfpub.epa.gov/npdes/home.cfm?program_id=298

Best Management Practice Selection Tool

The BMP Selection Tool is intended to help educate site designers and developers about some of the important factors associated with the selection of post-construction stormwater BMPs for a given site. Volume control, groundwater protection, and pollution reduction are growing concerns in Central Indiana. Each of these, as well as other factors make some BMPs more applicable to certain sites and more successful tools for water quality protection.











Assumptions & Details Behind this Tool

To better understand the role of the various factors shown below as icons, click the 'Details' box. Information will appear to help you understand whether it is something you need/want to consider. If that factor is important to your goals, simply click the small box below to select it. A given BMPs ability to address that particular factor will be reflected by its presence/absence in the BMP remaining in the list on the right. Continue checking the boxes of other factors that represent your site conditions or objectives and watch the list narrow further. When you want to know more about a BMP that appears in the list, click on it. Fact sheet style information will appear for that BMP including some O&M guidance for that BMP. If you select a combination of factors that leads you to a very narrow list of BMPs or none at all, simply reconsider your selected factors and prioritize those that are most pressing. Try some different combinations – Enjoy and please be thoughtful about what you are designing!

PLEASE USE INTERNET EXPLORER WHEN USING THIS PROGRAM....

MAKE SELECTIONS

BMPs

| | | | | |
|---|--|--|--|--|
|  COST OF LAND DETAILS <input type="checkbox"/> |  SOILS INFILTRATION DETAILS <input type="checkbox"/> |  SLOPE DETAILS <input type="checkbox"/> |  GROUNDWATER DEPTH DETAILS <input type="checkbox"/> |  CONSTRUCTION COST DETAILS <input type="checkbox"/> |
|  MAIN COST DETAILS <input type="checkbox"/> |  WITHIN 10FT OF A BUILDING DETAILS <input type="checkbox"/> |  STORMWATER VOLUME REDUCED DETAILS <input type="checkbox"/> |  STORMWATER STORAGE DETAILS <input type="checkbox"/> |  REDUCES TIME OF CONCENT DETAILS <input type="checkbox"/> |

BMP Choices

- [Bioretention](#)
- [Bioretention with Underdrain](#)
- [Rain Gardens](#)
- [Rain Gardens with Underdrain](#)
- [Infiltration Basin](#)
- [Infiltration Basin with Underdrain](#)
- [Trench](#)
- [Trench with Underdrain](#)
- [Permeable Pavement](#)
- [Permeable Pavement with Underdrain](#)
- [Filter Strips](#)

<http://www.uwrwa.org/bmpTool/index.asp>

| | A | B | C | D | E | F | G |
|--|---|------------------------------|---|---------------------------------------|------------------------------------|-------------|----------------------|
| 1 | Residential Rain Garden | M | User entered 'MEDIUM' maintenance level in Sheet 1. | | | | |
| 2 | Site Name: | P | User entered 'Professional' installation type in Sheet 1. | | | | |
| 3 | Site Location: | S | User entered 'Single Home' installation type in Sheet 1. | | | | |
| 4 | Date: | A | User entered 'Option A' Capital Cost Option in Sheet 2. | | | | |
| 5 | Cost Summary | | | | | | |
| 6 | | | | | | | |
| 7 | CAPITAL COSTS | Total Cost | | | Included in WLC Calculation | | |
| 8 | | | | | Model | User | Chosen option |
| 9 | Base Cost of Garden (rounded up to nearest \$100) | | | \$ 3,210 | \$ 3,210 | | \$ 3,210 |
| 10 | Associated Capital Costs | | | \$ 572 | \$ 572 | | \$ 572 |
| 11 | Capital Costs | | | | \$ 3,782 | | \$ 3,782 |
| 12 | | | | | | | |
| 13 | REGULAR MAINTENANCE ACTIVITIES | months between events | Cost per Event | Total Cost per Year | Included in WLC Calculation | | |
| 14 | | | | | Model | User | Chosen option |
| 15 | | | | | | | |
| 16 | Vegetation Management | 12 | \$72 | \$72 | \$72 | | \$ 72.00 |
| 17 | add additional activities if necessary | 0 | \$0 | 0 | \$0 | | - |
| 18 | add additional activities if necessary | 0 | \$0 | 0 | \$0 | | - |
| 19 | Totals, Regular Maintenance Activities | | | | \$72 | | \$ 72.00 |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | CORRECTIVE AND INFREQUENT MAINTENANCE ACTIVITIES (Unplanned and/or >3yrs. betw. events) | Years between Events | Cost per Event | Total Cost per Year Equivalent | Included in WLC | | |
| 23 | | | | | Model | User | Chosen option |
| 24 | Replace mulch | 3 | \$336 | \$112 | \$112 | | \$ 112.00 |
| 25 | Till Soil | 5 | \$224 | \$45 | \$45 | | \$ 44.80 |
| 26 | add additional activities if necessary | 0 | \$0 | \$0 | \$0 | | - |
| 27 | Totals, Corrective & Infrequent Maintenance Activities | | | | \$157 | | \$ 156.80 |
| 28 | | | | | | | |
| 29 | | | | | | | |
| <div> 1.Design & Maintenance Options 2.Capital Costs 3.Maintenance Costs 4.Cost Summary 5.Whole Life Costs 6.Present Value </div> | | | | | | | |

<http://www.werf.org/AM/Template.cfm?Section=Stormwater3&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=10836>

The Value of Green Infrastructure

A Guide to Recognizing Its Economic,
Environmental and Social Benefits



© Center for Neighborhood Technology 2010



<http://www.americanrivers.org/assets/pdfs/reports-and-publications/the-value-of-green-infrastructure.pdf>

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Questions?

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