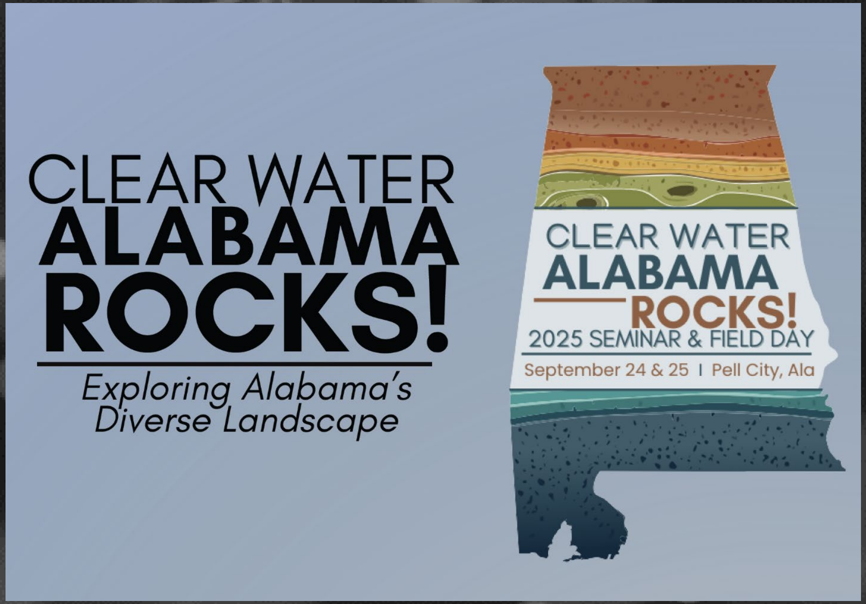
LOW IMPACT DEVELOPMENT
OR
GOOD DESIGN

FIVE GOOD NEIGHBOR POLICIES

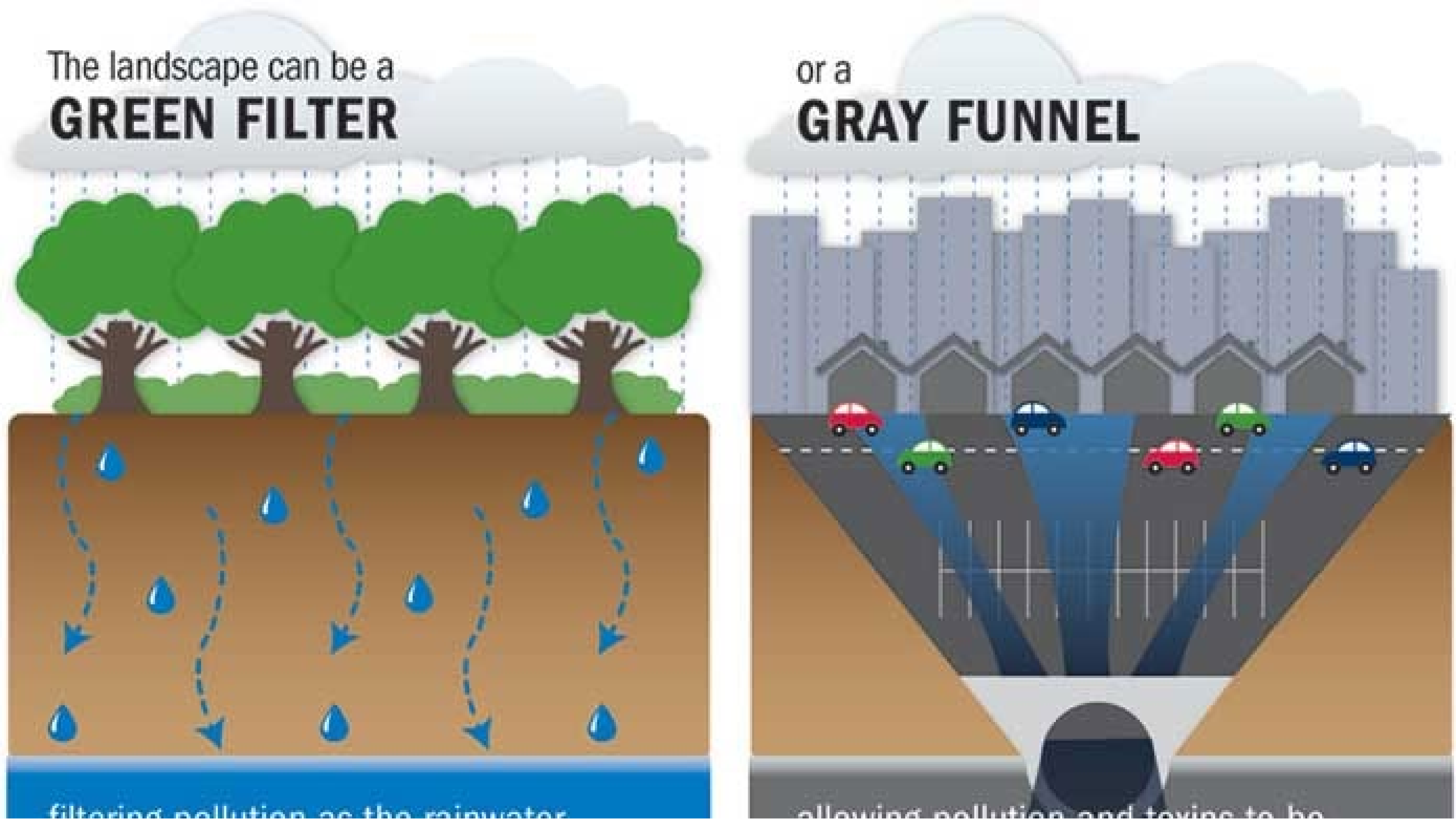
FIFTY-TWENTY ENGINEERING
50 20 ENGINEERING
RESOURCE GROUP INCORPORATED



DO YOU REMEMBER BEING A CHILD ON A STREAM?

- **Did you like playing in streams, creeks, rivers, lakes, mud puddles?**
- **What Amazed you about playing in streams?**
  - **Does this still amaze you?**
  - **Why or why not?**
- **What did you see along the banks of the streams and rivers - Riparian?**

More than 126/100 ml or 7 per 5 ml does not meet swimming water standards



The landscape can be a
GREEN FILTER
or a
GRAY FUNNEL

LOW IMPACT DEVELOPMENT – OTHER SIMILAR NAMES OF TECHNIQUES THAT ADDRESS COMMUNITY GROWTH ISSUES

- Green Infrastructure
- Sustainable Stormwater Management
- Better Site Design
- Conservation Design
- Smart Growth
- New Urbanism
- Light Imprint Design

GREEN INFRASTRUCTURE

In context of stormwater – an umbrella term

Engineered-as-natural ecosystems

- Such as green roofs, porous pavement, swales and raingardens
- Rely on soil and vegetation to infiltrate, evapotranspirate, and/or harvest stormwater and reduce flows

GREEN INFRASTRUCTURE

- **Outside of stormwater describes the creation and networking of natural ecosystems and greenway corridors**

SUSTAINABLE STORMWATER MANAGEMENT

- **Drainage solutions that minimize stormwater impacts from development and the need for ongoing or long-term maintenance**

BETTER SITE DESIGN

- **Approach to new residential and commercial development that focus on reducing pollutant loads, conserving natural areas, saving money and increasing property values.**
- **Reducing impervious cover, increased land conservation, stormwater integration on site**
- **Market Driven in many places!**

Table 2: Better Site Design Practice Evaluation

Category	Technique	Applies To SW Criteria[1]			Economics			Public Perception	Allowed by Local Codes[4]
		WQv	Cpv, Qp, Qf	How Applies To Criteria	Lowers Capital Costs[2]	Lowers O&M Costs[3]	Raises Property Value		
Preservation of Natural Features and Conservation Design	1. Preservation of Undisturbed Areas	◉	◉	Increases times of concentration, reduces CN[5]	●	●	◉	◉	◉
	2. Preservation of Buffers	◉	◉	Increases times of concentration, reduces CN	●	●	◉	◉	●
	3. Reduction of Clearing and Grading	◉	◉	Increases times of concentration, reduces CN	●	●	●	●	◉
	4. Locating Sites in Less Sensitive Areas	◉	◉	Increases times of concentration, reduces CN	●	●	◉	◉	◉
	5. Open-Space Design	◉	◉	Increases times of concentration, reduces CN	●	●	○	◉	◉
Reduction of Impervious Cover	6. Roadway Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	●	◉	○
	7. Sidewalk Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	◉	◉	○
	8. Driveway Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	◉	◉	◉
	9. Cul-de-sac Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	◉	◉	○
	10. Building-Footprint Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	◉	●	●
	11. Parking Reduction	●	●	Reduces impervious area, which reduces WQv & flows	●	●	◉	◉	◉
Use of Natural Features and Source Control for Stormwater Management	12. Vegetated Buffer/Filter Strips	◉	◉	Increases times of concentration, reduces CN	●	●	◉	●	◉
	13. Open Vegetated Channels	●	●	Stores WQv & Peak Flows	●	◉	◉	◉	●
	14. Bioretention	●	●	Stores WQv & Peak Flows	●	◉	◉	●	●
	15. Infiltration	●	●	Stores WQv & Peak Flows	●	◉	◉	●	●
	16. Rooftop Runoff Reduction Mitigation	●	●	Stores WQv & Peak Flows	●	●	◉	◉	●
	17. Stream Daylighting for Redevelopment Projects	○	○	Increases travel times, decreases peak flows	○	◉	●	●	●
	18. Tree Planting	◉	◉	Reduces volume of runoff, reduces CN	◉	◉	●	●	●

Key: ● = good/often ◉ = fair/sometimes ○ = poor/rarely

1 - WQv = Water Quality Volume, Cpv = Channel Protection, Qp = Overbank Flood, Qf = Extreme Flood

2 - "Lowers Capital Costs" is intended for general purposes. Capital costs may vary on a site-by-site basis.

3 - Operation and Maintenance

4 - "Allowed by Local Code" is intended for general purposes. User should consult with actual local planning codes.

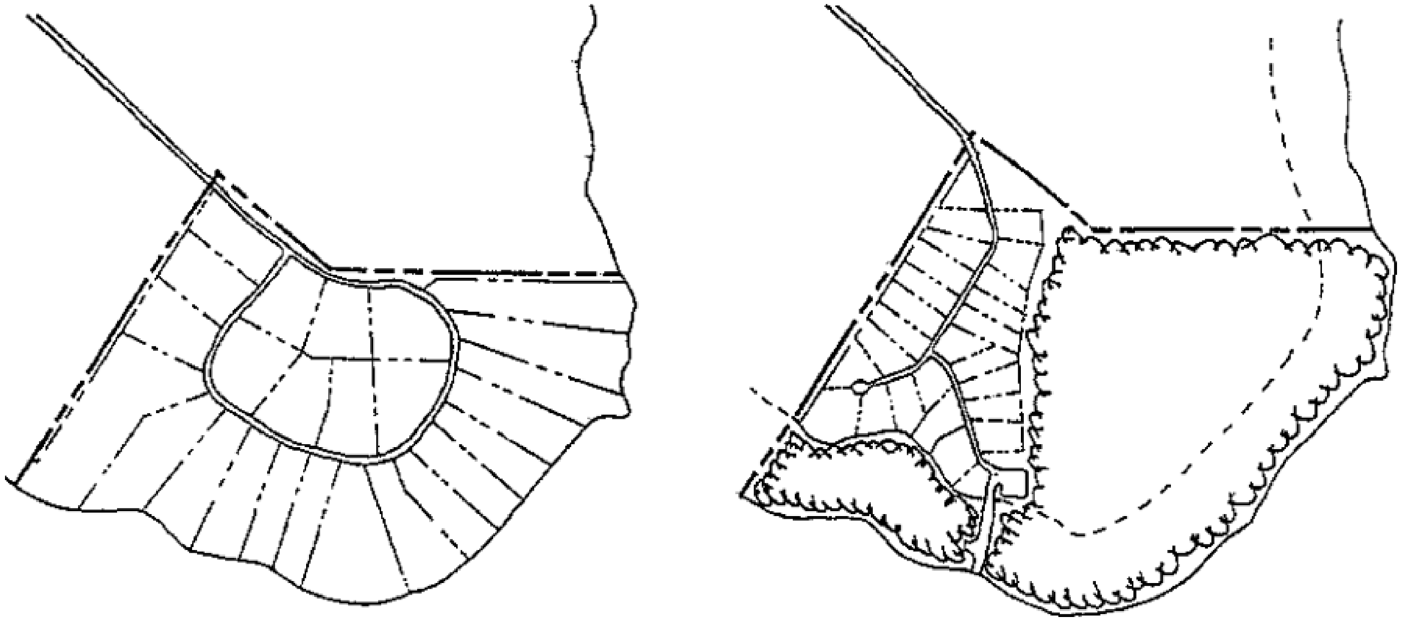
5 - CN = Runoff Coefficient "Curve Number"

(New York State Department of Environmental Conservation 2008)

CONSERVATION DESIGN

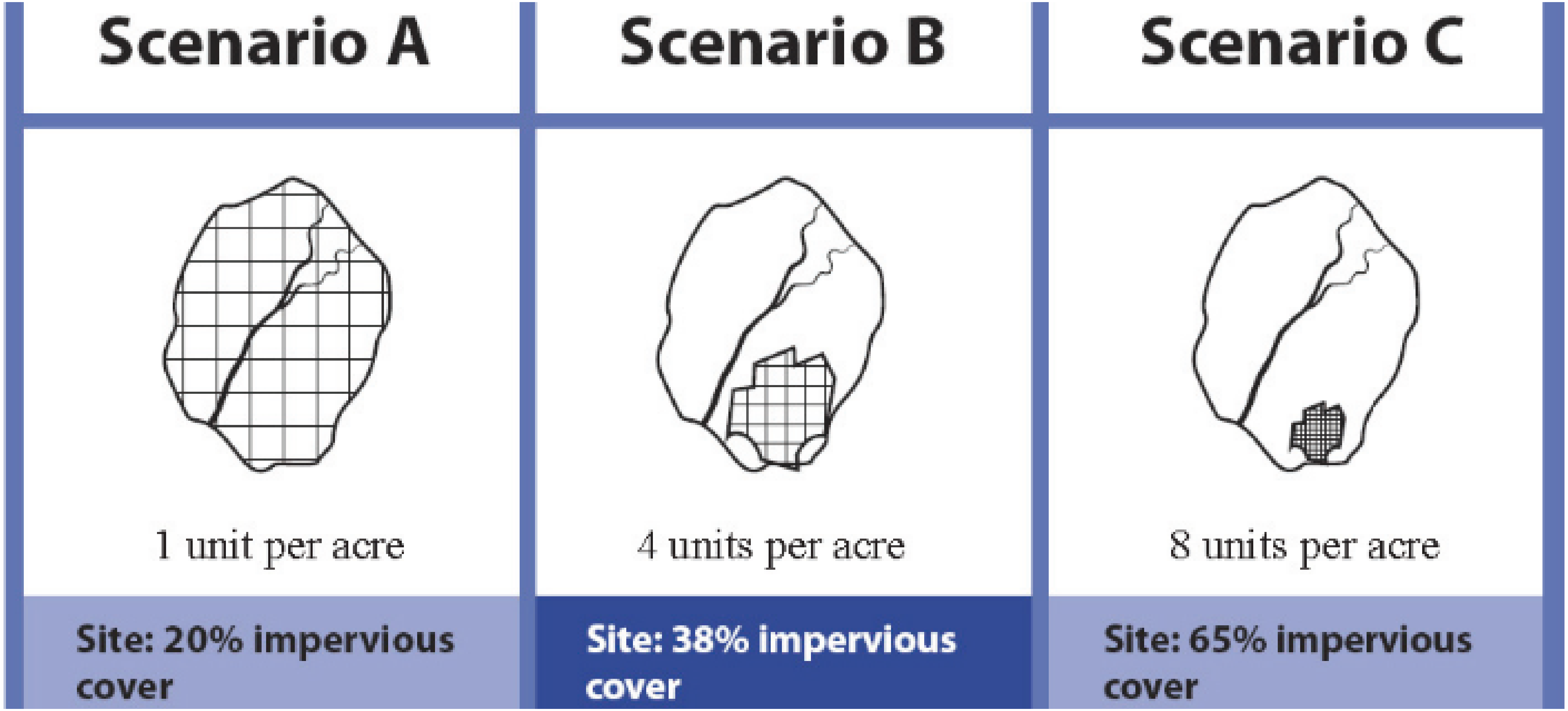
- Protect the natural environment of an area by controlling growth and applying land use with an eye toward sustainability

Conventional Development Versus Conservation Design Cluster



(A Joint Effort Between the Delaware Department of Natural Resources and Environmental Control and The Environmental Management Center of the Brandywine Conservancy 1997)

CONSERVATION DESIGN



(ARC, 2009)

SMART GROWTH

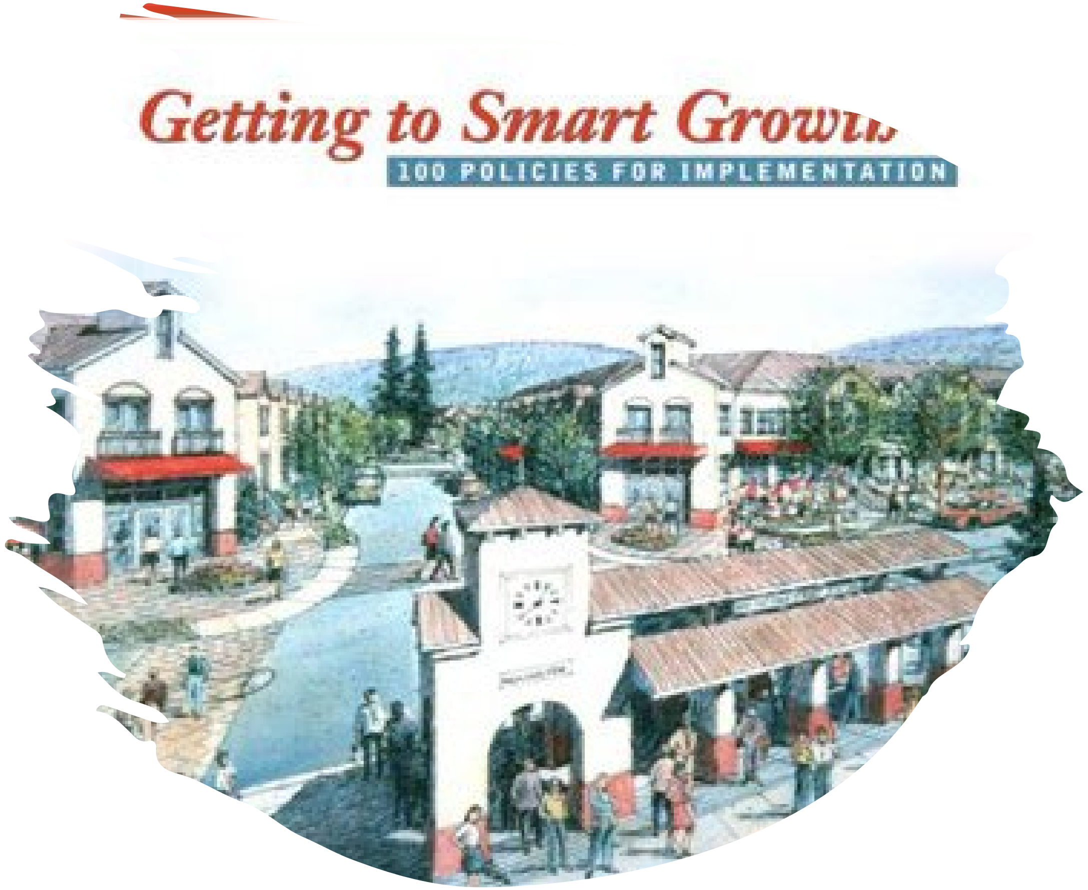
- **Range of development and conservation strategies intended to preserve and protect the natural environment while making communities more attractive, economically stronger , and more socially diverse.**

(Smart Growth Network n.d.)

SMART GROWTH KEY PRINCIPLES

- Mix land uses.
- Take advantage of compact building design.
- Create a range of housing opportunities and choices.
- Create walkable neighborhoods.
- Foster distinctive, attractive communities with a strong sense of place.
- Preserve open space, farmland, natural beauty, and critical environmental areas.
- Strengthen and direct development towards existing communities.
- Provide a variety of transportation choices.
- Make development decisions predictable, fair, and cost effective.
- Encourage community and stakeholder collaboration in development decisions.

[Getting to Smart Growth: 100 Policies for Implementation | US EPA]



(International City/County Management Association (ICMA) and the Smart Growth Network with EPA's support 2002)

NEW URBANISM

- Close to smart growth (sometimes interchangeable)
- Traditional neighborhood design (traditional street grids, strong sense of place and local identity, minimizes dependency on cars)

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- **Traditional neighborhood design (traditional street grids, strong sense of place and local identity, minimizes dependency on cars)**

Wikimedia Commons contributors, "File:St petersburg florida downtown.JPG," *Wikimedia Commons, the free media repository,* https://commons.wikimedia.org/w/index.php?title=File:St_petersburg_florida_downtown.JPG&oldid=504656410 (accessed October 31, 2022).

New Urbanism is a planning and development approach based on the principles of how cities and towns had been built for the last several centuries: walkable blocks and streets, housing and shopping in close proximity, and accessible public spaces. In other words: New Urbanism focuses on human-scaled urban design.

THE CHARTER OF THE NEW URBANISM

LIGHT IMPRINT DESIGN

- Grew out of New Urbanist movement
- LID with New Urbanism
- Sustainable, compact, mixed-use community development and walkable communities
- Placement of stormwater and other green practices to encourage interaction between people

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- Sustainable, compact, mixed-use community development and walkable communities
- Placement of stormwater and other green practices to encourage interaction between people
- Green fingerprint

LID - USA

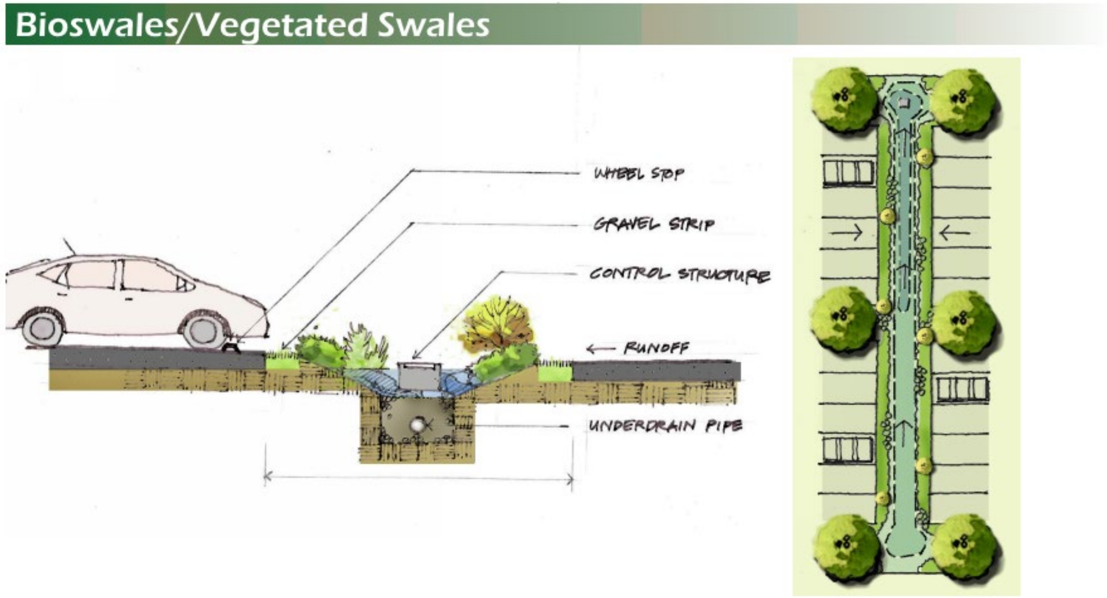
Maryland in 1980's

- poor sewage treatment, dirty industrial discharges
- not on a single cause for the decline but on the accumulation of insults
- Call for a 40 percent reduction in the flow of the nutrients

Currently 28 States have standards based on retainage of a certain volume of stormwater

LID - ALABAMA

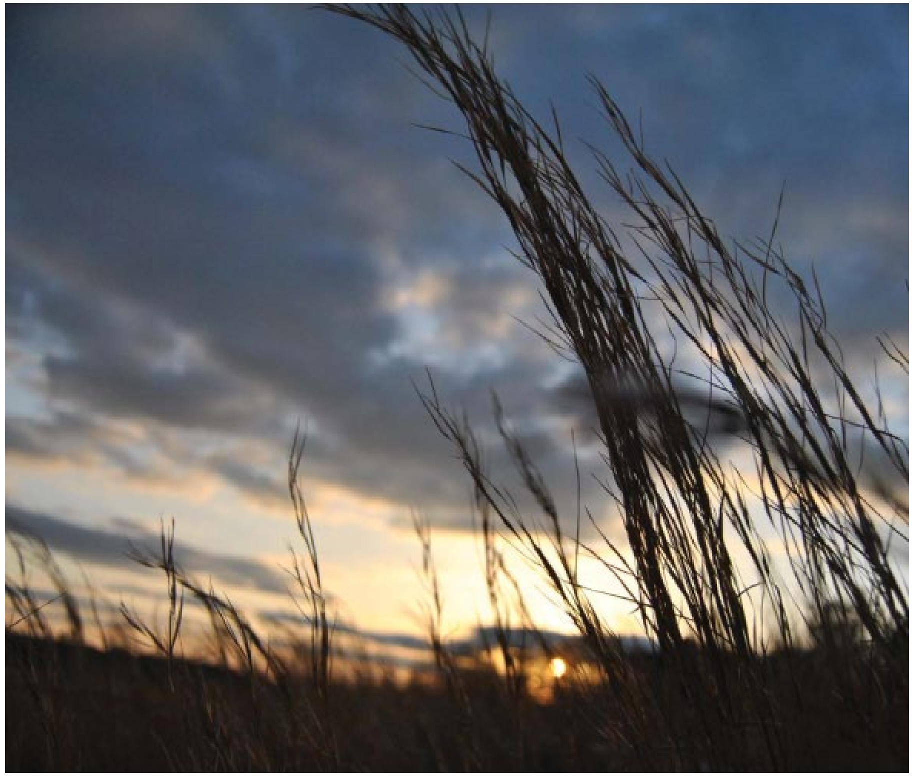
- National Guard
- City of Fairhope
- City of Foley
- City of Hoover
- City of Auburn
- City of Madison
- City of Leeds
- City of Vestavia Hills


Bioswales/Vegetated Swales
WHEEL STOP
GRAVEL STRIP
CONTROL STRUCTURE
RUNOFF
UNDERDRAIN PIPE


Surface Mulch and Plantings Layer
Engineered Soils Layer
Underdrain
Aggregate Storage Layer
Storm Sewer
Native Soils

ALABAMA LID HANDBOOK

Low Impact Development Handbook
for the State of Alabama



Alabama Department of Environmental Management
Alabama Cooperative Extension System
Auburn University

MAINTENANCE

"140910-Z-NI803-076" by Matt Hecht is marked with Public Domain Mark 1.0.

SOUTHEAST CITY A

- Population: 65,000
- Has a stormwater utility
- Allowed / required LID for several years
- Several City Owned LID projects
- Maintenance has not been an issue
- "We don't do anything different for our LID measures"
- Mulch replaced with other landscaped features
- Weeding done with other landscaped features
- Biggest issue was training for recreation department staff

SOUTHEAST CITY B

- Population: 80,000
- Has a stormwater utility
- Allowed / required LID for several years
- Several City Owned LID projects
- Mulch is replaced often
- Seeing water quality benefits (one stream currently being removed from impaired waters list)
- Maintenance is not a big issue
- Annual stormwater improvement budget about $1 million a year. None of that budget anticipated for LID repair or maintenance.
- Notices individual home owners embracing small parcel size LID measures
- Loves tree planters

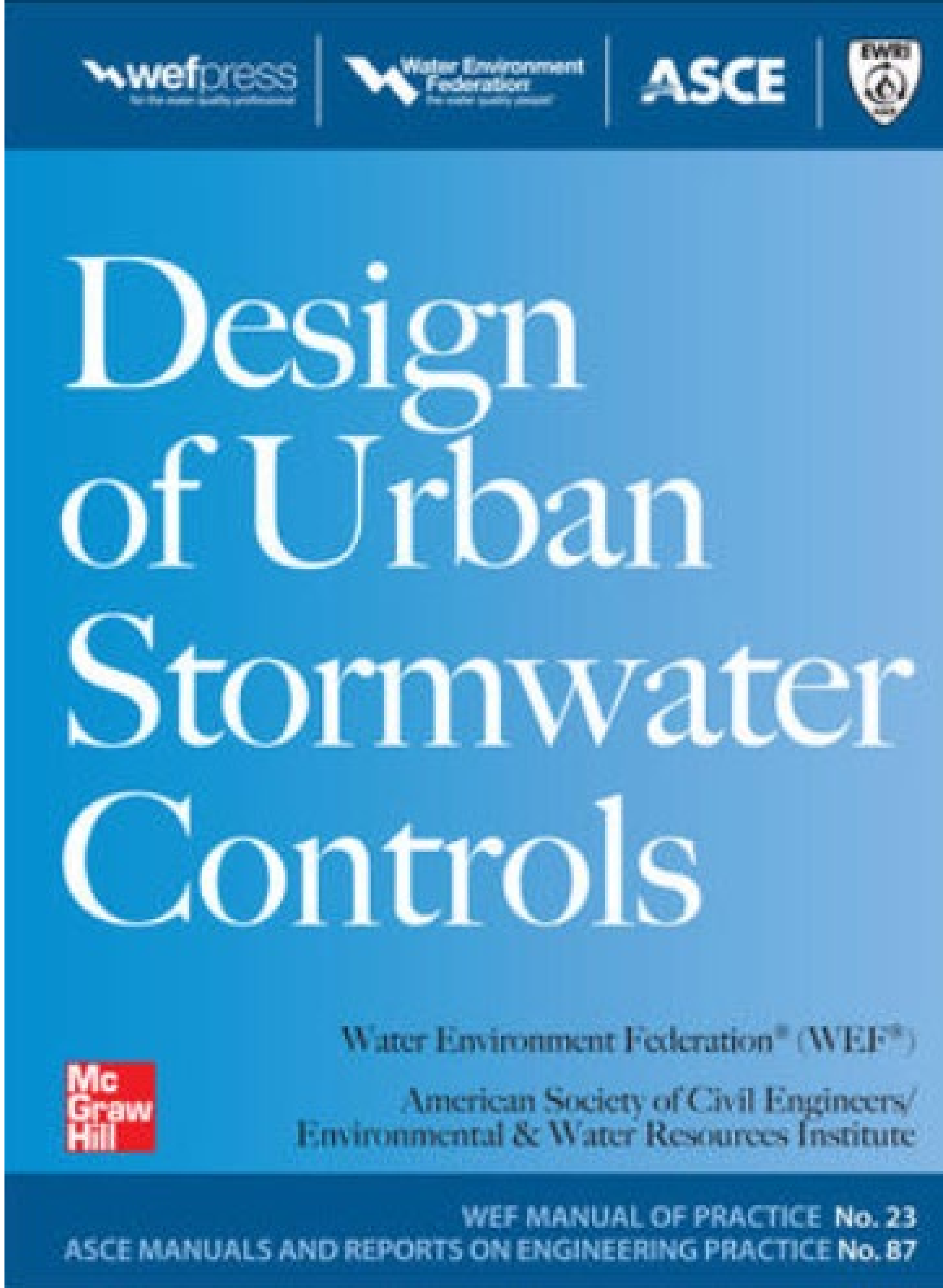
SOUTHEAST CITY C

- Population: 25,000
- Allowed / required LID for several years
- Dedicated Stormwater Manager with maintenance staff
- Algae blooms being noticed it wet ponds (education campaign being done)
- No known maintenance to LID measures
- LID measures required by ordinance, but staff would prefer they were not required

SOUTHEAST CITY D

- Population: 25,000
- Most systems have just been through one three-year maintenance inspection.
- LID in practice around five years
- Regulations have been award winning
- Regulations have been tweaked
- Few Conflicts
- Previous thoughts:
    - “It’s a great idea”
    - Not a silver bullet
- Has not killed development
- Compliance has not been an issue
- Has become second nature
- Maintenance has not been an issue

LID OR GOOD DESIGN?



AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS STORMWATER CASE STUDIES

- 479 case studies from 43 states
- Increased cost in 25% of cases
- No influence in cost in 31% of cases
- Cost reduction in 44% of cases

COST

Table 1. Summary of Cost Comparisons Between Conventional and LID Approaches
from EPA's Reducing Stormwater Costs Through Low Impact Development (LID) Strategies and Practices 2007,

Project[a]	Conventional Development Cost	LID Cost	Cost Difference[b]	Percent Difference[b]
2nd Avenue SEA Street	$868,803	$651,548	$217,255	25%
Auburn Hills	$2,360,385	$1,598,989	$761,396	32%
Bellingham City Hall	$27,600	$5,600	$22,000	80%
Bellingham Bloedel Donovan Park	$52,800	$12,800	$40,000	76%
Gap Creek	$4,620,600	$3,942,100	$678,500	15%
Garden Valley	$324,400	$260,700	$63,700	20%
Kensington Park	$765,700	$1,502,900	-$737,200	-96%
Laurel Springs	$1,654,021	$1,149,552	$504,469	30%
Mill Creek[c]	$12,510	$9,099	$3,411	27%
Prairie Glen	$1,004,848	$599,536	$405,312	40%
Somerset	$2,456843	$1,671,461	$785,382	32%
Tellabs Corporate Campus	$3,162,162	$2,700,650	$461,510	15%

[a] Some of the case study results do not lend themselves to display in the format of this table (Central Park Commercial Redesigns, Crown Street, Poplar Street Apartments, Prairie Crossing, Portland Downspout Disconnection, and Toronto Green Roofs).
[b] Negative values denote increased cost for the LID design over conventional development costs.
[c] Mill Creek costs are reported on a per-lot basis.

COST (RESIDENTIAL)

Table 1: Cost savings from installing LID stormwater controls in residential developments.

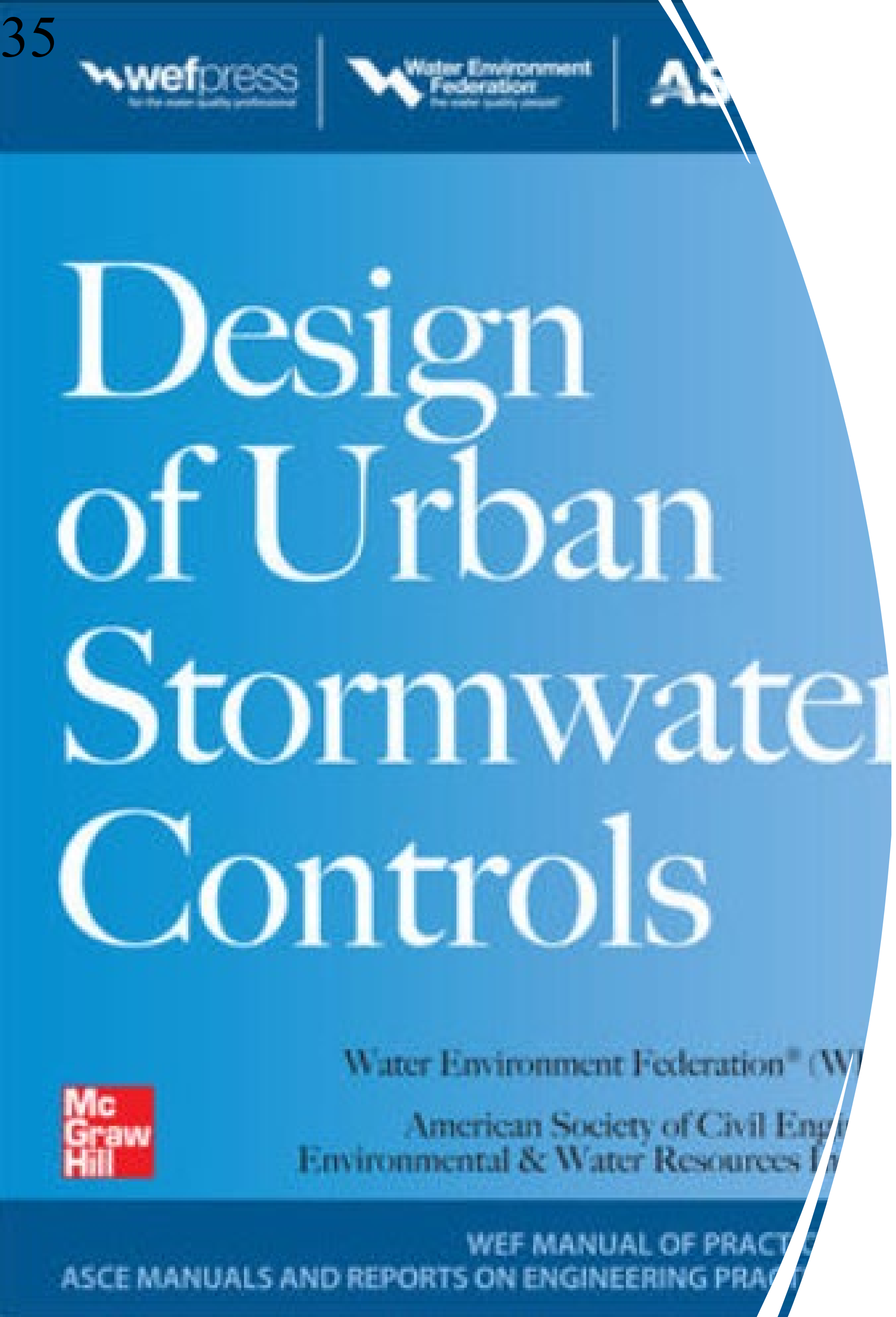
Location	Description	LID Cost Savings[a]
Meadow on the Hylebos Residential Subdivision Pierce County, WA	9-acre development reduced street width, added swale drainage system, rain gardens, and a sloped bio-terrace to slowly release stormwater to a creek. Stormwater pond reduced by 2/3, compared to conventional plan. (Zickler 2004)	LID cost 9% less than conventional
Somerset Community Residential Subdivision Prince George's Co., MD	80-acre development included rain gardens on each lot and a swale drainage system. Eliminated a stormwater pond and gained six extra lots. (NAHB Research Center Inc. 2003)	$916,382 $4,604 per lot
Pembroke Woods Residential Subdivision Frederick County, MD	43-acre, 70-lot development reduced street width, eliminated sidewalks, curb and gutter, and 2 stormwater ponds, and added swale drainage system, natural buffers, and filter strips. (Clar 2004; Lehner et al. 2001)	$420,000 $6,000 per lot[b]
Madera Community Residential Subdivision Gainesville, FL	44-acre, 80-lot development used natural drainage depressions in forested areas for infiltration instead of new stormwater ponds. (PATH 2005)	$40,000 $500 per lot[b]
Prairie Crossing Residential Subdivision Grayslake, IL	667-acre, 362-lot development clustered houses reducing infrastructure needs, and eliminated the need for a conventional stormwater system by building a natural drainage system using swales, constructed wetlands, and a central lake. (Lehner et al. 2001; Conservation Research Institute 2005)	$1,375,000- $2,700,000 $3,798-$7,458 per lot[b]
SEA Street Retrofit Residential street retrofit Seattle, WA	1-block retrofit narrowed street width, installed swales and rain gardens. (Tilley 2003)	$40,000
Gap Creek Residential Subdivision Sherwood, AK	130-acre, 72-lot development reduced street width, and preserved natural topography and drainage networks. (U.S. EPA 2005; Lehner et al. 2001; NAHB Research Center Inc. 2003)	$200,021 $4,819 per lot
Poplar Street Apartments Residential complex Aberdeen, NC	270-unit apartment complex eliminated curb and gutter stormwater system, replacing it with bioretention areas and swales. (U.S. EPA 2005)	$175,000
Kensington Estates* Residential Subdivision Pierce County, WA	24-acre, 103-lot hypothetical development reduced street width, used porous pavement, vegetated depressions on each lot, and reduced stormwater pond size. (CH2MHill 2001; U.S. EPA 2005)	$86,800 $843 per lot[b]
Garden Valley* Residential Subdivision Pierce County, WA	10-acre, 34-lot hypothetical development reduced street width, used porous paving techniques, added swales between lots, and a central infiltration depression. (CH2MHill 2001)	$60,000 $1,765 per lot[b]
Circle C Ranch Residential Subdivision Austin, TX	Development employed filter strips and bioretention strips to slow and filter runoff before it reached a natural stream. (EPA 2005)	$185,000 $1,250 per lot

COST (COMMERCIAL)

Table 2: Cost savings from installing LID stormwater controls in commercial developments.

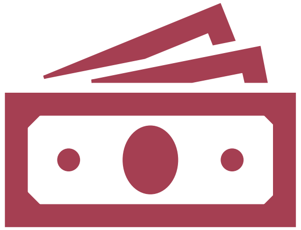
Location	Description	LID Cost Savings[a]
Parking Lot Retrofit Largo, MD	One-half acre of impervious surface. Stormwater directed to central bioretention island. (U.S. EPA 2005)	$10,500-$15,000
Old Farm Shopping Center* Frederick, MD	9.3-acre site redesigned to reduce impervious surfaces, added bioretention islands, filter strips, and infiltration trenches. (Zielinski 2000)	$36,230 $3,986 per acre[b]
270 Corporate Office Park* Germantown, MD	12.8-acre site redesigned to eliminate pipe and pond stormwater system, reduce impervious surface, added bioretention islands, swales, and grid pavers. (Zielinski 2000)	$27,900 $2,180 per acre[b]
OMSI Parking Lot Portland, OR	6-acre parking lot incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$78,000 $13,000 per acre[b]
Light Industrial Parking Lot* Portland, OR	2-acre site incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$11,247 $5,623 per acre[b]
Point West Shopping Center* Lexana, KS	Reduced curb and gutter, reduced storm sewer and inlets, reduced grading, and reduced land cost, used porous pavers, added bioretention cells and native plantings. (Beezhold 2006)	$168,898
Office Warehouse* Lexana, KS	Reduced impervious surfaces, reduced storm sewer and catch basins, reduced land cost, added bioswales and native plantings. (Beezhold 2006)	$317,483
Retail Shopping Center*	9-acre shopping development reduced parking lot area, added porous pavers, clustered retail spaces, added infiltration trench, bioretention and a sand filter, reduced curb and gutter and stormwater system, and eliminated infiltration basin. (Center for Watershed Protection 1998b)	$36,182 $4,020 per acre[b]
Commercial Office Park*	13-acre development reduced impervious surfaces, reduced stormwater ponds and added bioretention and swales. (Center for Watershed Protection 1998b)	$160,468 $12,344 per acre[b]
Tellabs Corporate Campus Naperville, IL	55-acre site developed into office space minimized site grading and preserved natural topography, eliminated storm sewer pipe and added bioswales. (Conservation Research Institute 2005)	$564,473 $10,263 per acre[b]
Vancouver Island Technology Park Redevelopment Saanich, British Columbia	Constructed wetlands, grassy swales and open channels, rather than piping to control stormwater. Also used amended soils, native plantings, shallow stormwater ponds within forested areas, and permeable surfaces on parking lots. (Tilley 2003)	$530,000

Source: ECONorthwest, with data from listed sources.
Notes: * indicates hypothetical or modeled project, not actually constructed.
[a] Dollar amounts as reported at the time of study.
[b] Per-acre cost savings calculated by ECONorthwest.

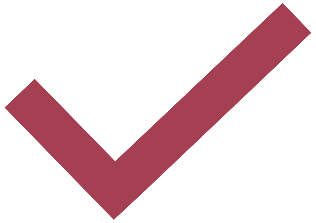


IS IT LID OR GOOD DESIGN?

DEVELOPER'S PERSPECTIVE



Initial concern is cost



Now most heard complaint is code compliance

Codes written prior to advent of LID

ORDINANCE CHANGES

- Sometimes difficult
- Consider watershed level ordinances

"Total capital cost savings ranged from 15 to 80 percent when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs. " (EPA, 2007, iv)

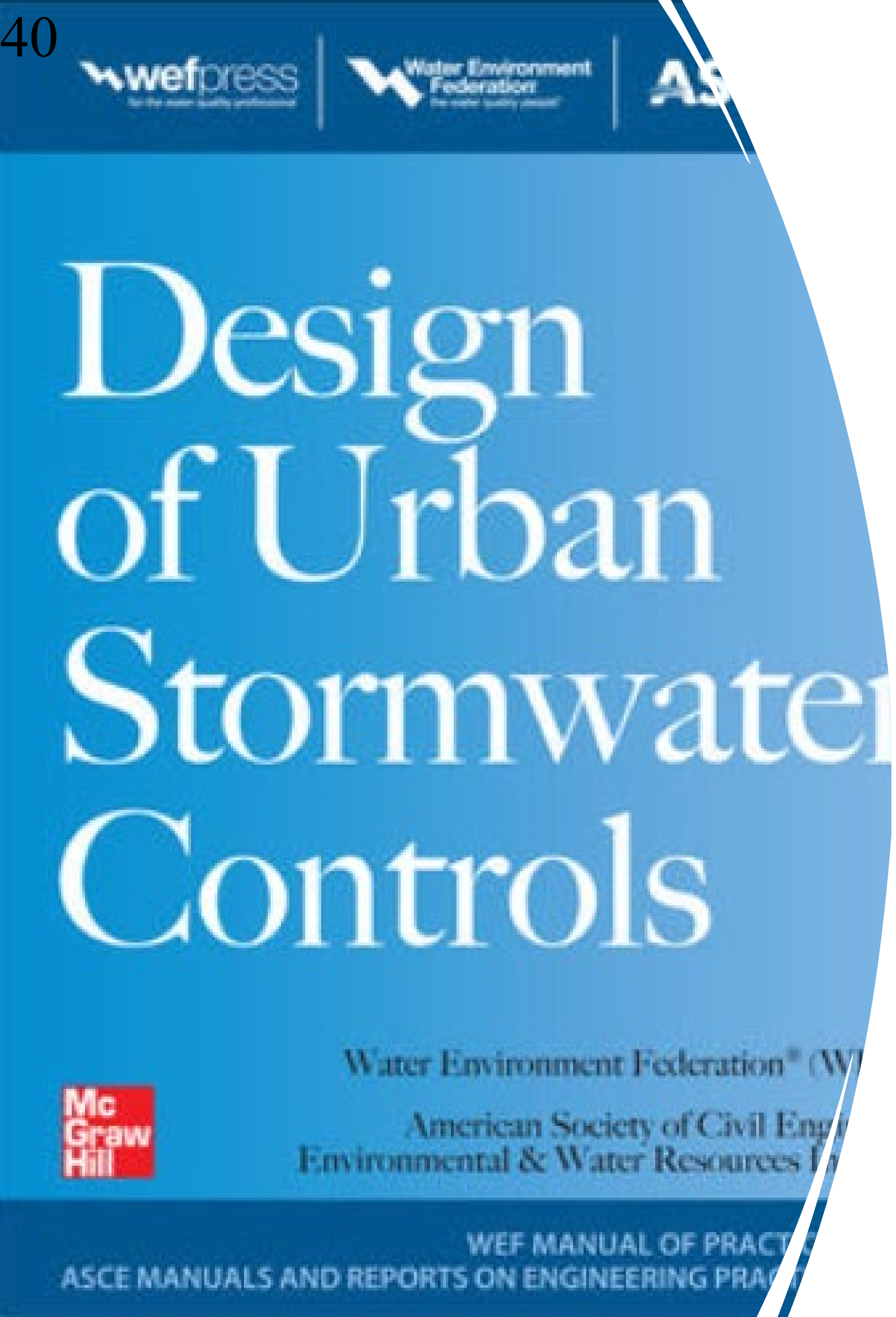
Does not monetise enhanced property values, improved habitat, aesthetic amenities, and improved quality of life. (EPA, 2007, iii)

KEY THOUGHTS

Low Impact Development does not necessarily mean higher cost.

LID has been used successfully throughout the US.

Low Impact Development (LID) Stormwater doesn't have to be a Headache



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• Did you like playing in streams, creeks, rivers, lakes, mud puddles?
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• Does this still amaze you?
• Why or why not?
• What did you see along the banks of the streams and rivers - Riparian?

What Makes a Stream Healthy?

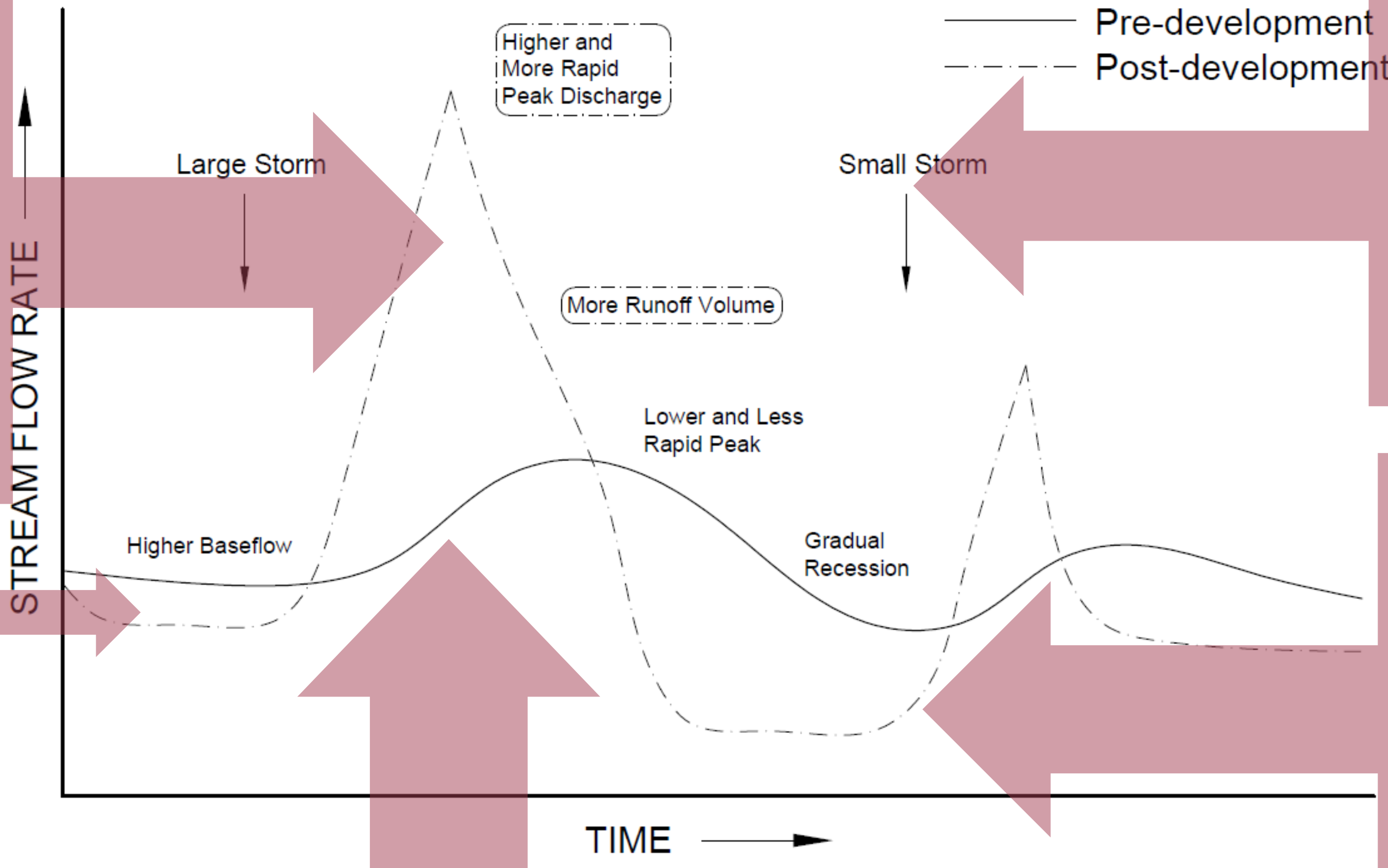
- Bed stability & diversity
- Sediment transport balance
- In-stream habitat & flow diversity
- Bank stability (native plant roots)
- Riparian buffer (streamside forest)
- Active floodplain

IMPACTS OF URBANIZATION ON STREAM FLOWS

Differential Runoff - The difference in rate of storm water runoff from a parcel or project in its existing condition and its developed condition. (Baldwin County Zoning Department 21)

Natural vegetation difficulties in highly urbanized streams

Life cycle disruption due to changes in timing of flows



Changes in stream hydrology as a result of urbanization (Schueler, 1992)

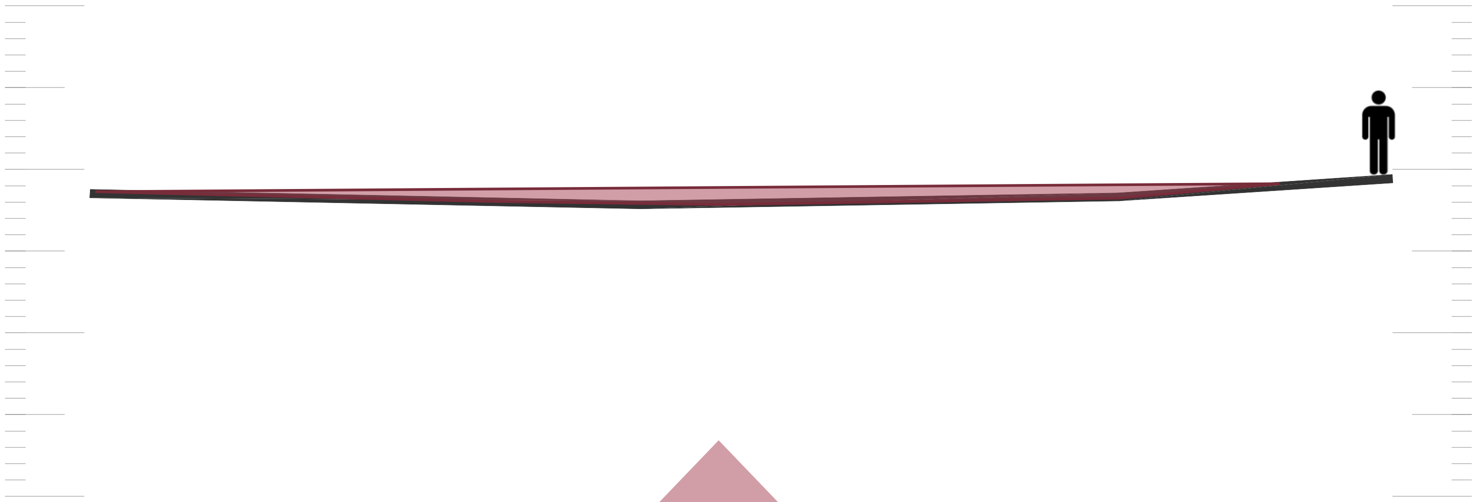
Direct scour and dislodgement from benthic surfaces due to increased peak flows

Other flow-associated alterations (e.g., increased sediment, nutrient and contaminant delivery, changes in food resources)

Altered physical habitat
Changes in in-stream hydraulic conditions (e.g., water velocity, wetted channel area and duration)
Changes in channel geomorphology

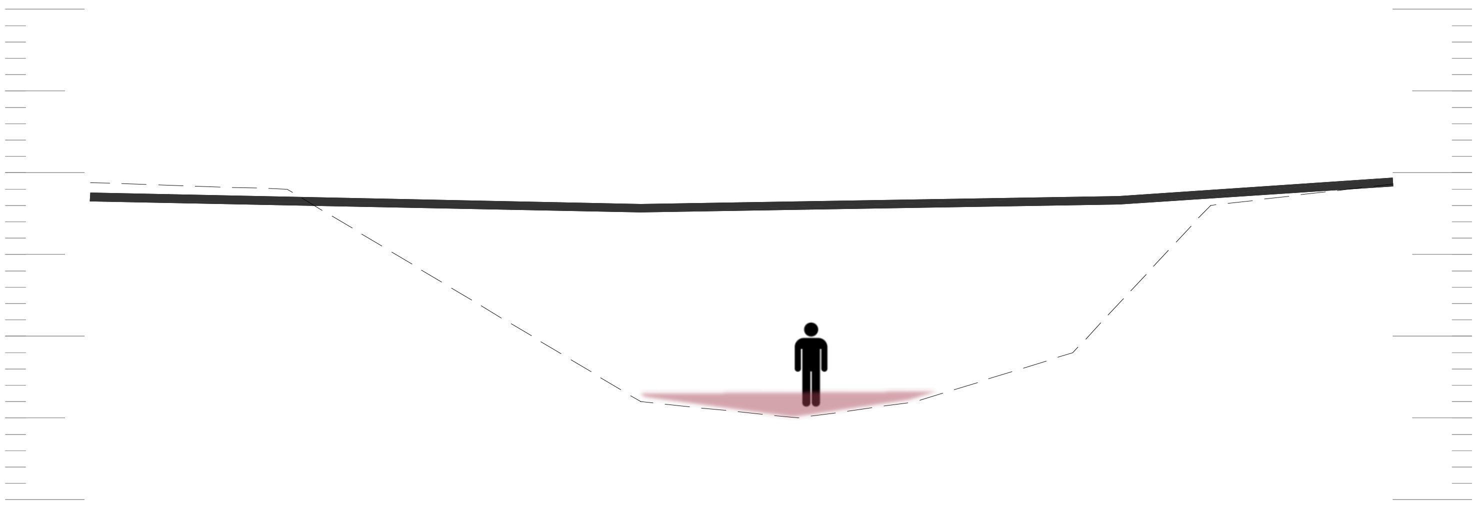
(Schueler, 1992 Cited by ARC Vol 1 2016)

“PRE” CROSS SECTION



Cross Section – A vertical view cut across a horizontal alignment that is rotated 90 degrees

AFTER DEVELOPMENT CROSS SECTION



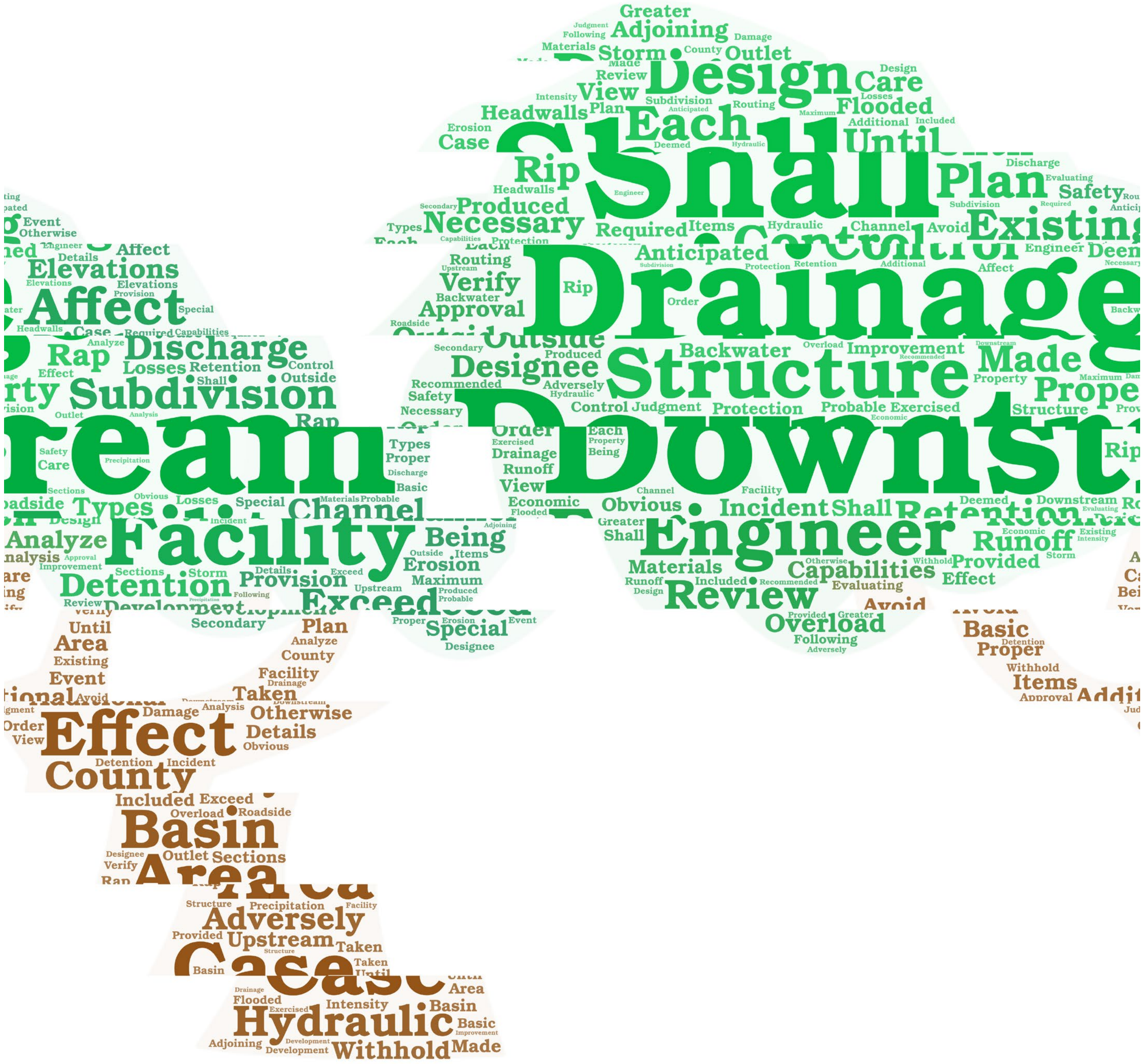
SEDIMENTATION IN LAKES (LAKE FOREST EXAMPLE)

(Carlton & Gail, Jr., 1979)

(Google Earth 2018)

NO ADVERSE DOWNSTREAM IMPACTS

- The hydraulic elevations resulting from channel retention/detention shall not **adversely affect** adjoining properties.
- **Effect on Downstream Drainage Areas**. The Design Engineer shall review the effect of each subdivision on existing downstream drainage facilities outside the area of the subdivision. Where it is anticipated that the additional runoff incident to the development of the subdivision will overload an existing downstream drainage facility, the County Engineer, or his/her designee, may withhold approval of the subdivision until provision has been made for the necessary downstream improvement.
- In all cases the design engineer must analyze the backwater that is produced and verify that no upstream property is being flooded or otherwise **adversely affected**.
- Special types of headwalls, rip-rap, and other materials may be required by the County Engineer or his/her designee when deemed necessary for erosion control, **protection of existing downstream drainage facilities**, and roadside safety.
- In no case shall the discharge from a drainage basin **exceed the hydraulic capabilities** of the downstream drainage structures and facilities.
- Retention/detention facilities shall be provided with obvious and effective control structures. Plan view and sections of the structure with details shall be included in plans. In no case shall the discharge from a drainage **basin exceed the hydraulic capabilities of the downstream drainage** structures and facilities. Care should be taken in evaluating the following items (1-3) in the design of the outlet control structure.
- Proper engineering judgment shall be exercised in analysis of secondary routing of discharge of greater intensity than the basic design storm in order to **avoid economic losses or damage downstream**. Review with the maximum probable precipitation event is recommended.



Deterministic Nonperiodic Flow[1]

EDWARD N. LORENZ

Massachusetts Institute of Technology

(Manuscript received 18 November 1962, in revised form 7 January 1963)

ABSTRACT

Finite systems of deterministic ordinary nonlinear differential equations may be designed to represent forced dissipative hydrodynamic flow. Solutions of these equations can be identified with trajectories in phase space. For those systems with bounded solutions, it is found that nonperiodic solutions are ordinarily unstable with respect to small modifications, so that slightly differing initial states can evolve into considerably different states. Systems with bounded solutions are shown to possess bounded numerical solutions.

A simple system representing cellular convection is solved numerically. All of the solutions are found to be unstable, and almost all of them are nonperiodic.

The feasibility of very-long-range weather prediction is examined in the light of these results.

Lorenz, Edward N. 1963. "Deterministic Nonperiodic Flow." *Journal of the Atmospheric Sciences* 130-141.

THE BUTTERFLY EFFECT

- Lorenz: Found that when testing various weather simulations rounding off one variable from .506127 to .506 dramatically changed the two months of weather predictions
- Dizikes: It is extremely hard to calculate such things with certainty. There are many butterflies out there. A tornado in Texas could be caused by a butterfly in Brazil, Bali, or Budapest. Realistically, we can't know. "It's impossible for humans to measure everything infinitely accurately," says Robert Devaney, a mathematics professor at Boston University. "And if you're off at all, the behavior of the solution could be completely off." When small imprecisions matter greatly, the world is radically unpredictable.

Dizikes, Peter. 2008. "The meaning of the butterfly." *The Boston Globe*. JUN 08. Accessed APR 4, 23. http://archive.boston.com/bostonglobe/ideas/articles/2008/06/08/the_meaning_of_the_butterfly/?page=2.

Photographed in 1980 given in Pittsburgh Post-Gazette source Published by 1981, the last year Old Friends New Friends aired Open Source

DO NO HARM TO YOUR NEIGHBOR

Five things to reduce harm to your neighbor:

1) Employ green infrastructure practices to treat stormwater as close as possible to where it falls and permit the smaller infrastructure necessary to convey the reduced runoff and allow the decreased construction costs.

2) Retain the first one inch of runoff during any rain event.

3) If not feasible, remove 80% of solids from runoff associated with that event.

4) Protect the downstream channel by detaining runoff from any one-year rain event for 24 hours.

5) Demonstrate that flows are not increased downstream to a point where the site represents only 10% of the drainage area.

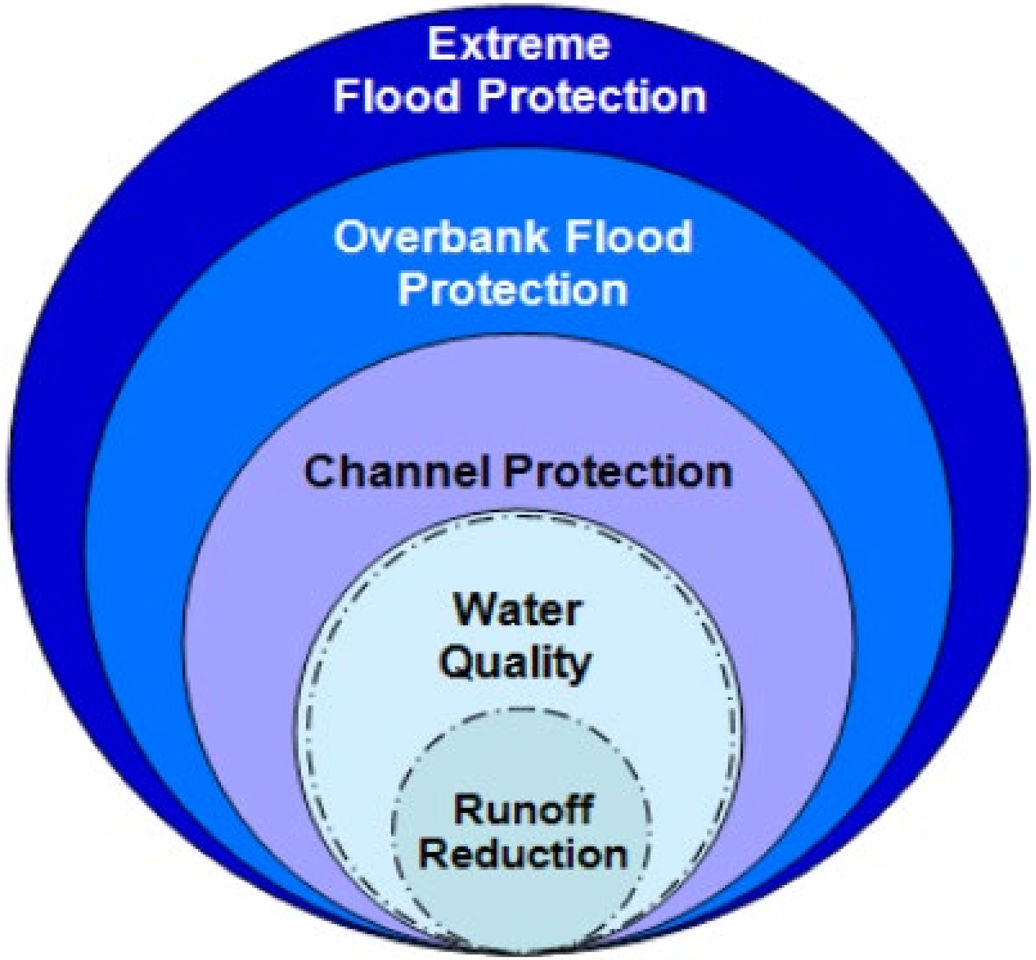


Figure 2.2.3-1 Representation of the Unified Stormwater Sizing Criteria

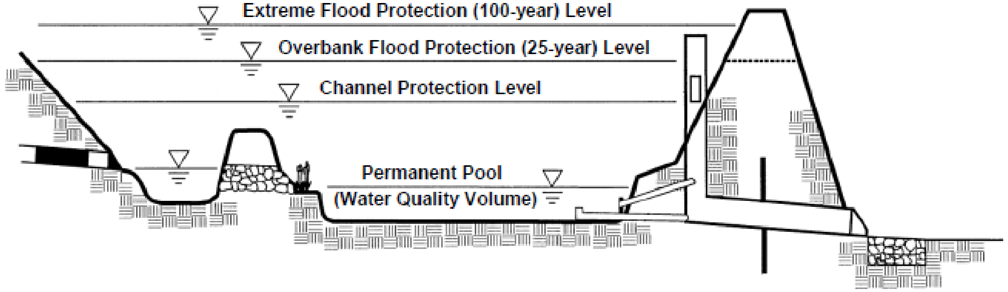


Figure 2.2.3-2 Unified Sizing Criteria Water Surface Elevations in a Stormwater (Wet) Pond

IMPACT AREA

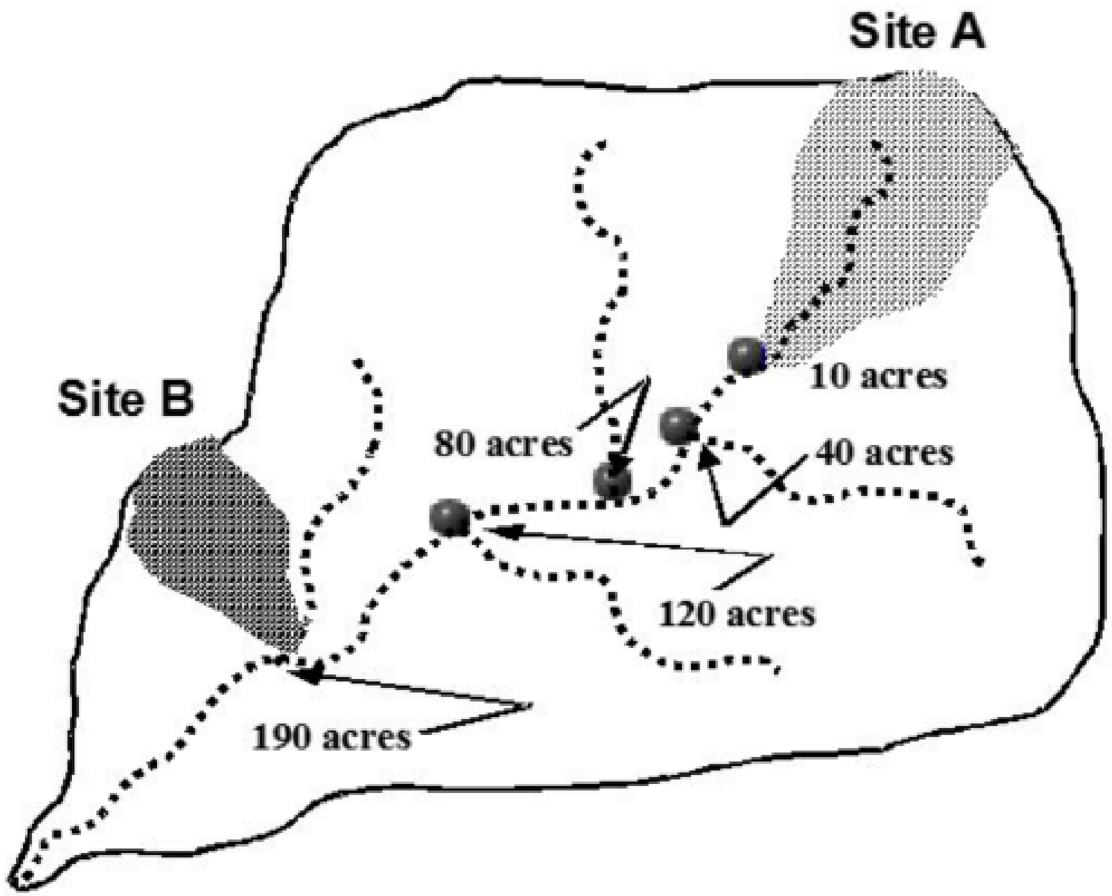


Figure 3.1.9-3 Example of the Ten-Percent Rule

DO NO HARM TO YOUR NEIGHBOR

Here are the reasons why these things matter:

1) Failure to allow this forces developers to oversize pipes and transfer the problem offsite. By allowing this method, developers can better manage stormwater onsite and pay for it with savings realized through infrastructure reduction.

2) and 3) Developments will transfer nearly all pollutants downstream.

4) and 5) Developments will cause stream degradation

And…HELP ME PROMOTE THIS!

Photographed in 1980 given in Pittsburgh Post-Gazette source Published by 1981, the last year Old Friends New Friends aired Open Source

1. Employ green infrastructure practices to treat stormwater as close as possible to where it falls and permit the smaller infrastructure necessary to convey the reduced runoff and allow the decreased construction costs.

Why does this Matter:

Failure to permit this recommendation **forces** developers to employ **large infrastructure** that transfers problems with stormwater runoff offsite. By allowing this practice, developers are incentivized to better manage stormwater onsite with savings realized through infrastructure cost reductions.

What is the benefit:

Cost to the consumer is **reduced** (75%).

Stormwater runoff is managed by the producer rather.

Provides a higher level of ecosystem services.

2. Retain the first one inch of runoff during any rain event.
3. Retain runoff from any 85th percentile storm; if not feasible, remove 80% of solids from runoff associated with that event.

Why does this Matter:

Failure to follow these recommendations will cause developments to **transfer** nearly all **pollutants downstream.**

In Layperson Terms: This means that the first inch of rain from the 2, 5, 10, 25, 50, and 100 year storm events will be retained on site and will either evaporate into the air or percolate into the ground.

What is the benefit:

The Benefit: This requirement will help **reduce** the chances of those **pollutants** impacting downstream neighbors.

4. Protect the downstream channel by detaining runoff from any one-year rain event for 24 hours.

Why does this Matter:

Failure to follow these recommendations **will increase downstream degradation**.

In Layperson Terms: Extended detention is draining a runoff volume over a specified period of time, typically 24 hours, and is used to meet channel protection criteria. Under this requirement, an applicant must demonstrate that the development's detention facilities will slowly release the volume of the one-year storm at a rate of 1/24 the volume per hour.

What is the benefit:

The Benefit: When the water level of a stream or river is at the top of its banks and any further rise would result in water moving into the flood plain, the river is said to be at bankfull flow condition. As an area urbanizes, bankfull flow conditions increase in frequency and duration and become a primary cause of streambank erosion, including the widening and downcutting of stream channels. By storing and releasing stormwater runoff from storm events that cause bankfull flow conditions (these storms correspond approximately to the 1-year storm event) in a gradual manner, the erosive velocities and volumes of stormwater downstream can be reduced with a corresponding **reduction in downstream channel erosion**.

5. Demonstrate that flows are not increased downstream to a point where the site represents only 10% of the drainage area.

Why does this Matter:

Failure to follow these recommendations **will increase downstream degradation**.

In Layperson Terms: This means that a developer must look downstream to see how the stormwater volumes produced by the development might impact downstream neighbors and define how far downstream the developer must look. The applicant will be required to confirm that the post-development peak flow a this downstream point is no more than the pre-development peak flow a this downstream point.

What is the benefit:

The Benefit: This requirement will **help protect downstream ditches, streams, and rivers** from increased degradation by retaining to pre-developed peak flow levels.

Applicants who employ green infrastructure practices to treat stormwater as close as possible to where it falls may utilize the runoff reduction method as described in accepted publications such as the Georgia Stormwater Management Manual (MM) when calculating infrastructure requirements.

Stormwater Runoff Quality/Reduction: Stormwater Runoff Quality/Reduction shall be provided by using the following:

(i) For development with a stormwater management plan submitted before [insert applicable date], the applicant may choose either

(A) Runoff Reduction or

(B) Water Quality.

(ii) For development with a stormwater management plan submitted on or after [insert applicable date], the applicant shall choose

(A) Runoff Reduction and additional water quality shall not be required. To the extent (A) Runoff Reduction has been determined to be infeasible for all or a portion of the site, then (B) Water Quality shall apply for the remaining runoff from a 1.5-inch rainfall event and must be treated to remove at least 80% of the calculated average annual post-development total suspended solids (TSS) load or equivalent as defined in the MM.

(1) Runoff Reduction – The stormwater management system shall be designed to retain the first 1.0 inch of rainfall on the site using runoff reduction methods, to the maximum extent practicable.

(2) Water Quality – The stormwater management system shall be designed to remove at least 80% of the calculated average annual post-development total suspended solids (TSS) load or equivalent as defined in a MM for runoff from a 1.5-inch rainfall event.

(iii) If a site is determined to be a hotspot, the [local jurisdiction] may require the use of specific or additional components for the stormwater management system to address pollutants of concern generated by that site. A "hotspot" means a land use or activity on a site that has the potential to produce higher than normally found levels of pollutants in stormwater runoff. As defined by the administrator, hotspot land use may include gasoline stations, vehicle service and maintenance areas, industrial facilities, material storage sites, garbage transfer facilities, and commercial parking lots with high-intensity use.

(i) Stream Channel Protection: Stream channel protection shall be provided by using all of the following three approaches:

(A) 24-hour extended detention storage of the 1-year, 24-hour return frequency storm event;

(B) Erosion prevention measures, such as energy dissipation and velocity control; and

(C) Preservation of any applicable stream buffer.

(i) Downstream Analysis: Due to peak flow timing and runoff volume effects, some structural components of the stormwater management system fail to reduce discharge peaks to pre-development levels downstream from the site. A downstream peak flow analysis shall be provided to the point in the watershed downstream of the site or the stormwater management system where the area of the site comprises 10% of the total drainage area in accordance with the MM. This is to help ensure that there are minimal downstream impacts from development on the site. The downstream analysis may result in the need to resize structural components of the stormwater management system.

THANK YOU

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STREAM'GINEERING
RELEVANCE
EXPOSURE
FIELD

HOW CAN YOU EVEN SAY THERE IS NO ADVERSE EFFECT WITHOUT: (

The Atlanta Regional Commission worked with the state Environmental Protection Division, the state Environmental Finance Authority, a Technical Advisory Group (TAG), and a consultant team led by AECOM to update the Georgia Stormwater Management Manual (GSMM), known as the “Blue Book.”

Standard #1 – Natural Resource Inventory

- Topography and Steep Slopes (i.e., Areas with
- Slopes Greater Than 15%)
- Natural Drainage Divides and Patterns
- Natural Drainage Features (e.g., swales,
- basins, depressional areas)
- Wetlands
- Water Bodies
- Floodplains
- Aquatic Buffers
- Shellfish Harvesting Areas
- Soils
- Erodible Soils
- Groundwater Recharge Areas
- Wellhead Protection Areas
- Trees and Other Existing Vegetation
- High Quality Habitat Areas
- Protected River Corridors
- Protected Mountains
- Karst Areas

Standard #2 –Better Site Design Practices for Stormwater Management

Standard #3 – Runoff Reduction

Runoff reduction practices shall be sized and designed to retain the first 1.0 inch of rainfall

Standard #4 – Water Quality

Stormwater management systems shall be designed to retain or treat the runoff from 85% of the storms that occur in an average year, and reduce average annual post-development total suspended solids loadings by 80%

Standard #5 – Stream Channel Protection

1. 24-hour extended detention storage of the 1-year, 24-hour return frequency storm event
2. Erosion prevention measures, such as energy dissipation and velocity control
3. Preservation of the applicable stream buffer

Standard #6 – Overbank Flood Protection

Overbank flood protection shall be provided by controlling the post-development peak discharge rate to the pre-development rate (natural or existing condition, as applicable) for the 25-year, 24-hour return frequency storm event

Standard #7 – Extreme Flood Protection

Extreme flood protection shall be provided by controlling and/or safely conveying the 100-year, 24-hour storm event

Standard #8 – Downstream Analysis

Due to peak flow timing and runoff volume effects, some structural practices fail to reduce discharge peaks to pre-development levels downstream from the development site. A downstream peak flow analysis shall be provided to the point in the watershed downstream of the site or the stormwater management system where the area of the site comprises 10% of the total drainage area.

Standard #9 – Construction Erosion and Sedimentation Control

Erosion and sedimentation control practices shall be utilized during the construction phase of development or during any land disturbing activities.

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