



SEPTEMBER 21-23, 2015
EL PASO, TEXAS



**FIRST MEETING OF
THE BORDER 2020 PROGRAM**
National Coordinators

Climate Change and Green Infrastructure In the Arid Southwest

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Office of Integrated Planning
City of Tucson



Climate Change and Green Infrastructure



A Few Considerations



IMPACTS:

Deaths and Injuries

(e.g. dehydration, heat stroke, respiratory ailments from ozone level exceedances)



Delayed/canceled flights

On June 26, 1990 temperatures reaching 122°F caused the closure of Sky Harbor Airport in Phoenix for several hours.



Exacerbates wildfires and drought conditions



Blackouts

On June 29, 2013 extreme heat knocked out power for 2 hours in Las Vegas

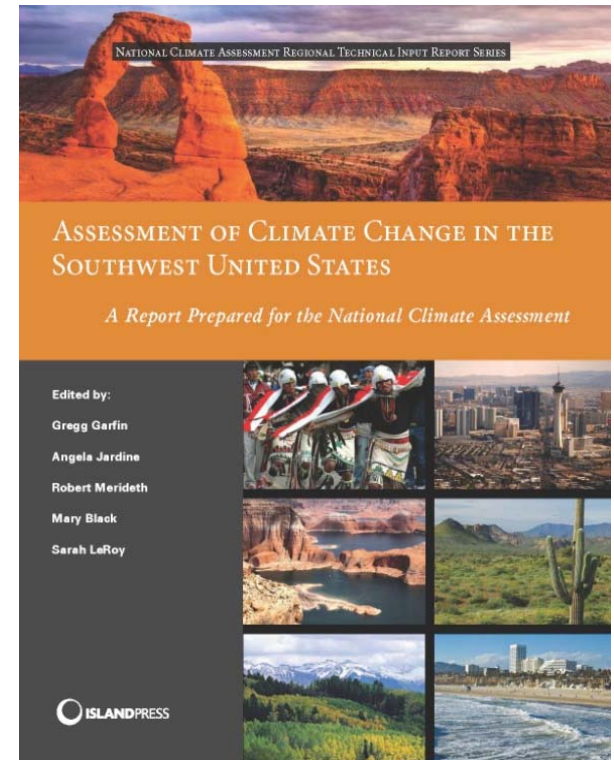
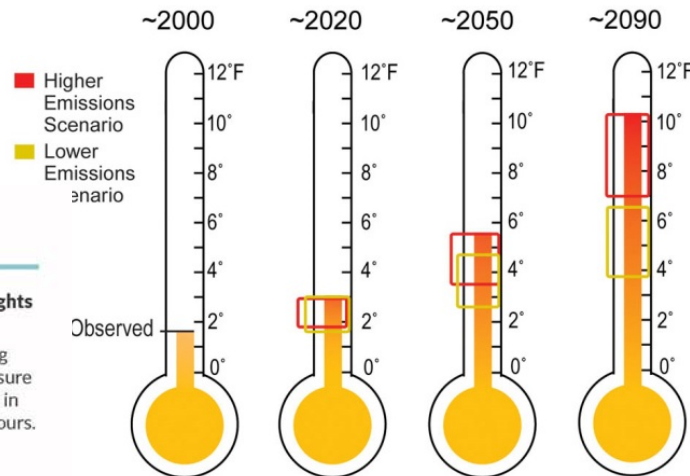


Buckled roads

In late June 2013 extreme heat caused an interstate on-ramp to buckle in Salt Lake City



Increased water use



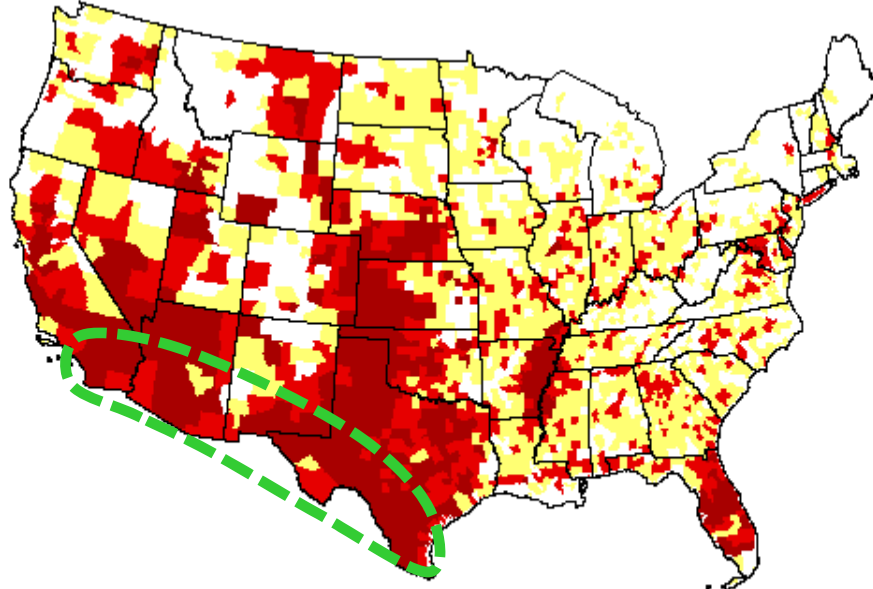
Garfin, G., G.Franco, H. Blanco, A.Comrie, P.Gonzalez, T.Piechota, R.Smyth, and R.Waskom, 2014: Ch. 20: Southwest. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J.M.Melillo, Terese (T.C.) Richmond, and G.W.Yohe, Eds, U.S. Global Change Research Programs .

Climate Change and Green Infrastructure

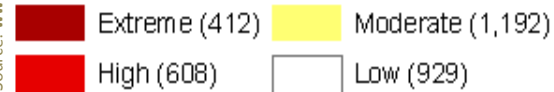


A Few Considerations

Water Supply Sustainability Index (2050) With Climate Change Impacts

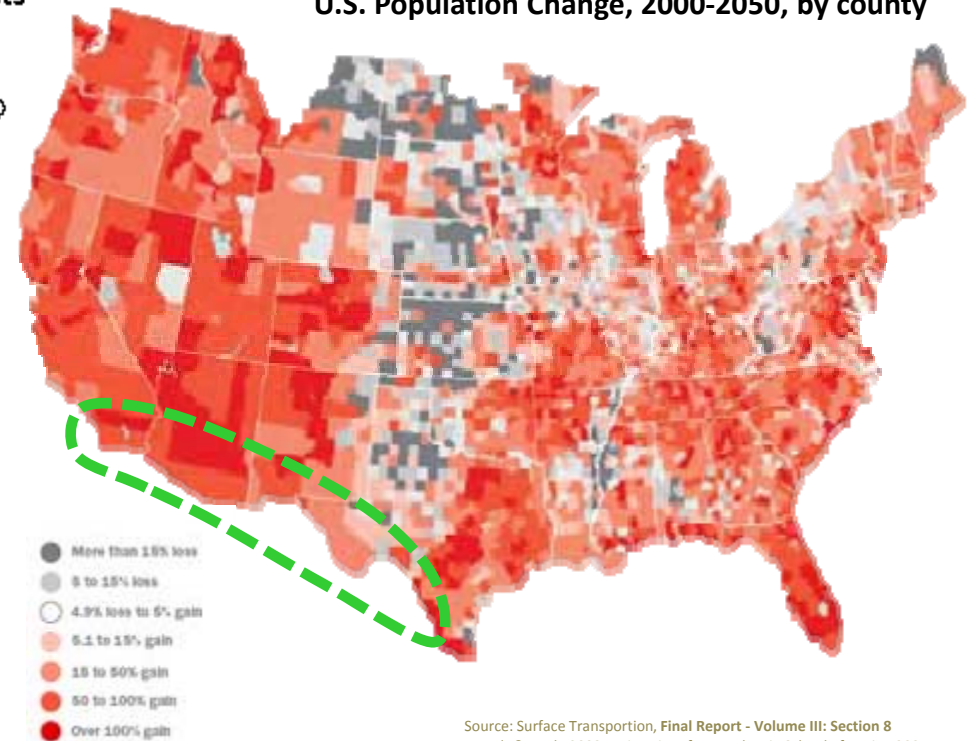


Number of Counties for each Category in Parentheses



Source: www.nrdc.org/globalwarming/watersustainability

U.S. Population Change, 2000-2050, by county

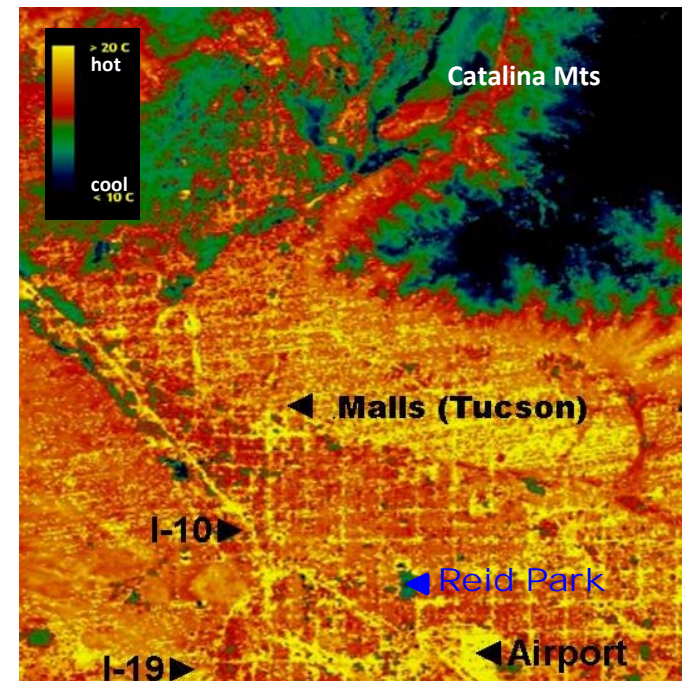
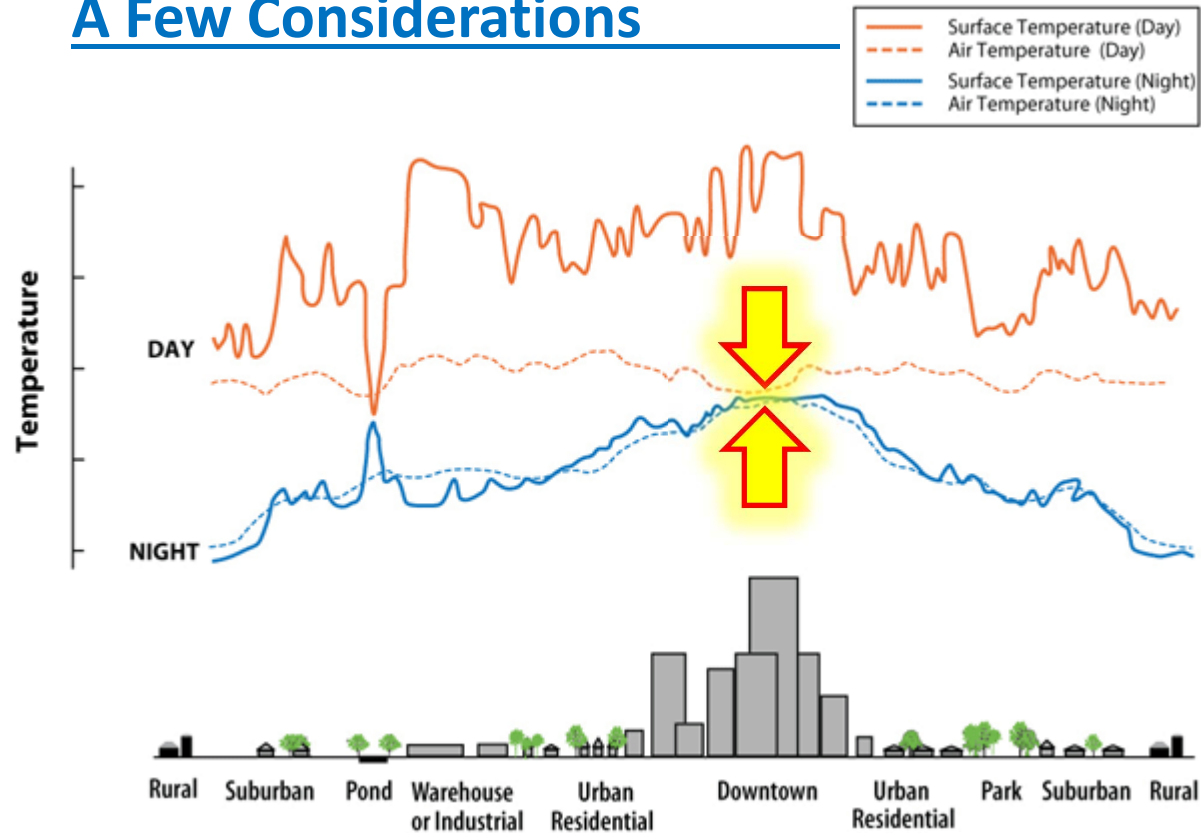


Source: Surface Transportation, Final Report - Volume III: Section 8
Woods & Poole 2002; University of Pennsylvania School of Design 2004

Climate Change and Green Infrastructure

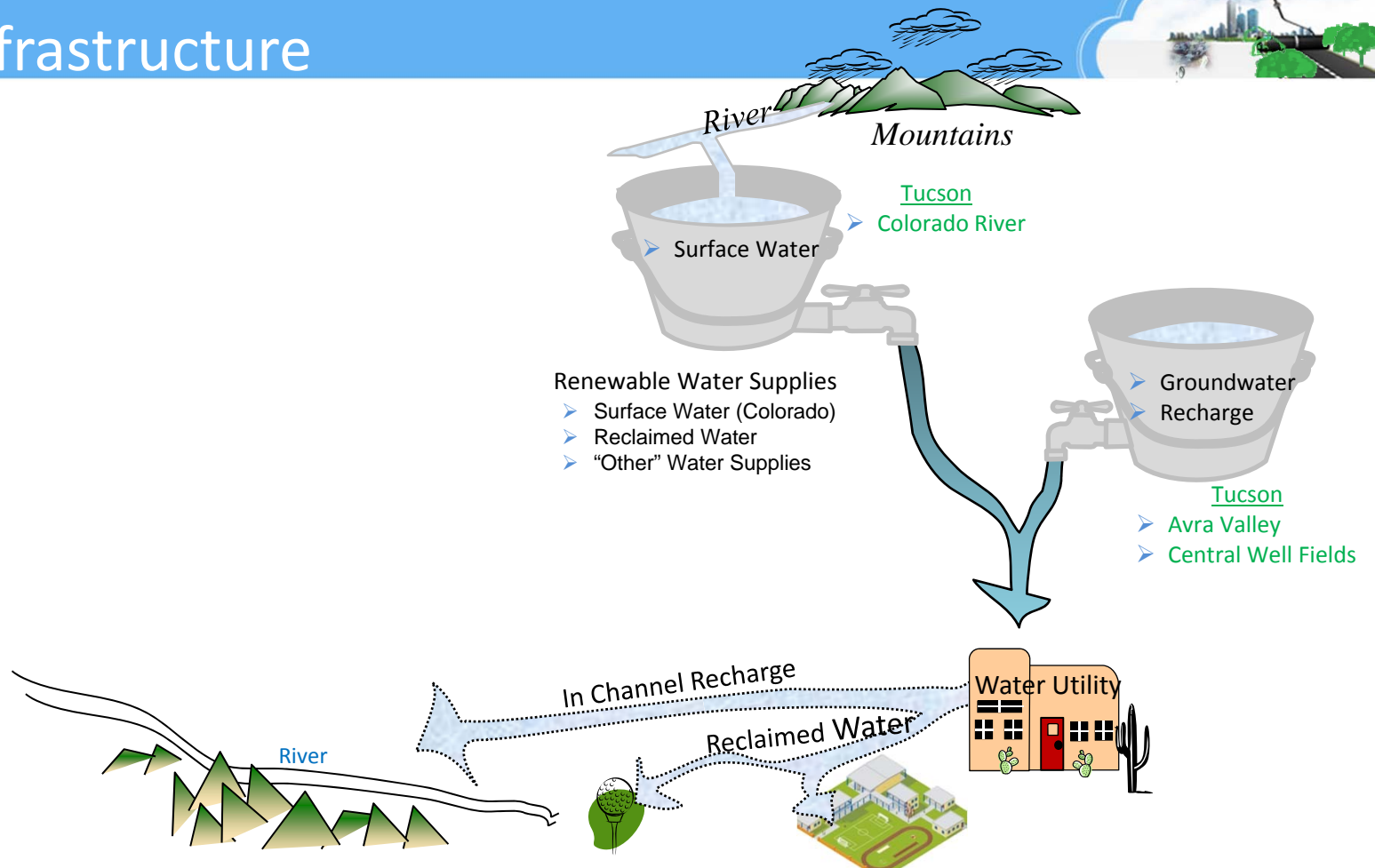


A Few Considerations

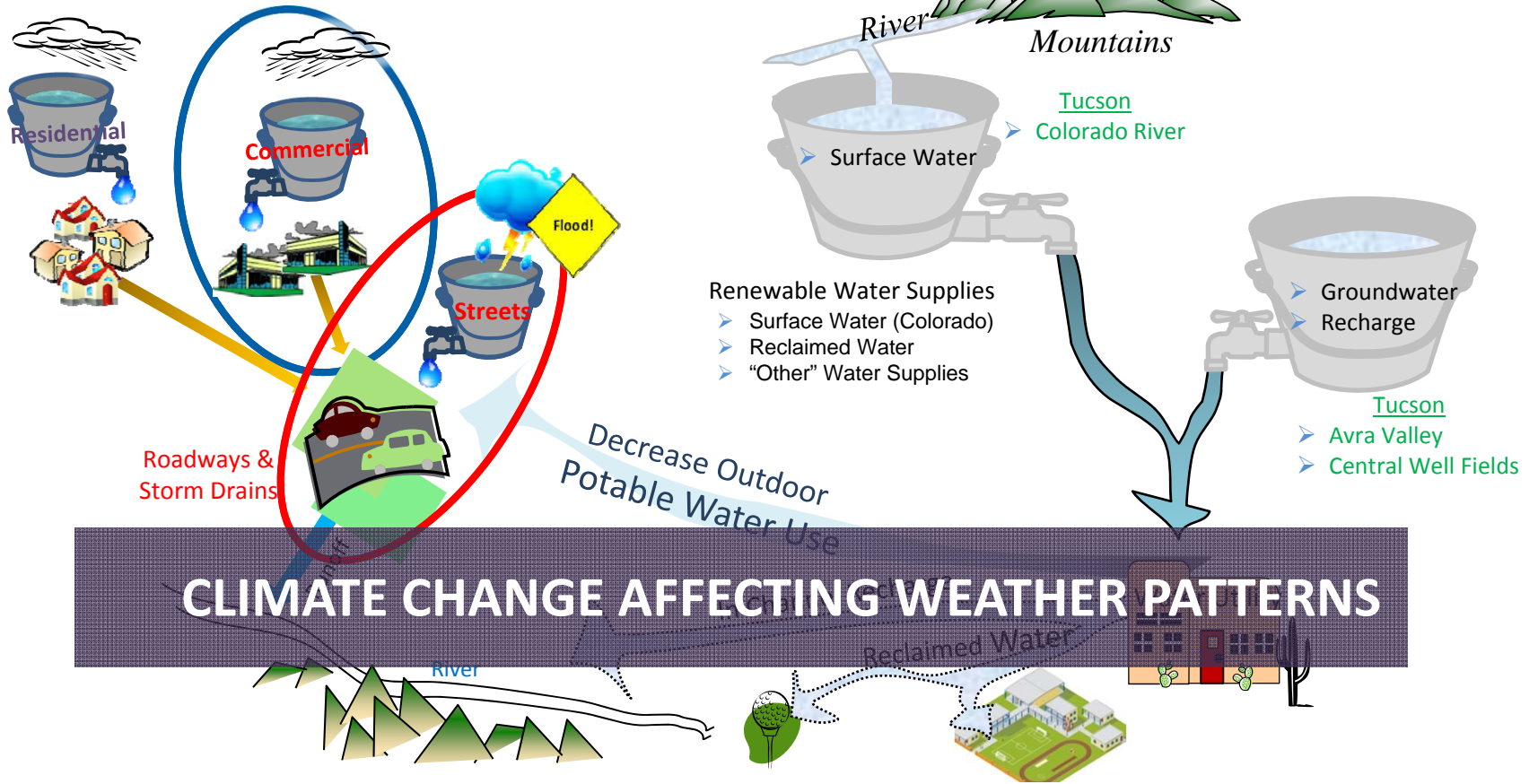


Tucson Basin | 2005 | Kinetic Surface Temperature

Climate Change and Green Infrastructure



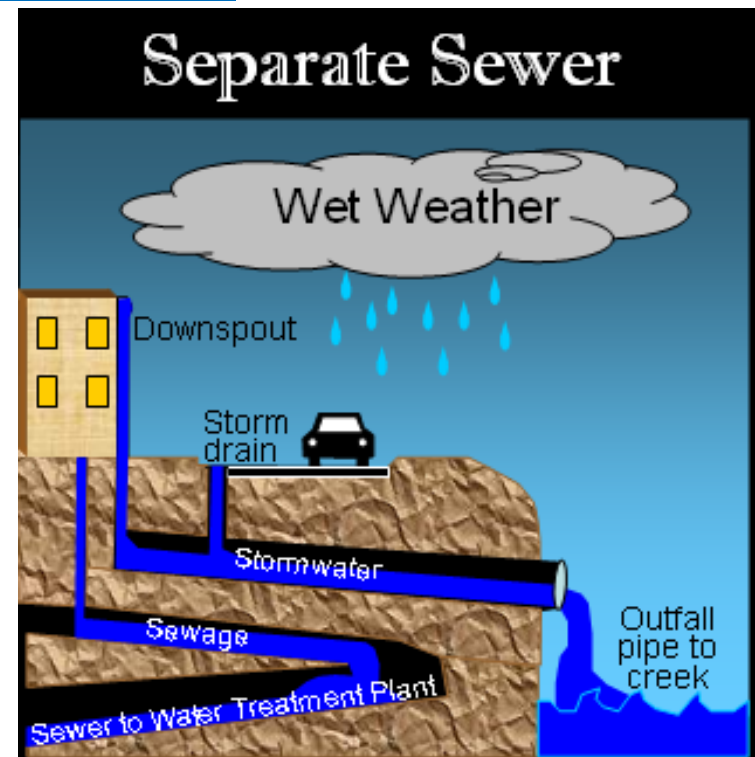
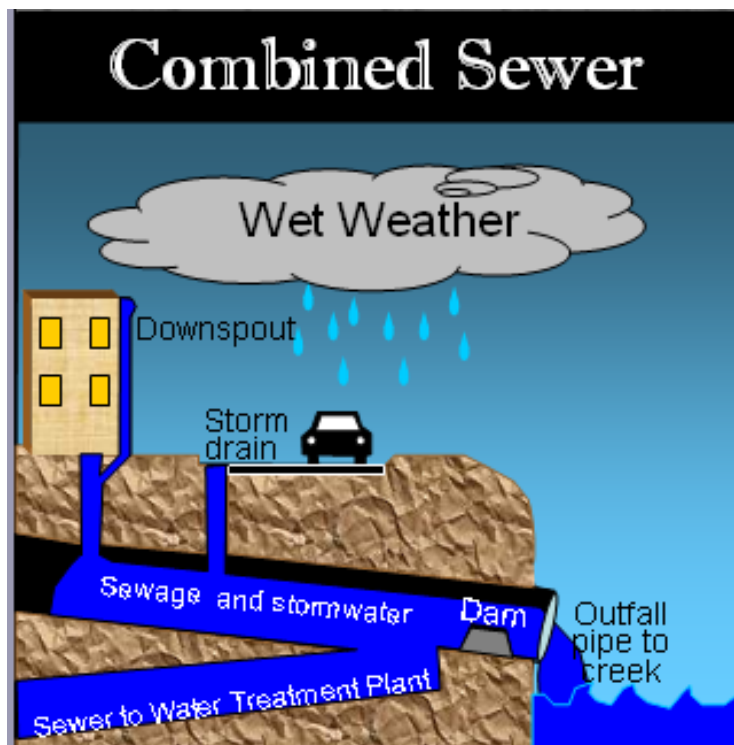
Climate Change and Green Infrastructure



A Primer of Green Infrastructure



Story of 2 Stormwater Systems



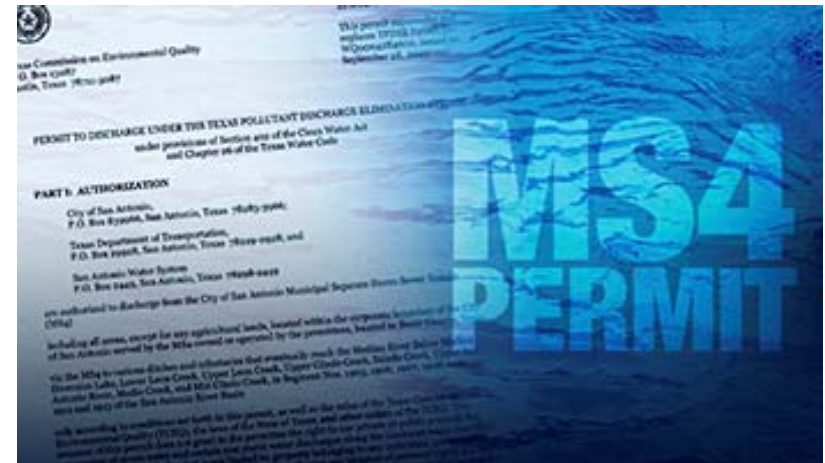
A Primer of Green Infrastructure



Story of 2 Stormwater Systems : Drivers



CSO: Consent Decrees



MS4: Permit

A Primer of Green Infrastructure



A Few Elements



URBAN GREEN INFRASTRUCTURE

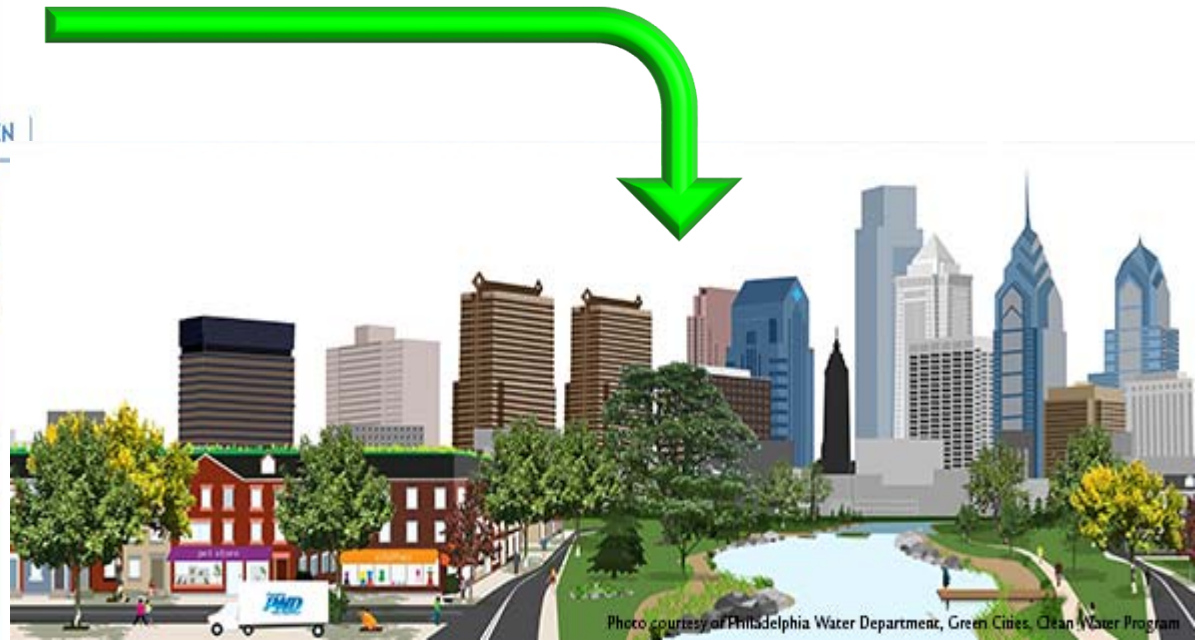
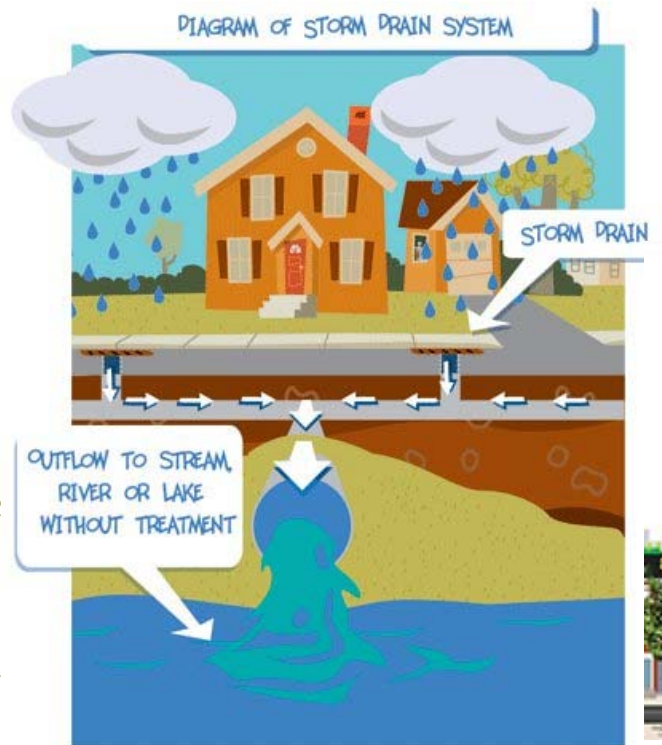


Source: Upstream Matters, Illinois
Watershed Conservation,
Dec. 2013

A Primer of Green Infrastructure



Shift of Single Approach to Multi-disciplinary Approach



A Primer of Green Infrastructure



Green Stormwater Infrastructure Installations



GREEN INFRASTRUCTURE: DIFFERENT DRIVERS

Professional installations

Community-based installations

Source: <http://greenworkspc.com/stormwater/zidell-green-infrastructure/>

Source: <http://www.sonorainstitute.org/where-we-work/southwest/santa-cruz-river/315-water-harvesting.html>

(R)Evolution of Green Infrastructure

The Tucson Story



Regulatory Tools

- Ordinances/Codes = Mandatory
 - Commercial Water Harvesting Ordinance (Code)
- Policy = General Guidance; but has weight internally
 - Standard curb cut details
 - Green Streets Active Practice Guidelines (APG)



(R)Evolution of Green Infrastructure

The Tucson Story



Beginning:

- Applying GI practices
- Sporadic application



1998: median captures onsite rainwater



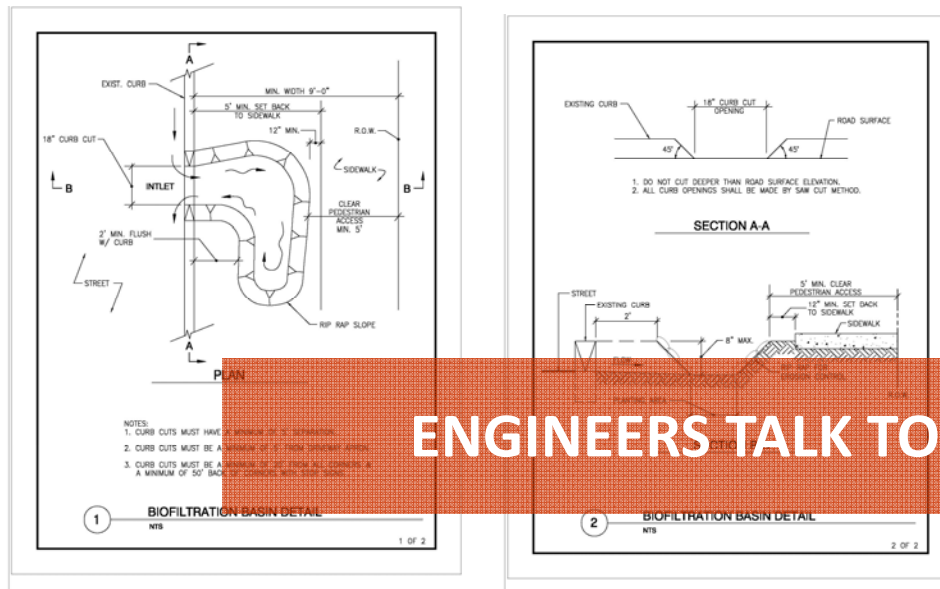
2005: median captures onsite rainwater

(R)Evolution of Green Infrastructure

The Tucson Story



Late 1990's, early 2000's:
Transportation landscape architect
attempting to develop curb cut standards



ENGINEERS TALK TO ENGINEERS



Standard Details on-line

(R)Evolution of Green Infrastructure

The Tucson Story



City Manger's Office
Special Projects: Scott Ave
Completed 2009



Parks & Recreation:
Camino de Campestre
Completed 2010

(R)Evolution of Green Infrastructure

The Tucson Story



**INFRASTRUCTURE BUILDING COMMUNITY
then
COMMUNITY IMPROVES INFRASTRUCTURE**

Downtown Links



Houghton Road

Analyzing Economic Benefits

of Green Infrastructure



Managing stormwater infrastructure : At What



Gray Infrastructure:

Escalating needs

- Deferred Maintenance
- Growing communities
- Climate Change



Analyzing Economic Benefits

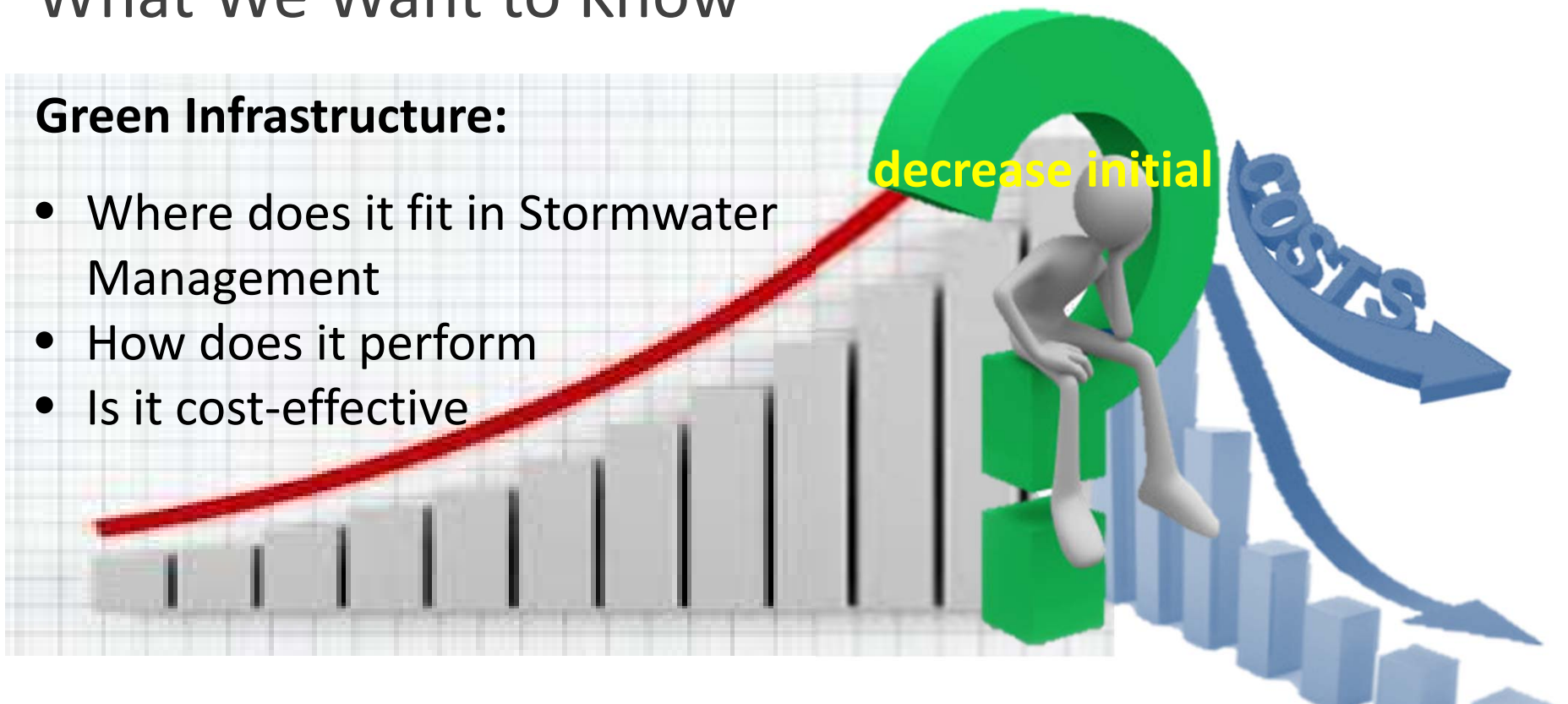
of Green Infrastructure



What We Want to Know

Green Infrastructure:

- Where does it fit in Stormwater Management
- How does it perform
- Is it cost-effective



Analyzing Economic Benefits of Green Infrastructure



Analysis: the Bean Counter



Analysis: Benefits of the Bean

Analyzing Economic Benefits of Green Infrastructure



Tucson Story

Does GI Pay For Itself



A Bit Complicated

Analysis: why do an analysis

- Evaluate alternatives
- Does cost exceed benefits
(Expense + Revenue)
- ✓ **Demonstrate range of benefit**

(Public : Triple Bottom Line | more than cash flow)

Tool: methodology

- Consultant
- Stormwater software

Metrics: Universal standards/site specific

- Expense / benefit seeking
- Net present value (NPV) of program
- Net present value to owners
- Net present value to stakeholders
- Avoided costs
- Monetized social & environmental benefits
- Life-cycle costs

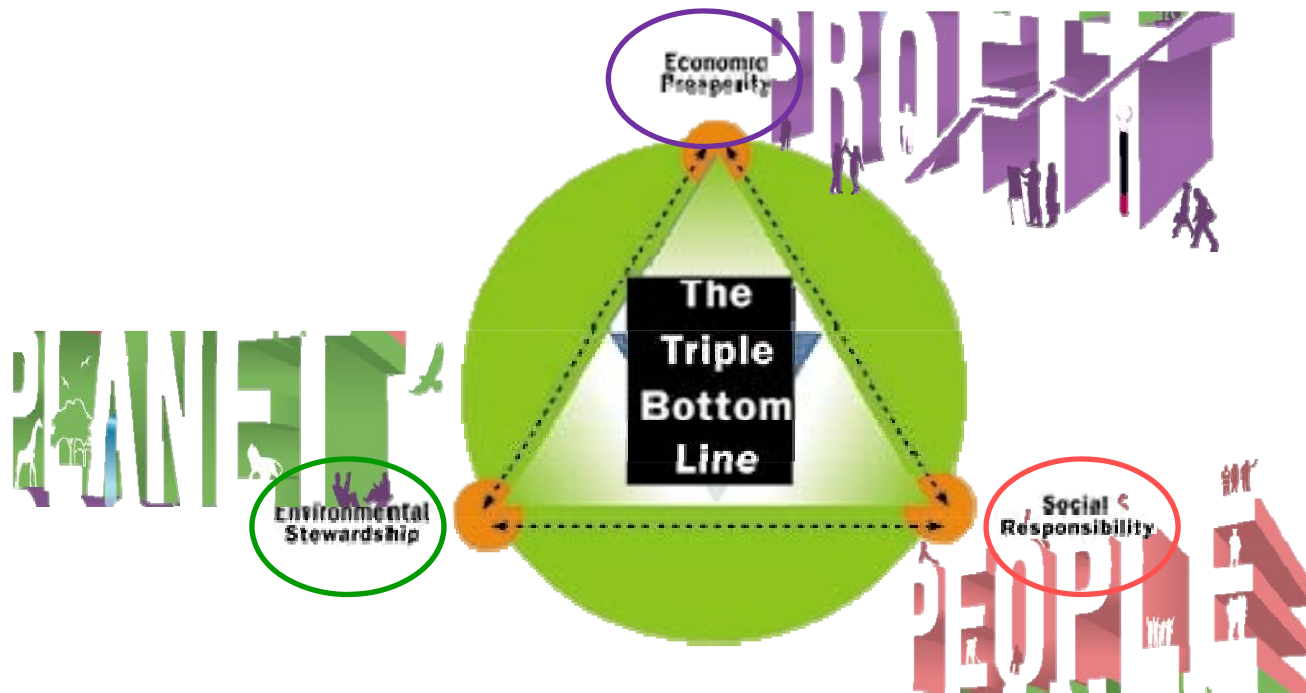
Analyzing Economic Benefits

of Green Infrastructure

Triple Bottom Line



Green Infrastructure Benefit : Triple Bottom Line



Economic Benefits

of Green Infrastructure

Tucson Story



Green Infrastructure Benefit : Triple Bottom Line



Social : **People**

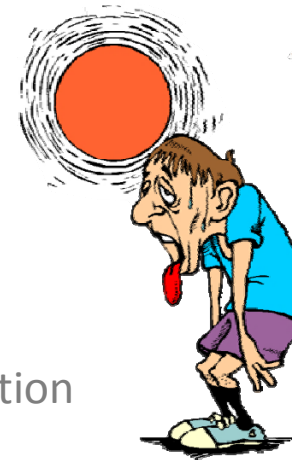
- Reduced flooding
- Greenways
- Human health

Environmental : **Planet**

- Water quality
- Air quality
- Urban heat stress reduction

Economic : **Profit**

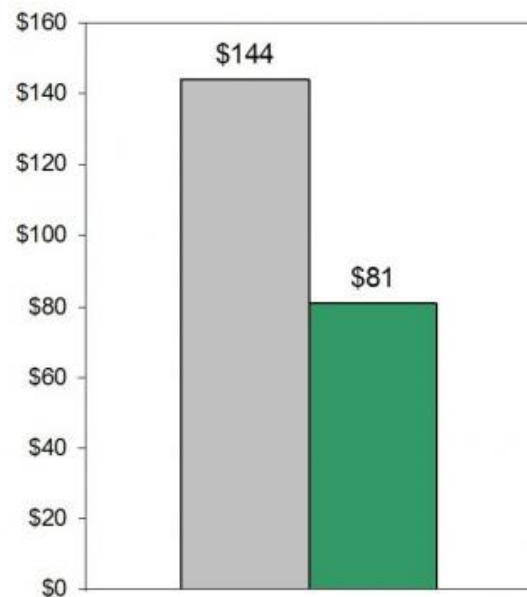
- Increase property value
- Water Security
- Green jobs



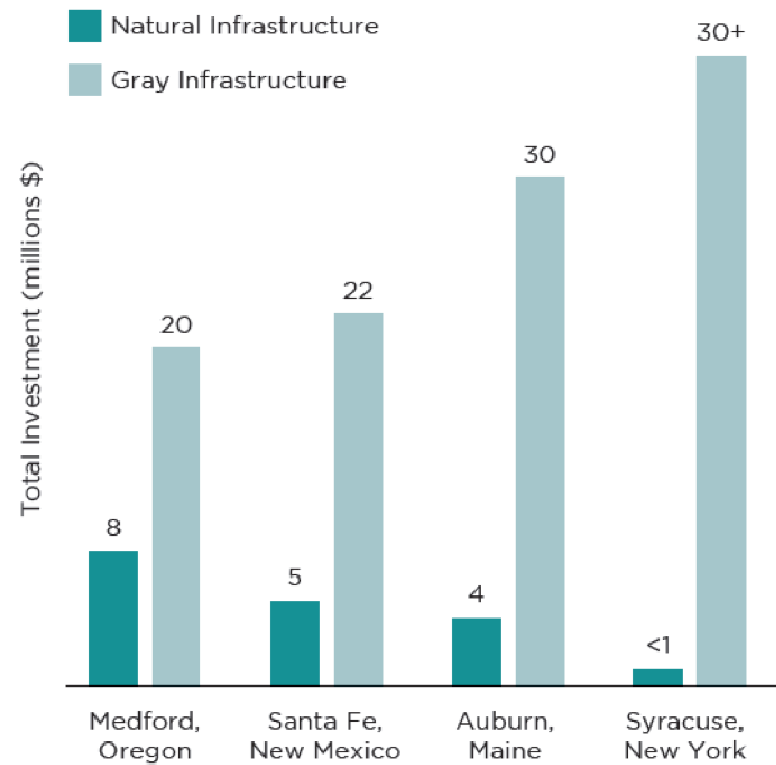
Economic Benefits of Green Infrastructure



Brooklyn Creek Basin



Source: City of Portland: Comparison replacing Gray only vs Combining Gray and Green Infrastructure



Source: McKinsey Report as reported by World Resources Institute, August, 2005

Analyzing Economic Benefits

of Green Infrastructure

Triple Bottom Line



The Business Case Evaluations for Tucson Projects

Analysis: Demonstrate range of net benefits

Tool: AutoCASE® | Business Case Evaluator

Metrics: Monetizing values, life-cycle calibrated to local weather, regional economy, demographics

Tucson Projects

Road: Silverbell Road

Garden: Blue Moon

TOP 5 MOST COSTLY FLOOD EVENTS			
	Cost (millions \$)	City	Date
1	530	Denver	June, 1965
2	400+	Flagstaff	January, 1993
3	400	Phoenix	January, 1993
4	300+	Boulder County	September, 2013
5	300	El Paso	August, 2006
Total	\$1.93 BILLION		

Source: CLIMAS Flood Fact Sheet

Analyzing Economic Benefits

of Green Infrastructure

Triple Bottom Line



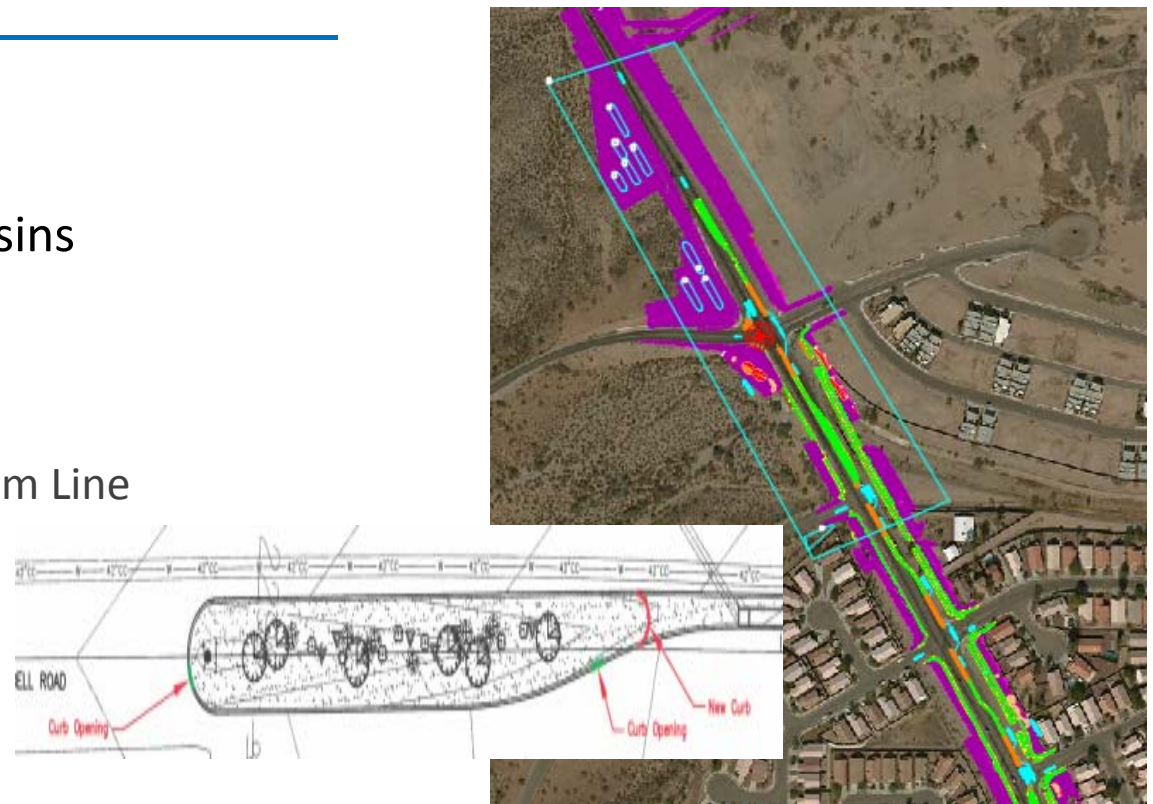
Silverbell Re-Design

GI Feature Added:

- Bioretention
- Water Harvesting basins
- Trees
- Traffic Calming

Analysis: Evaluate Triple Bottom Line

Tool: AutoCASE[®]



Analyzing Economic Benefits

of Green Infrastructure

Triple Bottom Line



Silverbell Who (Stakeholder) Benefits

Community:

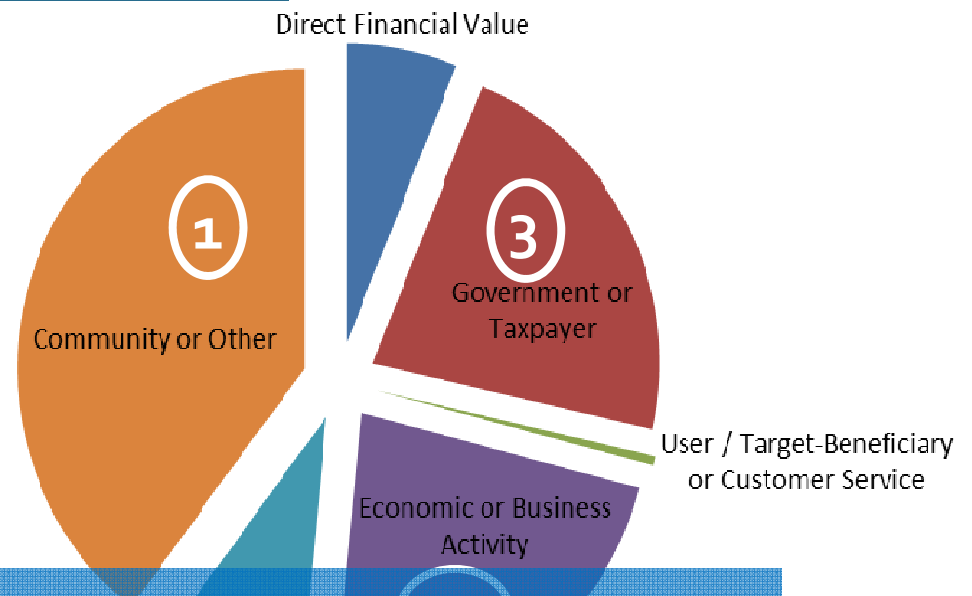
- Reduced traffic mortality
- Social cost of water; security

Economic

- Reduced accidents
- Reduced social cost of water

Government/Taxpayer

- Decreased traffic accidents
- Decreased flooding risk;
- Reduced carbon + air pollution



THE COMMUNITY BENEFITS GREATER THAN BENEFITS TO THE INDIVIDUAL DRIVER

Analyzing Economic Benefits

of Green Infrastructure

Triple Bottom Line



Blue Moon Community Gardens

GI Feature Added:

- Cistern
- Water harvesting basins

Analysis: Demonstrate range of net benefits

Tool: Business Case Evaluator



Economic Benefits

of Green Infrastructure

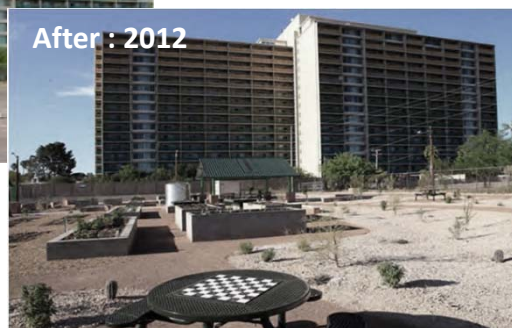
in Tucson



Blue Moon Community Gardens

Background:

- HUD project
- Elderly / Low / Fixed income



Economic Benefits of of Green Infrastructure

in Tucson



Blue Moon Community Gardens

Social

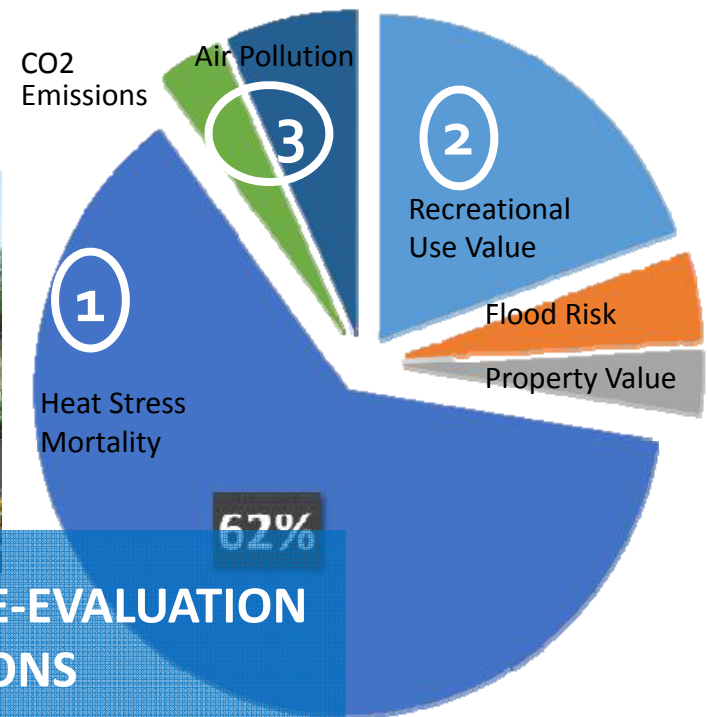
- Heat Stress Mortality
- Recreation

Environment

- Air Pollution

Economic

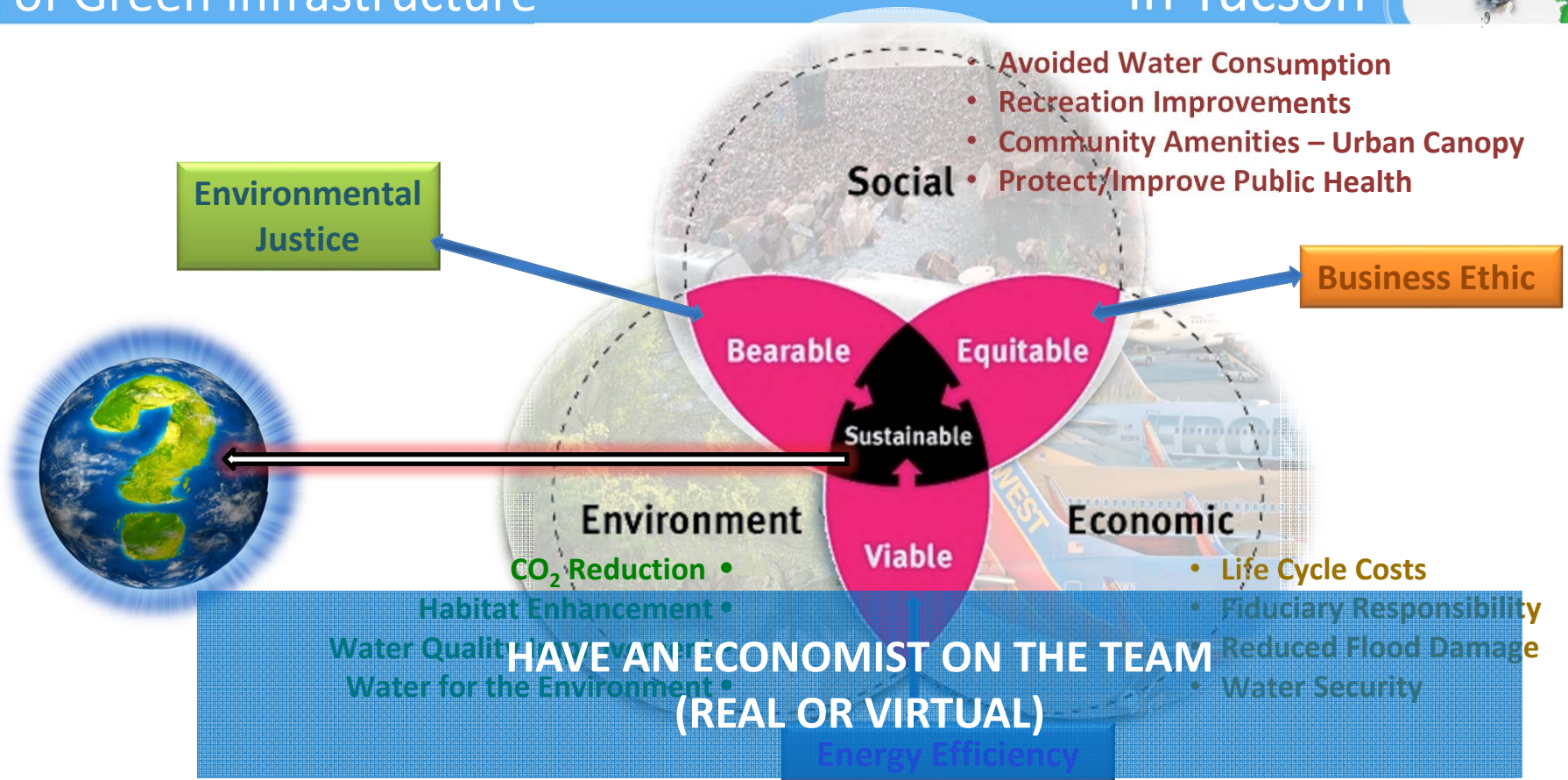
- Property Value
- Flood Risk



**ECONOMIC ANALYSIS MAY REQUIRE RE-EVALUATION
BASED ON UNIQUE SITUATIONS**

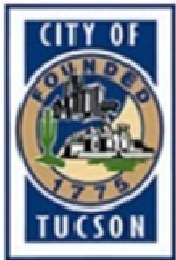
Triple Bottom Line of Green Infrastructure

in Tucson





ACKNOWLEDGEMENTS



- Office of Integrated Planning
- Tucson Water
- Dept. of Transportation



QUESTIONS & RESOURCE



Pima County LID Working Group Website:

<http://webcms.pima.gov/cms/one.aspx?portalId=169&pageId=65263>

AutoCASE™ Beta Testing Project: Evaluation of GI/LID Benefits in the Pima County Environment:

[Same as above](#)

Business Case Evaluator for Stormwater Management Website:

<http://impactinfrastructurellc.com/blog/?p=233>



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