Low Impact Development Or Proper Design

For Better Stormwater Management

September 8, 2016

30th Annual Alabama Water Resources Conference and Symposium

Introduction

- Wade Burcham

  Integrated Science and Engineering (ISE)

  Engineering Ministries International (eMi)

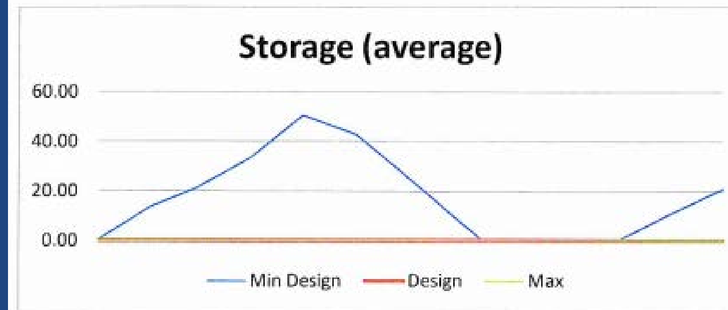
- Experience as developer, City Engineering Consultant, Designer, Design Build, Litigation Support
- Developing County Experience

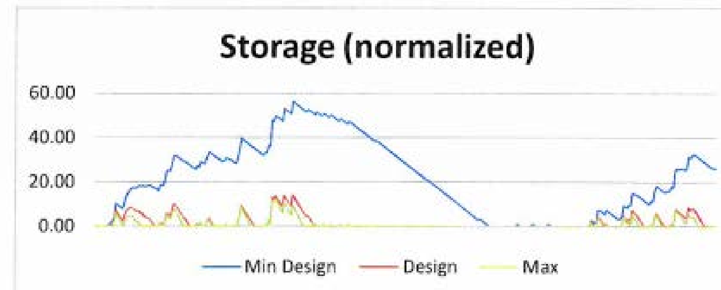
DEVELOPING COUNTRY

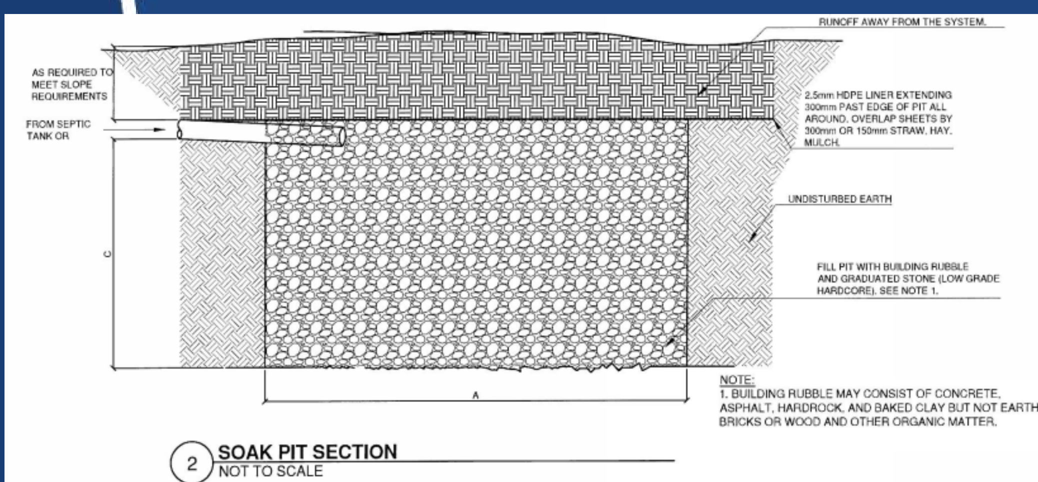
LID important there, but what about here?

Developing Country

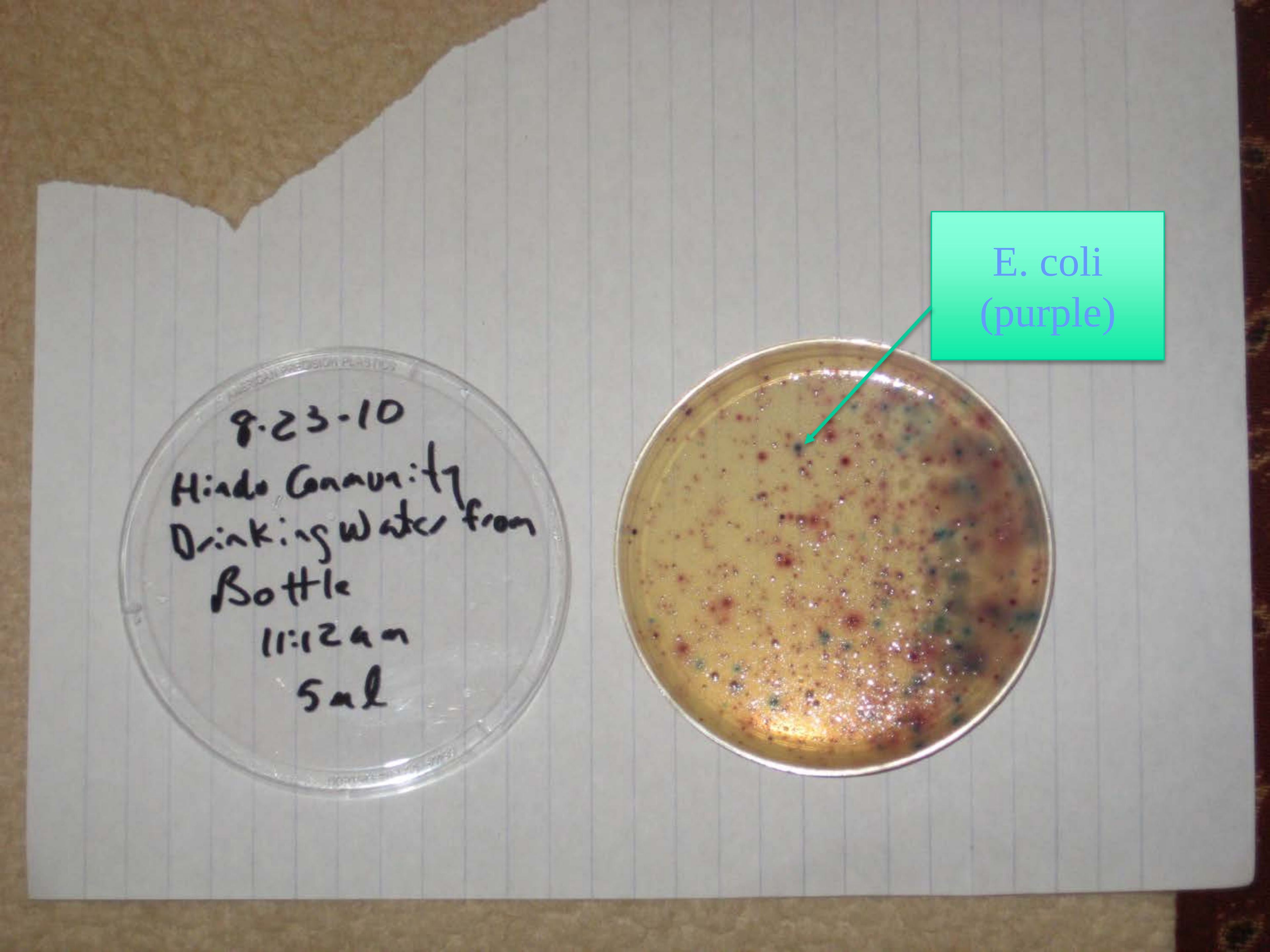
LID primarily due to water quality

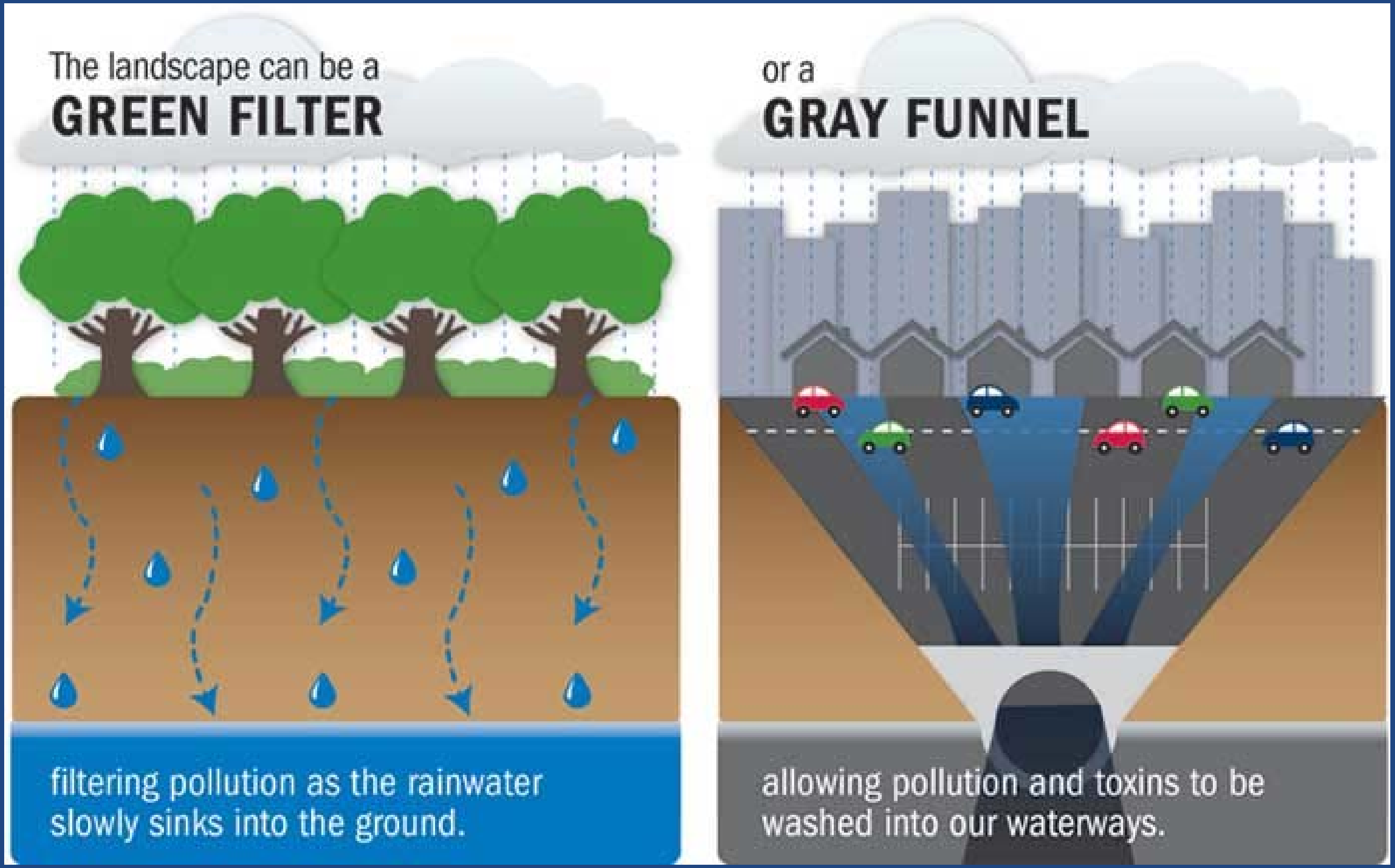






INTEGRATED Science & Engineering


8.23.10
Hindu Community
Drinking Water from
Bottle
11:12 am
5 ml
E. coli
(purple)


The landscape can be a
GREEN FILTER
filtering pollution as the rainwater slowly sinks into the ground.
or a
GRAY FUNNEL
allowing pollution and toxins to be washed into our waterways.

LID - USA

- Due to:
  - CSO and MS4 Requirements
  - Assest Management
    - Lenexa, Kansas, compared three alternative stormwater management approaches and found that on-site detention with green infrastructure costs about 25 percent less than the old approach of retrofitting and reactive solutions
  - Flood Control
  - Sustainability Goals

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										CO_2								
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	◒	●	◒	◒	●	●
Tree Planting	●	●	●	●	○	◒	○	●	●	●	●	●	●	●	●	◒	●	●
Bioretention & Infiltration	●	●	●	●	◒	◒	○	○	●	●	●	●	●	◒	◒	○	●	●
Permeable Pavement	●	●	●	●	○	◒	●	◒	●	●	●	○	○	●	○	○	○	●
Water Harvesting	●	●	●	●	●	◒	○	◒	◒	◒	○	○	○	○	○	○	○	●

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 26 States have standards based on retainage of a certain volume of stormwater

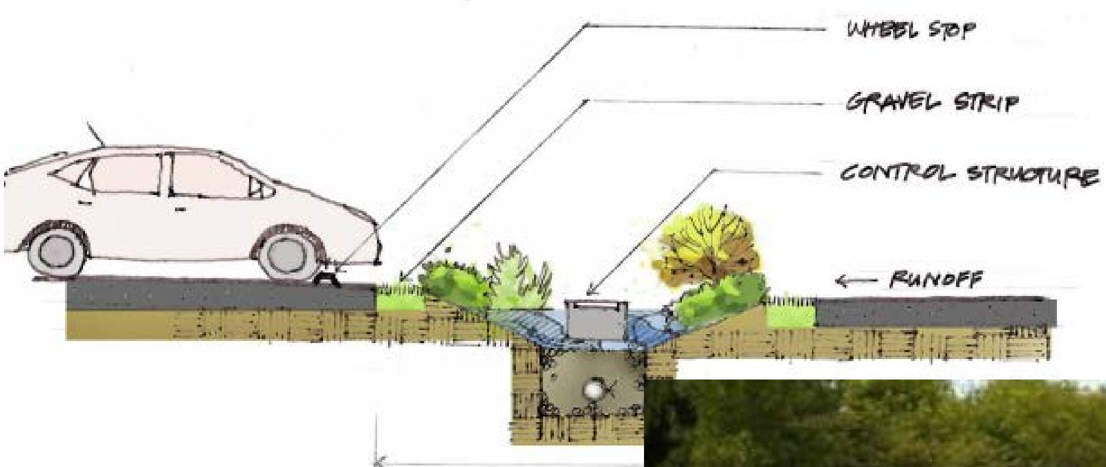
LID - Alabama

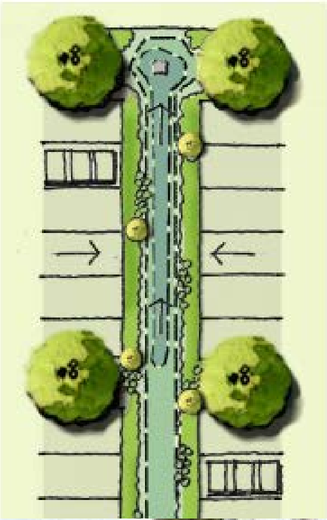
- National Guard
- City of Fairhope
- City of Tuscaloosa
- City of Hoover
- City of Auburn
- City of Madison
- City of Leeds
- City of Vestavia Hills ….

LID -

- St. Vincent’s One-Nineteen Health and Wellness
  - Lake Purdy Watershed (drinking water source)
  - Bioretention, Grass Filter Strips

Bioswales/Vegetated Swales





Cost approximately
$1 / sf

Sinclairs Restaurant Renovation

- Lake Martin, AL
- Request of developer
- Slightly less cost than grey infrastructure (1% savings)

Detention Pond Retrofit

Spanish Fort

GA Blue Book

Sizing Criteria		Description
Water Quality	Runoff Reduction, RR_v (Standard #3)	Retain or reduce the runoff for the first 1.0 inch of rainfall, or to the maximum extent practicable. Since runoff reduction practices eliminate stormwater runoff, and the pollutants associated with it, rather than treating or detaining, they can contribute to other stormwater management standards. If the entire 1.0 inch runoff reduction cannot be achieved, the remaining runoff from the 1.2 inch rainfall must be treated, as described in Standard #4.
	Treatment, WQ_v (Standard #4)	Retain or treat the runoff from 85% of the storms that occur in an average year. For Georgia, this equates to providing water quality treatment for the runoff resulting from a rainfall depth of 1.2 inches. The water quality treatment goal is to reduce average annual post-development total suspended solids loadings by 80%.
Channel Protection		Provide extended detention of the 1-year, 24 hour storm event released over a period of 24 hours to reduce bankfull flows and protect downstream channels from erosive velocities and unstable conditions.
Overbank Flood Protection		Provide peak discharge control of the 25-year, 24 hour storm event such that the post-development peak rate does not exceed the predevelopment rate to reduce overbank flooding.
Extreme Flood Protection		Evaluate the effects of the 100-year, 24 hour storm on the stormwater management system, adjacent property, and downstream facilities and property. Manage the impacts of the extreme storm event through detention controls and/or floodplain management.

- + 10% Rule – Aligning hydrographs

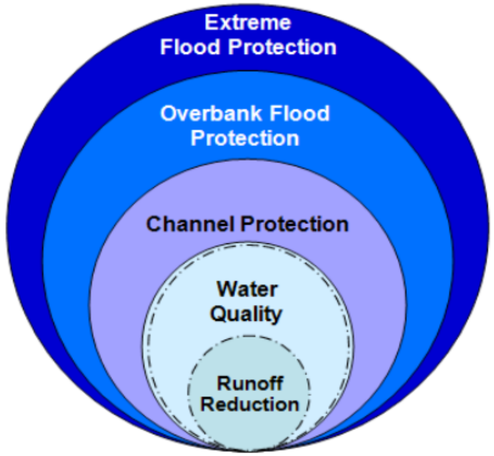


Figure 2.2.3-1 Representation of the Unified Stormwater Sizing Criteria

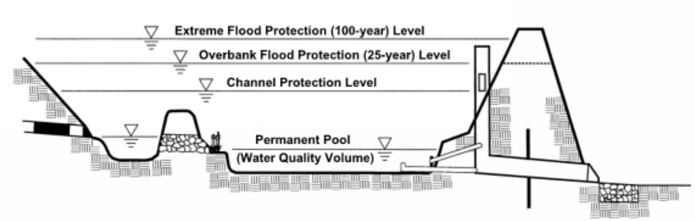


Figure 2.2.3-2 Unified Sizing Criteria Water Surface Elevations in a Stormwater (Wet) Pond

Chattanooga, TN
Rainwater Management Guide

- Pre vs. Post (2 – 25)
- Stay On Volume 1" (recovery volume in 72 hours) – must be accomplished through evapotranspiration, harvesting, reuse, infiltration,
- Whenever the SOV from an applicable project area cannot be managed or achieved onsite, per City requirements, the applicant/owner shall provide appropriate documentation to the City, using approved methodology and in acceptable detail, why the SOV cannot be managed.
- And then - Treatment of 1 year 24 hour runoff

Fairhope, AL

- Treatment of Water Quality Volume

$$WQv = P \times Rv \times \frac{A}{12}$$

Where:

WQv = water quality treatment volume, acre-feet
P = rainfall for the 85% storm event (1.8 inches)
Rv = runoff coefficient (see below)
A = drainage area in acres

$$Rv = 0.015 + 0.0092I$$

I = drainage area impervious cover in percent (50% imperviousness would be 50)

- 80% Removal

BMP Removal Efficiency for Total Suspended Solids (TSS)	
Structural Control	**TSS Removal (%)**
General Application BMPs	
Wet Pond	80
Storm water Wetland	80
Bioretention Area	80
Sand Filter	80
Enhanced Swale	80
Limited Application BMPs	
Filter strip	50
Grass Channel	50
Organic Filter	80
Underground Sand Filter	80
Submerged Gravel Wetland	80
Infiltration Trench	80
Gravity (Oil/Grit Separator)	40
Proprietary Structural Control	Varies
Dry Detention Basin	60

- Stream Velocity (pre vs post) or provide 24 hours of extended detention on-site, for post-developed storm water runoff generated by the 1-year, 24-hour storm

Fairhope, AL

- Use a minimum of 10 LID Techniques or prove cannot be successfully implemented.

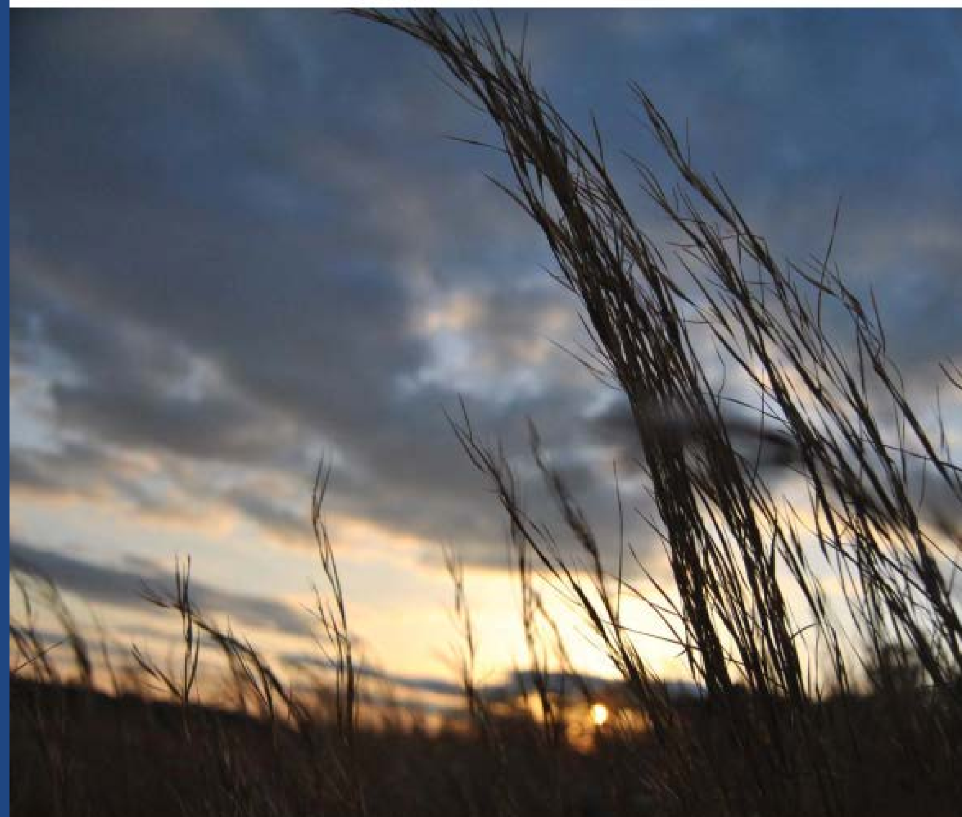
Wet Basins
Rain Gardens
Permeable Pavement
Sand Filter
Grass Swales
Constructed wetlands
Step Pools
In-line Stormwater Storage
Restoration of Habitat
Greenways
Stream Restoration
Bio Retention
Level Spreader
Innovative Measures

Fairhope, AL

- Jonathan Smith (Historic Preservation Meeting)
- First systems have just been through three year maintenance inspection.
- Most measures are less than two years old.
- Regulations have been successful (contributed to a recent America in Bloom Award)
- Regulation development really considered public input
- Need tweeking (many only can provide 4 measures)
- Few Conflicts
- Thinks "It's a great idea"
- Not a silver bullet
- Several subdivisions completed
- Maintenance has not been an issue

Alabama LID Handbook

Low Impact Development Handbook
for the State of Alabama



Alabama Department of Environmental Management
Alabama Cooperative Extension System
Auburn University

South East 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

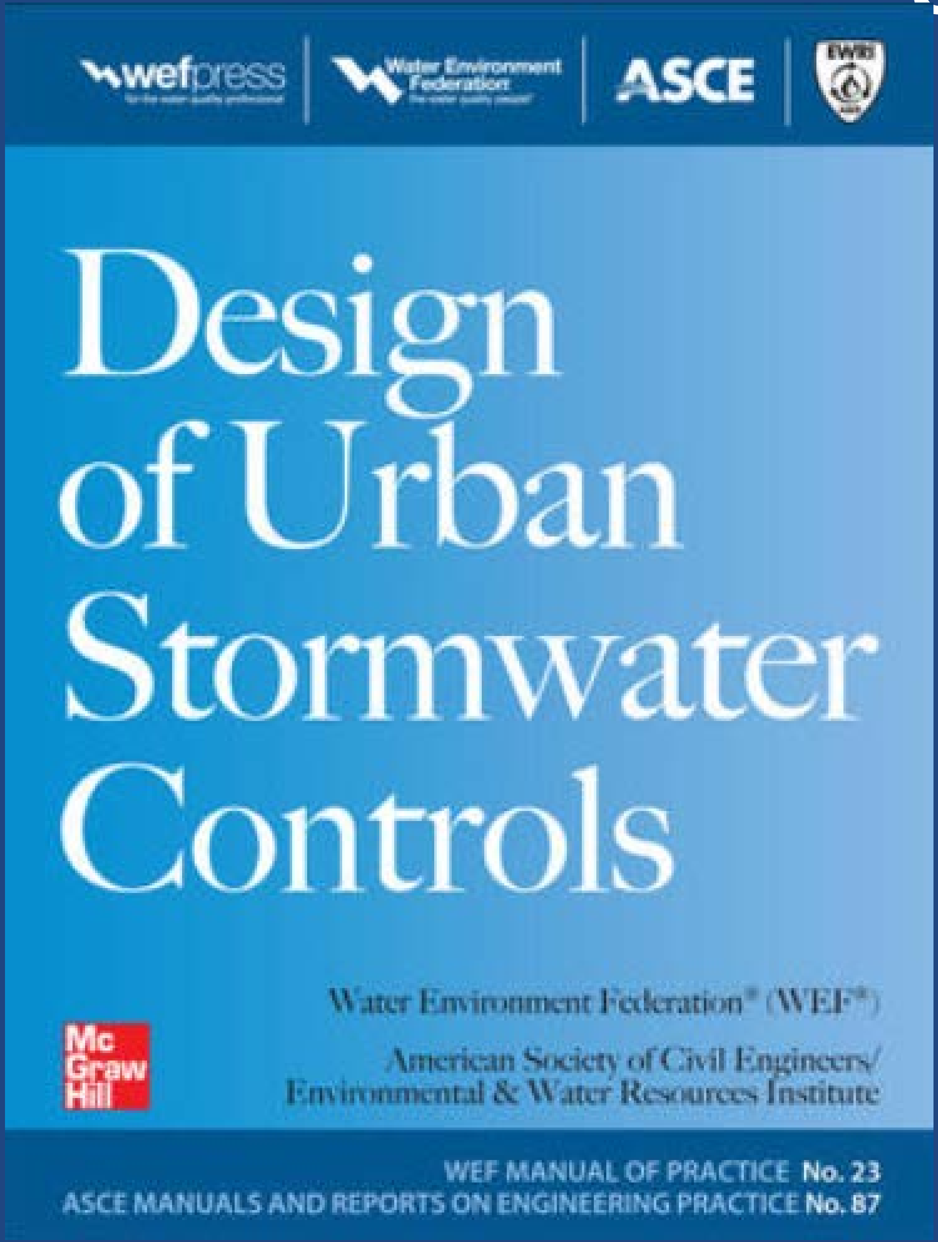
South East City B

- 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

South East City C

- Population: 25,000
- Allowed / required LID for several years
- Dedicated Stormwater Manager with maintenance staff
- Algea 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

Is it 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

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

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.

Developer's perspective

- Initial concern is cost
- Now most heard complaint is code compliance
  - Codes written prior to advent of LID

Ordinance Changes

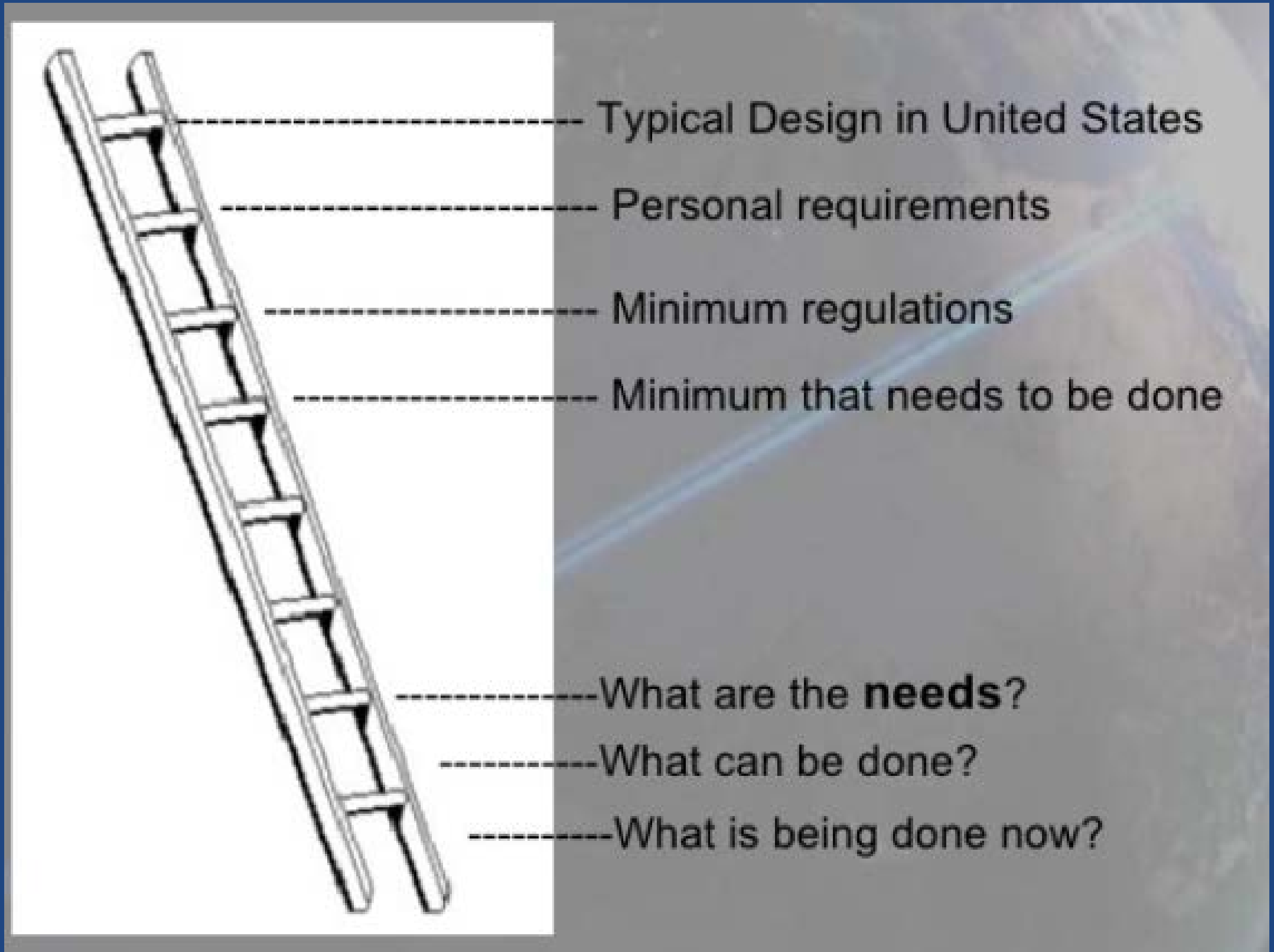
- Sometimes difficult
- Consider watershed level ordinances

Ordinance Changes

- Sometimes difficult
- Consider watershed level ordinances

Ordinance Changes

- Consider stepped approach



Thanks!

Wade Burcham
wburcham@intse.com
(912) 656-8150
1290 Main Street, Suite C
Daphne, AL 36526

INTEGRATED Science & Engineering