Adapting to Extreme Heat, Flooding & Drought in Urban Areas of the Desert Southwest

Integrating GI/ID into Hazard Mitigation Plans (HMPs) for Maricopa County, City of Phoenix, and City of Tempe December 10, 2019, Marie Light, Pima County Department of Environmental Quality Irene Ogata, City of Tucson, Tucson Water

STAGES OF INNOVATION



INNOVATION ADOPTION LIFECYCLE

2011: Conceptualize LID for arid southwest at neighborhood scale

2015: Build tools for Early Adopters

- Guidance manuals, case studies, GIS
- Institutionalize GI/LID
- Assess Life-cycle costs

3 2019: Increase construction & care of GI/LID

- Outreach
- Training professionals
- Design scales: lot, neighborhood, watershed, developments
- Costs

INFORMATION FOR ARID SOUTHWEST

For those people ready to develop GI/LID what do they need?

- Technical information: GI/LID Guidance Manual
- Examples of success: Case Studies
- Mesa Toolkit



CASE STUDIES Low Impact Development Green Infrastructure



LID WORKING GROUP SPRING 2019



Low Impact Development and Green Infrastructure Guidance Manual August 2014 (Draft)





GIS WEBSITES

- Pima Association of Governments GI Prioritization Tool
- Collaborative efforts:
 - Jurisdictions shared costs to purchase additional layers
 - RFCD processed LiDAR to obtain flow paths
- Relevant information
 - Plan for what you want to see
 - Select layers providing the most bang for the buck.
 - Keep in mind that each entity is solving a different problem
 - Control flooding
 - Revitalizing a neighborhood
 - Supporting alternate transportation (shaded bu sstops... etc)
- Design Details (here or another slide)

INSTITUTIONALIZING GI/LID

- Resolutions (PAG 2012, 2015)
- Ordinances
 - Incentives (encourage new building)
 - Requirements (safety)
- Partnerships
 - Green Streets, Complete Streets
 - Sustainability
 - Universities
 - Businesses
- Utilities (water or stormwater)

CITY OF TUCSON ORDINANCES





PLANNING AND DEVELOPMENT SERVICES DEPARTMENT Commercial Plan Review

Rainwater Harvesting Ordinance

GET READY FOR COMMERCIAL RAINWATER HARVESTING ORDINANCE !!!

On October 14, 2008, the City of Tucson Mayor and Council adopted the Commercial Rainwater Harvesting Ordinance No. 10597, the first of its kind in the country. The ordinance takes effect June 1, 2010, and applies to all new commercial construction.

Since its adoption, the Commercial Rainwater Harvesting Ordinance has been receiving attention as a model for cities and communities across the United States who are considering similar ordinances. These new rules are part of Tucson's effort to promote water conservation and efficient use of water resources by the City and its residents.

The code changes for Commercial Rainwater Harvesting require:

- Facilities subject to the ordinance must meet 50% of their landscape demand using harvested rainwater, prepare a site water harvesting plan and water budget, meter outdoor water use, and use irrigation controls that respond to soil moisture conditions at the site.
- 2. Facilities have 3 years to establish plants before the 50% requirement must be met, and the requirement is waived during periods of drought.
- 3. The details of how facilities will comply with the Commercial Rainwater Harvesting Ordinance are contained in the Commercial Rainwater Harvesting Development Standard. Both passive water harvesting systems (systems that passively infiltrate rainwater into soil or porous pavement for use by vegetation), and active systems (systems that store water in tanks for future distribution to beneficial uses) are addressed in the Development Standard. Applicants may choose the water harvesting system or combination of systems that is most appropriate for their site. In general, commercial sites in Tucson should be able to meet 50% of the landscape water demand using passive water harvesting systems alone.
- The Ordinance and Development Standards can be found at: <u>http://www.tucsonaz.gov/ocsd/sustainability/water/rainwaterharvesting.php</u>

CITY OF TUCSON INCENTIVE PROGRAMS



520.404.7369, 520.321.9488 o www.seriaz.org



USING WATER

LIFESTYLE

TUCSON

CITY OF TUCSON GREEN STREETS



CITY OF TUCSON, ARIZONA DEPARTMENT OF TRANSPORTATION

ENGINEERING DIVISION ACTIVE PRACTICES GUIDELINES

UPDATED 08/06/13

PREPARED BY:	GARY WITTWER	EFFECTIVE:	08-06-13	
APPROVED BY:	DIRECTOR OF TRANSPORTATION	DATE: <u>08</u>	-06-13	

SUBJECT: GREEN STREETS

A. DEFINITIONS:

- 1. Basin: The area footprint which identifies the total area of detained or retained runoff.
- 2. Bottom of Basin: The flat area of the basin or the basin area minus the side slopes.
- 3. Green Infrastructure: Landscape and engineering features that utilize soils and vegetation to manage stormwater for multiple environmental and community benefits. These features, as described in *Pima County and City of Tucson Guidance Manual for Low Impact Development and Green Infrastructure* (in process), include but are not limited to, curb scuppers, curb depressions, core drills, water harvesting basins, swales, bio-retention basins, berms, check dams, infiltration trenches, and active water harvesting/storage systems.
- 4. Green Streets: Roadways that incorporate the use of Green Infrastructure.
- 5. Mature Tree Canopy: The estimated diameter of leafy vegetation of a given tree.
- Project Manager: The City of Tucson, Department of Transportation individual who is appointed to oversee the project.
- 7. Shrub, Grass and Groundcover Requirement: A minimum 25% recommended vegetative coverage of the bottom of basin area.
- Tree Canopy Area: The area that can be planted with trees without sight visibility or utility conflicts. The shade for each tree shall be calculated at an average of 18' mature diameter in order to provide the recommended minimum 25% coverage of the tree shade area.

B. INTENT:

The intent of these guidelines is to require the incorporation of green infrastructure features into Tucson roadways wherever possible. The costs and benefits of green infrastructure shall be evaluated and determined for all new projects and shall be included within the project budget.

COT WATER HARVESTING PROGRAM





NSSH: Light House YMCA, 2018

NSSH: Richland Heights, 2019

LIFE CYCLE COST ANALYSIS

- Financial:
 - construction costs
 - maintenance costs
- Social:
 - Extreme heat
 - Recreation
 - Property value
 - Flooding
- Environmental:
 - Air quality
 - Stormwater quality
 - Energy use
 - Habitat



TEMPERATURE CHANGES DUE TO LAND COVER CHANGE



MEANDER BEND PARK – LOCAL SCALE REGIONAL TEMPERATURE CANOPY DENSITY





SOCIAL COST/BENEFITS

Cost/Benefit	Mean Value	2.5%	97.5%
		confidence	confidence
Other Benefits	\$ 0	\$0	\$0
Flood Risk	\$100,913	\$100,913	\$100,913
Property Value	\$1,159,372	\$651,931	\$1,708,405
Education	\$16,149	\$9,388	\$24,516
Recreational Value	\$3,721,554	\$3,721,554	\$3,721,554
Public Health	\$38,012	\$6,879	\$86,165
Food	\$523,563	\$314,602	\$735,216
Social Value of Water	\$0	\$0	\$0

ENVIRONMENTAL COST/BENEFITS

Impact	Mean Value	2.5% Confidence	97.5% Confidence
Water quality	\$55 <i>,</i> 889	\$55,889	\$55,889
Concrete C Emissions	\$0	\$ 0	\$0
Air Pollution: Vegetation	\$328,524	\$243,049	\$414,799
Carbon Reduction: Veg	\$20,154	\$7,906	\$35,648
Air Pollution: Energy Use	\$25,970	\$13,270	\$41,597
Energy Use C Emissions	\$3,132,994	\$1,223,733	\$5,553,594
Habitat	\$385,145	\$385,145	\$385,145
Pollination	\$133,763	\$133,763	\$133,763

DESIGN EMERGENCY IRRIGATION: PRESERVE SHADE INFRASTRUCTURE

- Truck delivered water
- Curb Access
- Gravity flow



AIR TEMPERATURES FOR URBAN HEAT ISLAND IMPACTS

→Normal (1981-2010) -- RCP8.5 (2068) -- 2016 -- 2017



AIRPORT WASH – REGIONAL SCALE



10% & 25% SCENARIO: GREEN STORMWATER INFRASTRUCTURE RETROFITS

1. Residential Parcels: ~1/3 of available landscape for selected parcels delineated as rain gardens. Included streetside basins if appropriate for the space.



Model representation







10% & 25% Scenario: Green Stormwater Infrastructure Retrofits

2. Street Segments: Apply the COT Green Streets Policy to major arterials and reconstructed streets







Photo: Wheat Design Group

10% & 25% Scenario: Green Stormwater Infrastructure Retrofits

3. Commercial & Community Centers: Retrofit parking lots, buffer yards, and open spaces









On-the-ground potential practice

EXAMPLEURBANNADEA ELOCATION



EL VADO US EL VIRA

Drainage Area: 30 acres











Policy Implications

Develop neighborhood-scale GI/LID demonstrations to target floodprone areas

Asses hydrologic impacts and CBA of urban arroyos and floodplain enhancements

Quantify water quality impacts for neighborhood-scale projects

Develop funding sources to implement GI/LID.





GI/LID AT AN HOA



REALIZED COST SAVINGS FOR AN HOA



Board of Supervisors

- Resolution to develop adaptation and mitigation plans to address climate change
- Add GI/LID + Trees to
 - Pima County properties
 - Pima County ROW
- Strategies
 - Identify 43 projects
 - Document benefits with life-cycle costs of GI projects
 - Increase canopy from 8% to 20%

PIMA COUNTY GI PLAN Map of Projects

- Add map of 43 projects
- Find report at Pima County Department of Environmental Quality Water, stormwater, publications, page 19 or 39 of the report

HEALTH DEPARTMENT INTEREST IN GI/LID

• Current activities

- Map of cooling stations
- Building Resilience Against Climate Change: urban/rural splash pad
- Future activities
 - Develop a multi-dimensional approach to minimizing heat illnesses
 - Time of exposure
 - Temperature
 - Age of person
 - Exertion level
 - Plan for extreme events, like a power outage during the summer
 - Facilitate connection with local power company (TEP) to identify those with heat co-morbidities

LOWER SANTA CRUZ RIVER BASIN STUDY IDENTIFY IMBALANCE BETWEEN SUPPLY & DEMAND

• Water Sources

- Groundwater
- CAP water
- Reclaimed water
- Stormwater
- Water Users
 - Municipal
 - Farming
 - Mining
 - Environment



CONCEPTS UNDER CONSIDERATION

Watershed models

- 1. Measure % perviousness to imperviousness
- 2. Model predevelopment runoff
- 3. Measure post-development runoff
- 4. Identify how much more GI/LID is needed to reach predevelopment runoff
- 5. Develop iterative method of assessing watershed runoff as GI/LID is added

Pro-active Development Techniques

- Lot scale
 - Cisterns
 - Low Impact Features & native plants
- Common areas
 - Cisterns : potable or non-potable
 - Maintenance similar to public water system
- Contract with well owner to provide water during extended drought
- Truck water during extended drought

BOND CREDIT RATINGS & PREPAREDNESS

Moody's Investors Services

"Our credit analysis considers the effects of climate change when we believe a meaningful credit impact is highly likely to occur and not be mitigated by issuer actions, even if this is a number of years in the future."

- Climate trends: long-term trends
- Climate shocks: sharp, immediate

Analysis criteria of issuers:

- Economy
- Fiscal position
- Capital infrastructure
- Management's ability to
 - Marshal resources
 - Implement strategies to recover
- Costs to employ mitigation strategies
 - Economic strength and diversity
 - Access to liquidity
 - Ability to leverage additional revenue

EXTREME WEATHER COSTS



TYPE OF DISASTER

- Drought/heat wave Wildfire
- Flood
- Hurricane
 - Tornado/hailstorm/thunderstorm
 - Blizzard/ice storm/freeze



COST OF

DISASTER

\$50 billion

\$20

\$1

HORNED LIZARDS HARVESTING RAIN





PIMA COUNTY DEPARTMENT OF ENVIRONMENTAL QUALITY https://webcms.pima.gov/cms/one.aspx?portalid=169&pageid=62831

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