



TETRA TECH

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# Implementing Existing LID Tools for Communities in the Region

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# Using tools in 3 categories...

- Using LID to reduce impacts from existing development
- Using LID to reduce impacts from new development
  - City of Phoenix Case Study
- Putting it in the larger perspective: Triple Bottom Line Analysis

A high-speed photograph of a single water droplet falling into a body of water, creating a series of concentric ripples. The background is a deep blue gradient. The text is positioned to the right of the droplet.

# Watershed Improvement- Getting at the Existing Impairment of Our Streams

How can we improve runoff conditions from existing development?

# Neighborhood Streets Retrofits



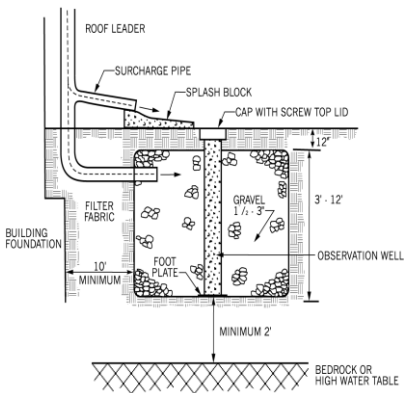
Photo courtesy Watershed Management Group



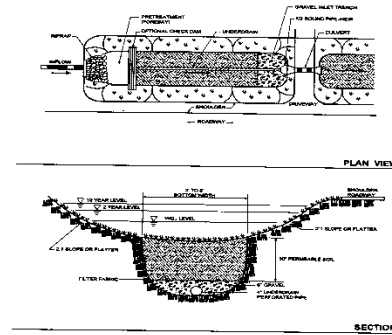
Photos courtesy Watershed Management Group

# Green practices aren't just pretty gardens....

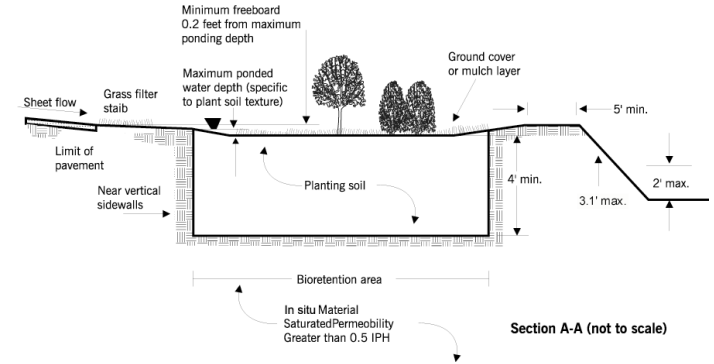
## Dry Well



## Vegetated Swale



## Bioretention Area or Raingarden



# Downtown Streetscape and Public Space Retrofits



# DOT Highway Retrofits



I-19 and Canoa Ranch Road, Pima County, AZ



Arizona State Highway 179, Sedona, AZ



# Public Property Retrofits



School micromanaging stormwater.

Municipal facility onsite capture.



Park stormwater detention basin also serving as playing field.



# Private Property Retrofits



Photos courtesy Watershed Management Group



# Look around. You'll see lots of retrofit opportunities...



Photos courtesy City of Phoenix



Photo courtesy Watershed Management Group

Photos courtesy City of Phoenix



# How can we pay for these retrofits?

- State DOT- Local Partnership
- Stormwater fees
- Wastewater utility fees (Fayetteville, Ark., Portland, Philadelphia, etc.)
- Trading (Washington, D.C)
- Private-Public Cost Sharing (Raleigh)

# Wastewater Utility Fee Example Fayetteville Ark

- State proposed strict, costly wastewater discharge Phosphorus limit.
- Agreed to allow the treatment plant to continue to meet current limit **IN EXCHANGE FOR** reducing nonpoint source loading in watershed.
- The City agreed to pay \$200,000/yr for retrofit and restoration projects.

# Trading Program Example Washington D.C.

- Washington D.C. Stormwater Retention Trading Program
  - Increases retention of stormwater at all regulated development
  - Dense downtown areas allowed to purchase credits
  - Less dense regulated and unregulated areas can install BMPs that generate retention credits
  - Provides more flexibility and cost-effectiveness

# Cost-Share Program Example City of Raleigh

- Up to 50-50 cost-share for private development
  - BMP retrofits for existing development
  - BMPs on new construction
  - Must go beyond regulatory requirements

Bioretention Area



Residential Cistern Project – Installation



# It's important to prioritize.....

- In times of decreasing funds, it's important to prioritize potential sites for LID/Green Infrastructure.
  - Most effective to prioritize by watersheds.
  - There are existing watershed and site modeling tools and economic tools to assist in prioritizing.



# Prioritize Potential Sites

## Example Multi-Criteria

### Water Quality Treatment

- most cost effective for reducing existing pollution.

### Habitat and Biological Integrity

- most successful at improving stream habitat .

### Streambank and Channel Protection

- minimizes erosion of streambanks and channels.

### Community Enhancement

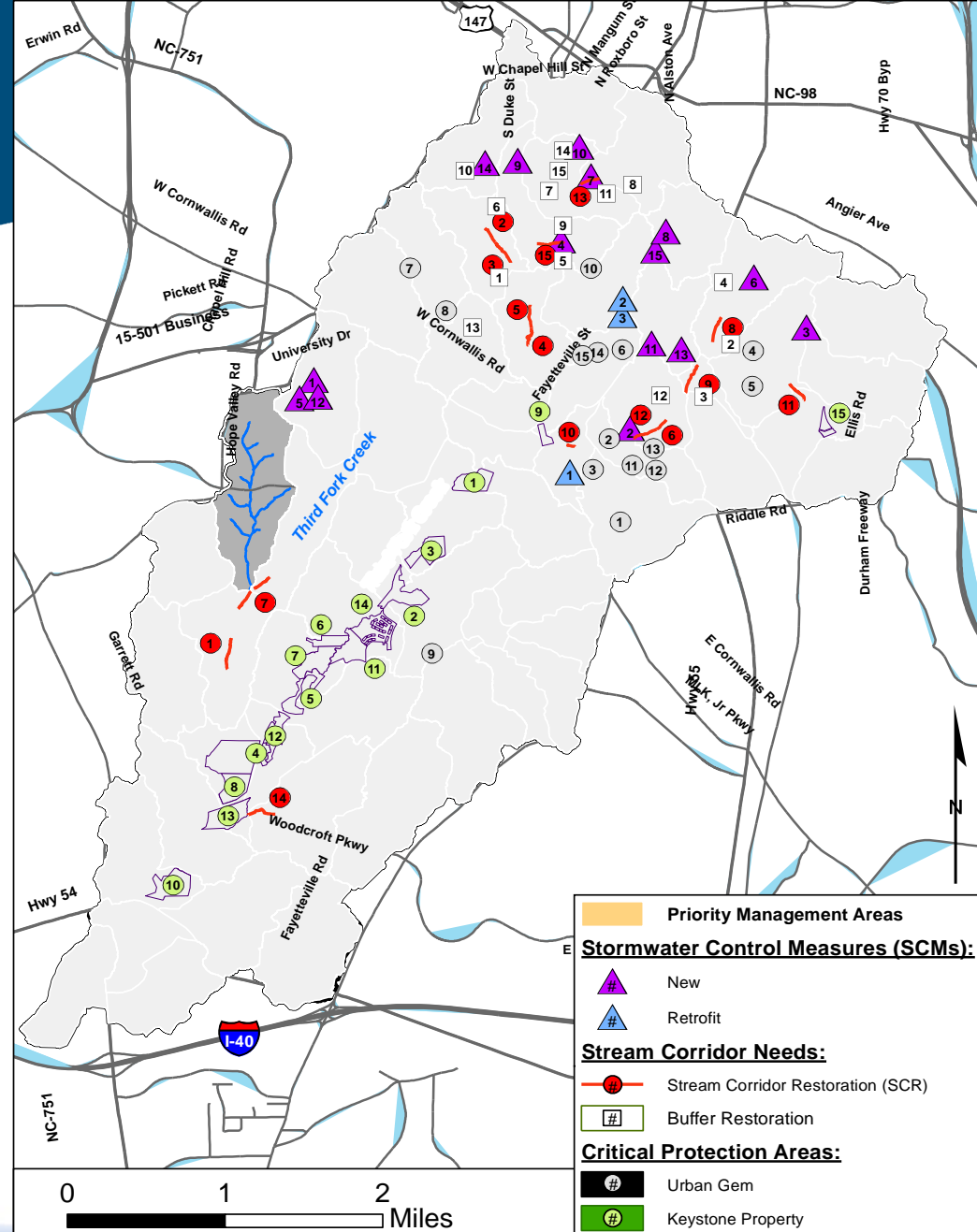
- added benefits to the citizens .

### Implementation Issues

- most feasible in terms of public acceptance, cost, site access, etc.

### Public Safety and Public Property

- most protective of public safety and public property.



A high-speed photograph of a water droplet falling into a pool of water, creating a series of concentric ripples. The background is a deep blue gradient.

# Watershed Protection- Performance Standards for New Development

# First.....

- Adopt clear stormwater management objectives (what you want to achieve)
- Evaluate/select LID practices that you want to encourage (to meet those objectives)

**WASHINGTON D.C. GREEN AREA RATIO LANDSCAPE ELEMENTS****MULTIPLIER****Landscaped area (select one of the following for each area)**

Landscaped areas with a soil depth of less than 24 in.

0.3

Landscaped areas with a soil depth of 24 in. or more

0.6

Bioretention facilities

0.4

**Plantings**

Ground covers, or other plants less than 2 ft tall at maturity

0.2

Plants at least 2 ft tall at maturity

0.3

Tree canopy for all trees 2.5 in. to 6 in. in diameter

0.5

Tree canopy for new trees 6 in. in diameter or larger

0.6

Tree canopy for preservation of existing trees 6 in. to 24 in. in diameter

0.7

Tree canopy for preservation of existing trees 24 in. diameter or larger

0.8

Vegetated wall, plantings on a vertical surface

0.6

**Vegetated roofs**

Extensive vegetated roof over at least 2 in. but less than 8 in. of growth medium

0.6

Intensive vegetated roof over at least 8 in. of growth medium

0.8

Water features (using at least 50% recycled water)

0.2

**Permeable paving**

Permeable paving over at least 6 in. and less than 2 ft of soil or gravel

0.4

Permeable paving over at least 2 ft of soil or gravel

0.5

Enhanced tree growth systems

0.4

Renewable energy generation (area of)

0.5

**Bonuses**

Native plant species

0.1

Landscaping in food cultivation

0.1

# What would you need to do to avoid non-functional, barren practices (and get the LID practices you want)?

- Revise ordinances to eliminate barriers:
  - Landscaping
  - Screening
  - Setbacks
  - Open Space
  - Right-of-Way
  - Barren, unsightly BMPs



# City of Phoenix Code Review

- Code review technical assistance provided by EPA (through Tetra Tech)
- City Team including
  - Office of Environmental Programs
  - Parks and Recreation
  - Water Services Dpt
  - Planning and Development Dpt
  - Street Transportation Dpt
  - Arizona State University
  - Local consultants
  - EPA
- Used EPA Water Quality Scorecard (tested/ modified for urban, arid environment) & LID Checklist



Photo courtesy Summer Waters,UA

# Tool #1: EPA Water Quality Scorecard – Evaluates at 3 Scales

- Site

- Raingardens, bioswales, pervious pavers



Photos courtesy Summer Waters, UA

- Neighborhood/District

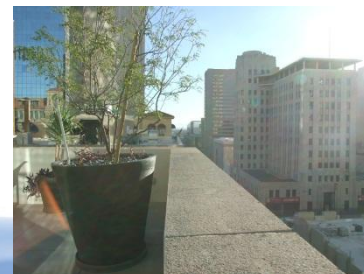
- Street network, parking, mixed use, open space



Photo courtesy Watershed Management Group

- Municipal

- Infill development, infrastructure extension, open space



Photos source City of Phoenix

# Scorecard's 5 Categories

1. Protect natural resources and open space
2. Develop in areas with existing infrastructure
3. Design complete, smart streets that reduce overall imperviousness.
4. Encourage efficient parking.
5. Adopt green infrastructure stormwater management provisions.

Within these – 21 policy areas, more than 230 different policies, codes, or incentives with “points”



# 4 Ways to Impact Change

- Adopt plans/educate
- Remove barriers
- Adopt incentives
- Enact regulations

1.A.2a

## Protection Of Water Bodies/Aquifers

QUESTION: Are no-development buffer zones and other protective tools in place around wetlands, riparian areas, and floodplains that improve/p

GOAL: Protect critical areas such as wetlands, floodplains, lakes, rivers, and estuaries with a mandatory no-development buffer.

WHY: The use of these practices will reduce pollutant loads and hydrologic alterations to water bodies.

Implementation Tools and Policies	Pts. Avail.	Pts. Rec. or N/A	M
<b>ADOPT PLANS/EDUCATE:</b>			
Identify and map critical water resource areas.	1		
The local comprehensive plan contains a water quality protection element with goals calling for protection of identified water bodies and other water resource areas such as wetlands.	1		
Identify key critical water resource areas for protection in jurisdiction's parks and open space plan.	1		
Cooperate in developing regional approaches to watershed protection and stormwater management.	1		
<b>REMOVE BARRIERS:</b>			
Wetlands and other water bodies and buffer areas qualify for credit against local open space dedication/set-aside regulations.	1		
<b>ADOPT INCENTIVES:</b>			
Protected water bodies and buffer areas qualify for twice the credit (or more) against open space requirements set by the municipality.	1		
Restoration of degraded riparian/wetland areas qualifies for additional open space credit within the local municipal system.	1		
Transfer of density from protected riparian areas/buffers to upland portions of development sites.	1		
<b>ENACT REGULATIONS:</b>			
Riparian and wetland buffer areas required by local land use regulations · Buffer is at least 50 feet (as measured from the top of bank) = 1 point · Buffer is at least 100 feet (as measured from the top of bank) = 2 points · Buffer is greater than 100 feet (as measured from the top of bank) = 3 points	1 to 3		
Critical water resource areas cannot be counted in calculating allowable density on a site (e.g., on a 200-acre site with 50 acres of wetlands, only 150 acres can be used to calculate density under zone district regulations, and only those 150 acres may be developed).	1		
		<b>PAGE TOTAL</b>	<b>SUBTOTAL FROM PREVIOUS PAGE</b>
		+	_____

# Tool #2: LID Opportunity Checklist

- More detailed focus on site scale code barriers/opportunities
- 5 goals
  - Minimize effective or connected impervious area
  - Preserve the hydrologic functions of unpaved areas
  - Harvest rainwater to enhance potable and nonpotable supply
  - Allow and encourage use of multi-use stormwater controls
  - Manage stormwater to sustain stream functions



**Degree of Importance Key to Symbols:**

- Essential
- ◐ Very important
- Important
- NI Not important to the City of Phoenix

**GOAL #1: MINIMIZE EFFECTIVE OR CONNECTED IMPERVIOUS AREA**

Objective: Minimize impervious area associated with streets.

Objective: Minimize impervious area associated with parking.

Objective: Minimize impervious area associated with driveways and sidewalks.

Objective: Clustering development.

Objective: Incorporate sustainable hydrology practices into urban redevelopment.

<b>GOAL #1 KEY QUESTIONS</b>	<b>DEGREE OF IMPORTANCE</b>	<b>COMMENTS</b> <b>(INDICATE ORDINANCE FINDINGS "YES" OR "NO".</b> <b>WHEN "NO", NOTE SPECIFIC LOCATION OF BARRIER IN</b> <b>CODE)</b>
<b>Effective Impervious Area</b>		
1. Does the code distinguish between pervious paved areas and impervious paved areas in the determination of onsite stormwater requirements?	◐	
2. Does the code definition of impervious area distinguish between impervious area connected to the storm drain system (effective impervious area) and disconnected impervious area?	◐	
<b>Streets</b>		
1. For residential development, are the street pavement widths allowed to be between 18 to 22 feet, with curb pullouts for passing of large vehicles?	●	
2. Are travel lanes allowed to be from 12 to 10 feet (or less), with curb pullouts for passing of large vehicles?	●	

Barrier	Optional Approach	Example Language (To Address Barriers)
<b>Streets</b>		
<p>1. City of Phoenix Street Planning and Design Guidelines. The paving width of local single-family residential streets is typically required to be 28 to 32 feet, and 40 feet for minor residential collector streets. Travel lanes for local single-family residential streets are required to be greater than 14 to 16 feet wide.</p>	<p>Amend the Phoenix Street Planning and Design Guidelines (and any related zoning ordinance and/or subdivision ordinance provisions) for right-of-way and paving widths to allow exceptions for narrower streets. Encourage Green Infrastructure practices such as curb pullouts with bioretention to allow for passing of larger vehicles and enhanced stormwater management.</p> <p>Or</p> <p>Adopt standard Green Infrastructure standard street drawings as part of the Street Planning and Design Guidelines and Street Landscape Standards.</p>	<p>“An exception to a requirement of a paving width for residential streets may be recommended by the Planning Commission to the Mayor and City Council on the merits of a particular case upon consideration of the following criteria: type of curbing, building heights, building density, use of Green Infrastructure stormwater management practices, and other applicable factors. In no case shall the paving width be less than 24 feet, provided there will be no less than 16 feet of right-of-way.”</p> <p>If the use of “curb” (distance to be measured from face of curb) is perceived as issue for implementation of Green Infrastructure streets, amend to specify “curb or street edge.”</p> <p>“Where a portion of a project or public improvement has been designed specifically as a Green Infrastructure stormwater management feature, the City Manager or designee shall have the authority to waive the dimensional requirements of this section to enable the installation of Green Infrastructure stormwater management measures.”</p> <p>Or</p> <p>Adoption and use of standard Green Infrastructure street drawings as part of the Street Planning and Design Guidelines and Street Landscape Standards.</p>
<p>2. City of Phoenix Street Planning and Design Guidelines. Curb bumpouts and curb extensions are allowed as traffic calming devices. However, they do not appear to be used as bioretention stormwater management opportunities. Moreover, the design specifications do not allow flexibility that could better accommodate Green Infrastructure practices.</p>	<p>Amend the Street Planning and Design Guidelines and related zoning ordinance and/or subdivision ordinance provisions regarding curb and street dimensional and material requirements. Provide waiver for uses of Green Infrastructure practices.</p> <p>Or</p> <p>Adopt standard Green Infrastructure standard street and</p>	<p>If the use of “curb” (distance to be measured from face of curb) is perceived as issue for implementation of Green Infrastructure streets, amend to specify “curb or street edge.”</p> <p>“Where a portion of a project or public improvement has been designed specifically as a Green Infrastructure stormwater management feature, the City Manager or designee shall have the authority to waive the dimensional requirements of this section to enable the installation of Green Infrastructure stormwater management measures.”</p> <p>“...or with materials and sizes necessary to support specifically designed Green Infrastructure drainage functions [consistent with the</p>

# City of Phoenix Code Review – Key Findings

## Existing **Strong Practices**

- Community level plans and incentives to promote infill, redevelopment, and mixed use
- Regulations promoting and protecting urban tree canopy
- Requirements for drought tolerant plants
- Tree care workshops and Citizen Forester Program
- Progressive stormwater retention standards (for 100-year, 2 hour duration storm)
- Policy favoring multi-use stormwater controls

# City of Phoenix Code Review – Key Findings

## Existing **Barriers**

- Lack of tree protection regulations for existing, private development
- Need to allow LID in street right-of-way
- Requirements for overly wide streets, right-of-ways, and parking areas
- Parking area screening and landscaping requirements

# City of Phoenix Code Review – Key Findings

## Existing **Barriers**

- Lack of weather based or moisture based irrigation controls
- Lack of design templates for LID in Street Landscape Standards & Street Planning and Design Guidelines
- Lack of LID Design Manual

Example streetscape  
LID standard



# City of Phoenix Code Review – Key Findings

## Existing **Barriers**

- Lack of inspections program for post-construction BMPs
- Lack of off-site mitigation provisions for developed infill areas (linked to habitat conservation goals and regional BMPs)

Potential offsite mitigation site linked to conservation goals



Photo courtesy City of Phoenix



A high-speed photograph of a water droplet falling into a pool of water, creating a series of concentric ripples. The background is a deep blue gradient.

Healthy environment  
Healthy economy  
Healthy community

Triple Bottom Line

# Greener Infrastructure - Triple Bottom Line Benefits

- Job Creation
- Reduced Infrastructure Costs
- Increased Property Values
- Increased Recreational Opportunities



# Greener Infrastructure - Triple Bottom Line Benefits

- Carbon Sequestration
  - Offsetting annual carbon emissions from autos/homes
- Reduced Energy Use
  - Reduction of kWh in energy use and energy savings



# Greener Infrastructure - Triple Bottom Line Benefits

- Load Reductions and Runoff Benefits
  - TSS removed per year
  - Reduction in runoff
- Groundwater recharge



Photo courtesy Watershed Management Group

# Triple Bottom Line Analysis – Other Benefits

- Interesting research findings on less “quantifiable” benefits such as
  - Downtown revitalization
  - Productivity
  - Health
- Here’s a quiz

# Triple Bottom Line Analysis – Other Benefits

- Amenity and comfort ratings are \_\_\_\_\_% higher for a tree-lined sidewalk compared to a non-shaded street.
  - 20%
  - 60%
  - 80%

# Triple Bottom Line Analysis – Other Benefits

- Amenity and comfort ratings are \_\_\_\_\_% higher for a tree-lined sidewalk compared to a non-shaded street.
  - 20%
  - 60%
  - 80%

# Triple Bottom Line Analysis - Other Benefits

- Desk workers who can see nature from their desks experience approx \_\_\_\_% less time off sick.
  - 10%
  - 25%
  - 45%



# Triple Bottom Line Analysis - Other Benefits

- Desk workers who can see nature from their desks experience approx \_\_\_\_% less time off sick.
  - 10%
  - 25%
  - 45%

# Triple Bottom Line Analysis - Other Benefits

- Study of green space amenity values related to customers' price valuation, participants priced goods \_\_\_\_\_% higher in landscaped districts.
  - 3%
  - 9%
  - 12%

# Triple Bottom Line Analysis - Other Benefits

- Study of green space amenity values related to customers' price valuation, participants priced goods \_\_\_\_\_% higher in landscaped districts.
  - 3%
  - 9%
  - 12%

# Triple Bottom Line Analysis - Other Benefits

- Survey of one community, \_\_\_\_\_% of the public preferred to patronize commercial establishments whose structures and parking lots have trees and landscaping.
  - 50%
  - 75%
  - 100%

# Triple Bottom Line Analysis - Other Benefits

- Survey of one community, \_\_\_\_\_% of the public preferred to patronize commercial establishments whose structures and parking lots have trees and landscaping.
  - 50%
  - 75%
  - 100%

# Triple Bottom Line Analysis - Other Benefits

- People make more walking trips when they are aware of natural features, and judge distances to be greater than they actually are in less green neighborhoods.
  - True
  - False

# Triple Bottom Line Analysis - Other Benefits

- People make more walking trips when they are aware of natural features, and judge distances to be greater than they actually are in less green neighborhoods.
  - True
  - False

# Contact information...

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