Water Harvesting Initiatives in Tucson and Pima County

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Arizona-Mexico Commission, Tucson, AZ

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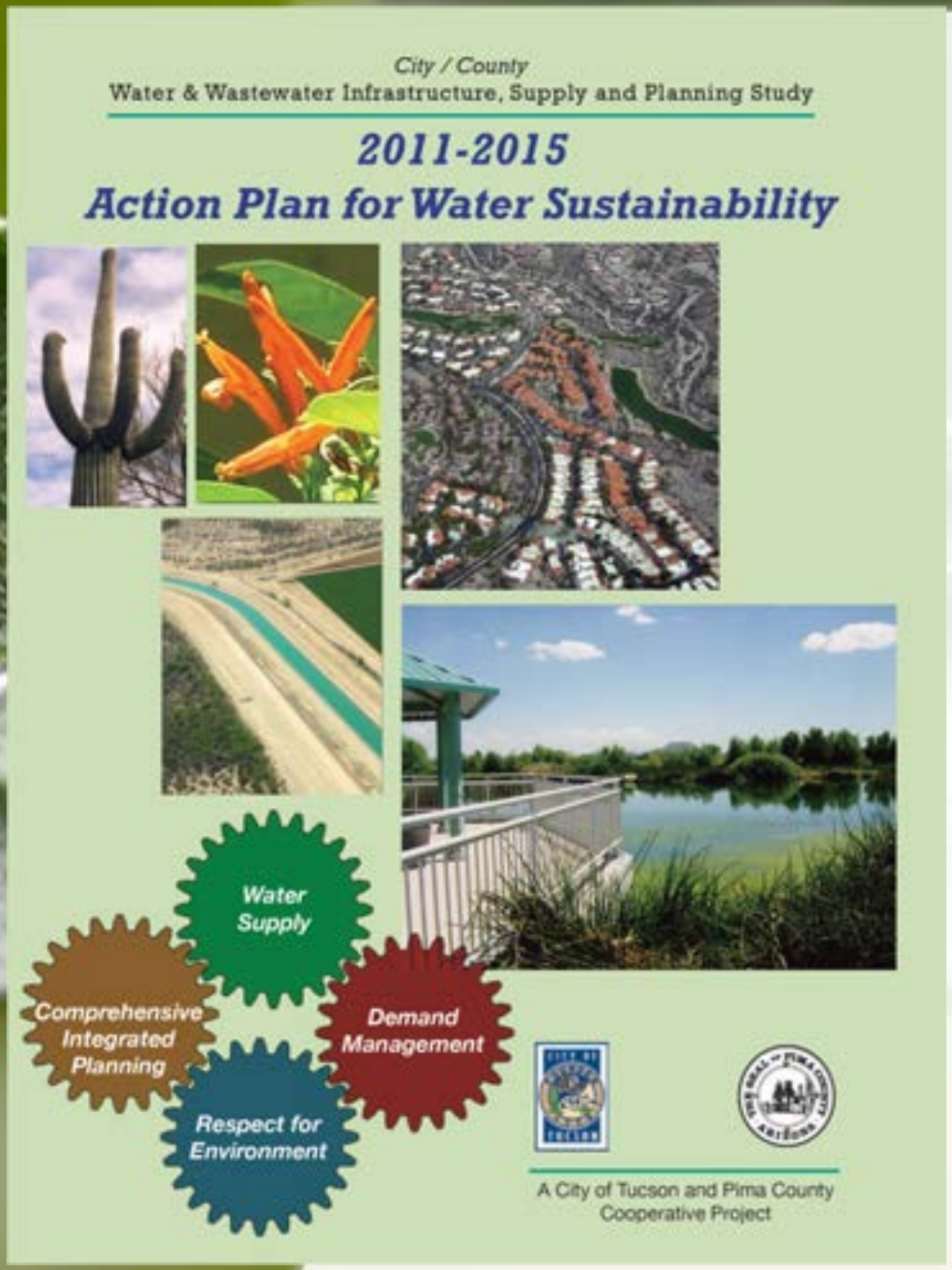
Pima County Regional Flood Control

Presentation Outline

- Motivations
- Regulatory Framework
- Rainfall and Runoff Characteristics
- Initiatives
- Summary

Presentation Outline

- Motivations
  - Water Scarcity
  - Clean Water Act Requirements
- Regulatory Framework
- Rainfall and Runoff Characteristics
- Initiatives
- Summary



Goal

Demand Management Goal #5:
Increase the use of rainwater and stormwater to reduce demands on potable supplies

Action Plan

Demand Management Action Plan #7:
Develop Design guidelines for neighborhood stormwater harvesting to encourage the creation of habitat and water efficient landscapes.

Low Impact Development and Green Infrastructure

LID/GI ~ Water Harvesting

Low Impact Development (LID)

'A comprehensive stormwater management and site-design technique. . . the goal of any construction project is to design a hydrologically functional site that mimics predevelopment conditions…'

Green Infrastructure

As a general principal, Green infrastructure techniques use soils and vegetation to infiltrate, evapotranspirate, and/or recycle stormwater runoff…'

EPA Green Infrastructure Homepage - Glossary

Low Impact Development (LID)

Mimic pre-development hydrology

Source: Low Impact Development Center

LID Planning

- Disconnect and minimize impervious surfaces.
- Maintain pre-development waterways.

LID Flow Paths

- Lengthen and roughen overland flow paths.

LID Infiltration / Features

- Pervious pavement.
- Swales, filter strips.
- Bioretention.
- Rainwater catchment systems.
- Detention basins.

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Regulatory Efforts to Encourage Integrated Use of Stormwater

Regulatory:

- City of Tucson
  - Commercial Water Harvesting Ordinance + Development Standards (2010)
  - Stormwater Discharge Permit (AZPDES)
  - General Plan *Green Infrastructure* component.
- Pima County:
  - Revised Detention/Retention Manual (expect – 2012)
  - Stormwater Discharge Permit (AZPDES)
- Town of Oro Valley:
  - Stormwater Ordinance and Stormwater Utility

AZPDES:MS4

- **Measurable Goal:** The county shall include in the fourth (4th) year annual report the findings of how the implementation of LID practices would contribute to the reduction of pollutants in stormwater discharges to the MS4 and identify a plan and schedule for incorporation into design standards.

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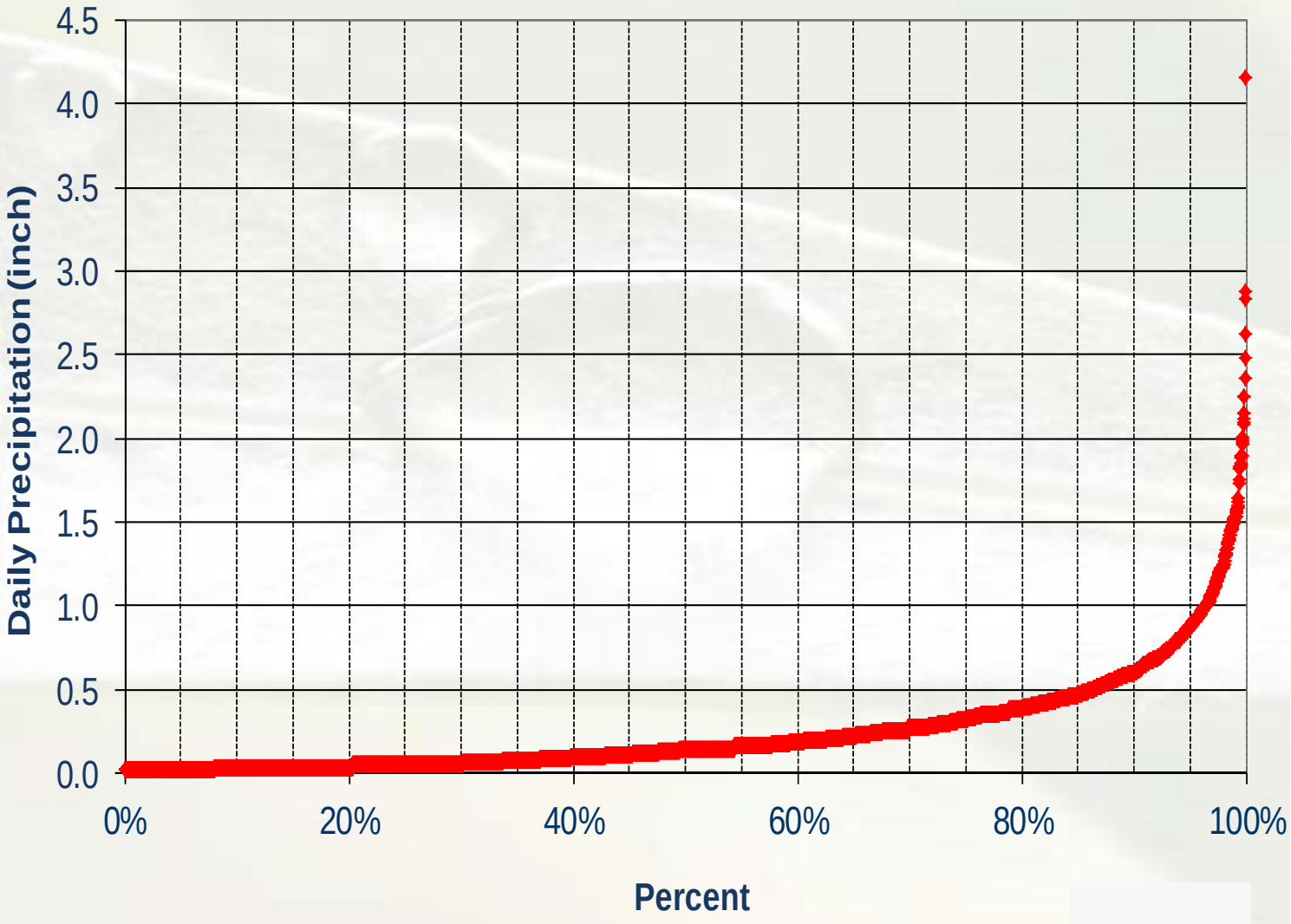
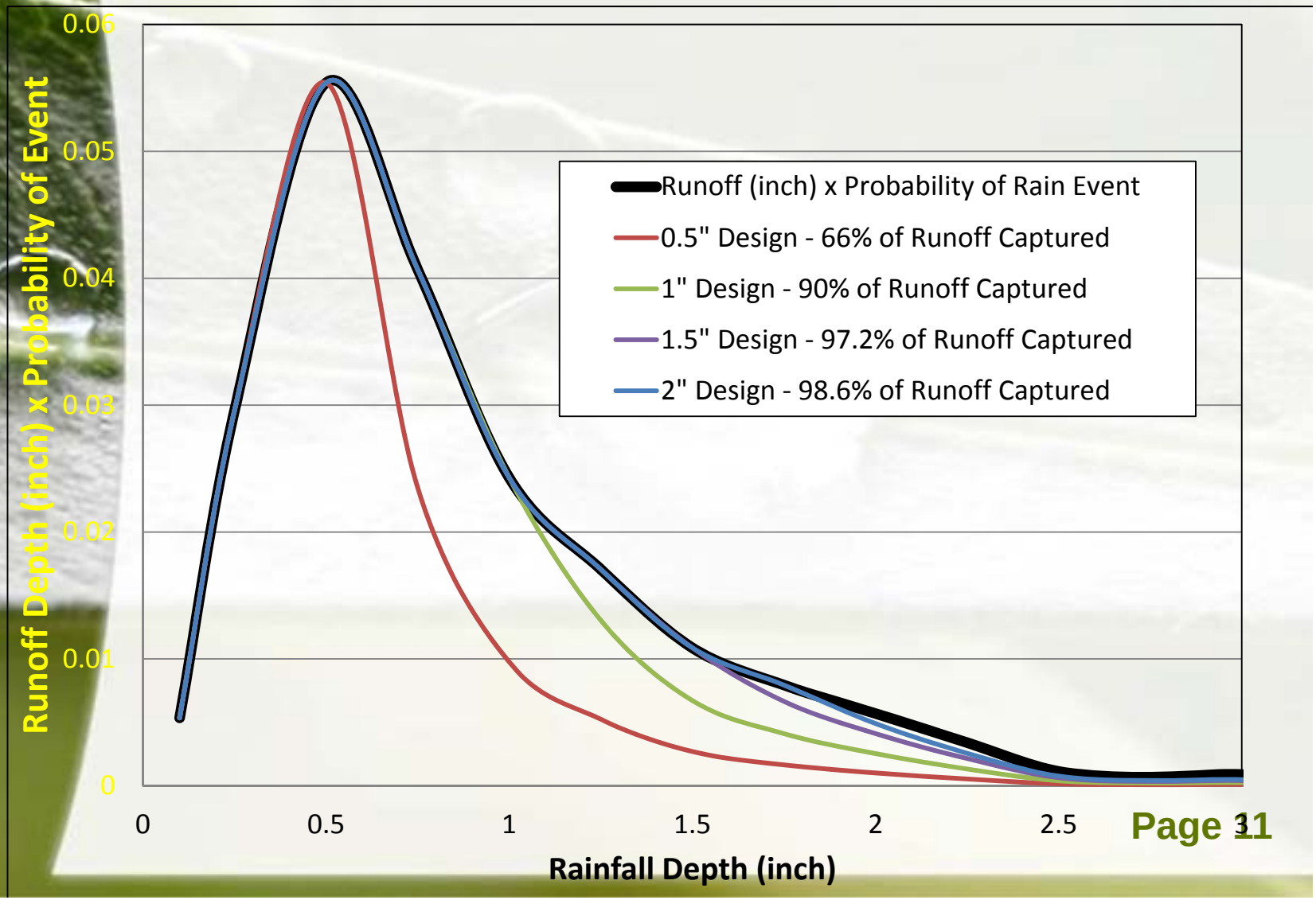
Cummulative Distribution 105 years of Daily Rainfall from University of Arizona

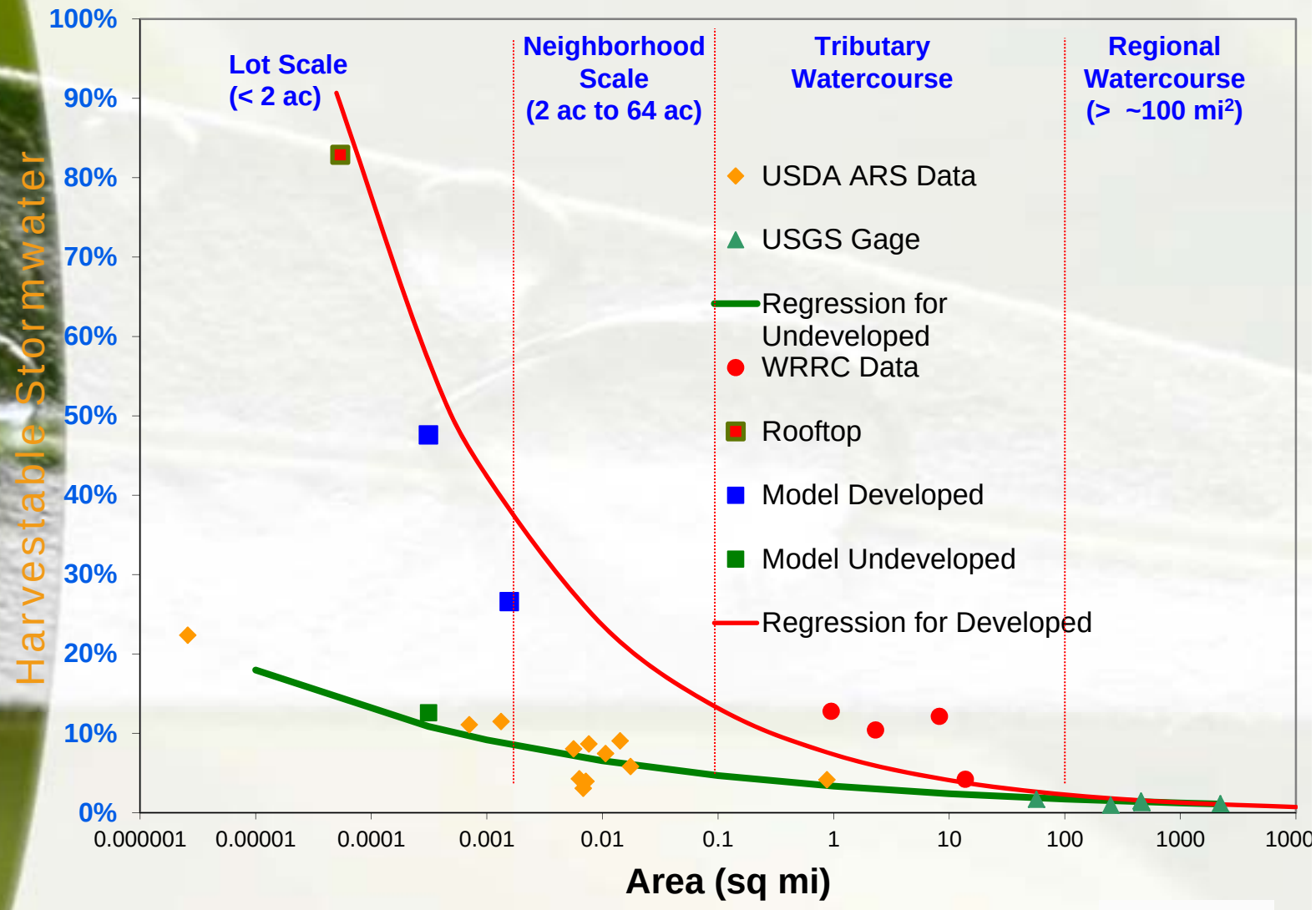


Probability of Runoff From Impervious Surfaces



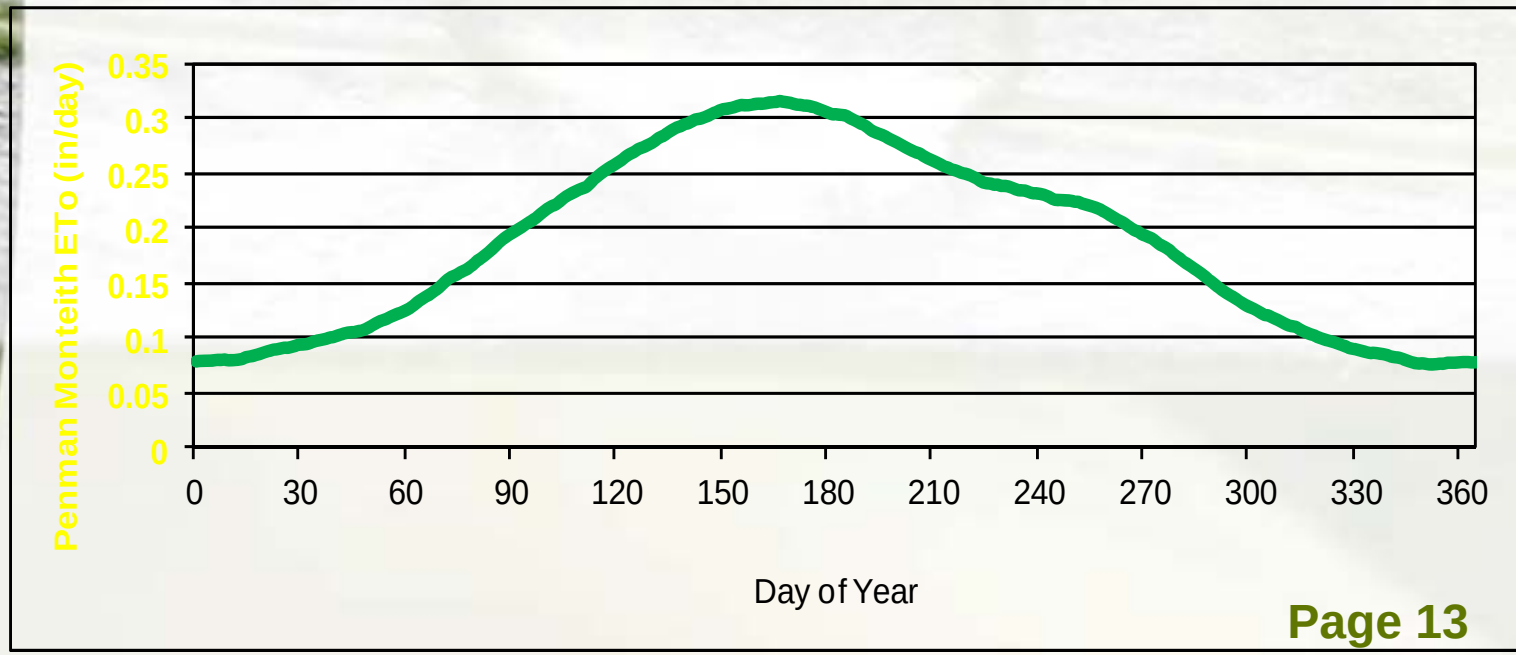
‘Harvestable’ Water (Rainwater/Stormwater)

i.e. water yield



Data Sets

- Daily Rainfall Data – 108 years of data gathered at U of A.
- Mean Daily Reference ET (ETo) – from Campbell Avenue Farm



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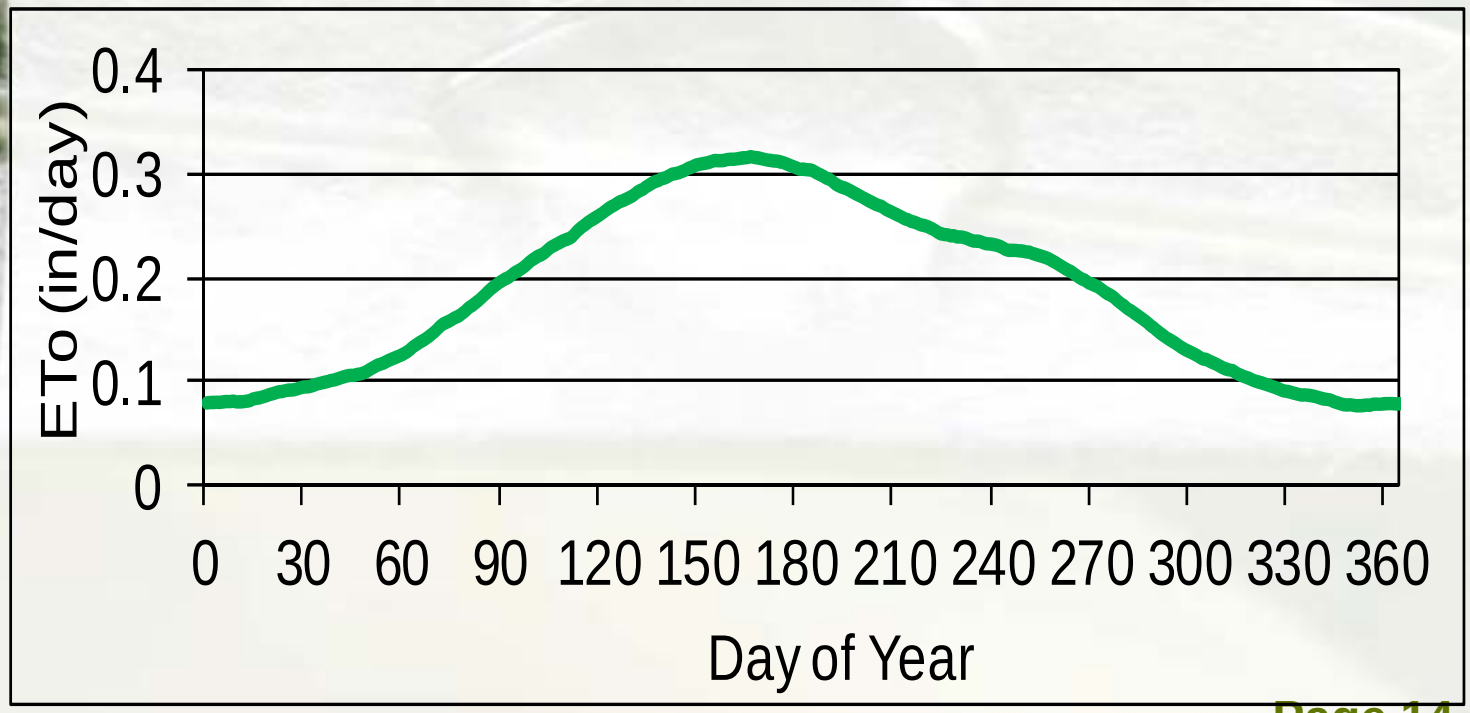
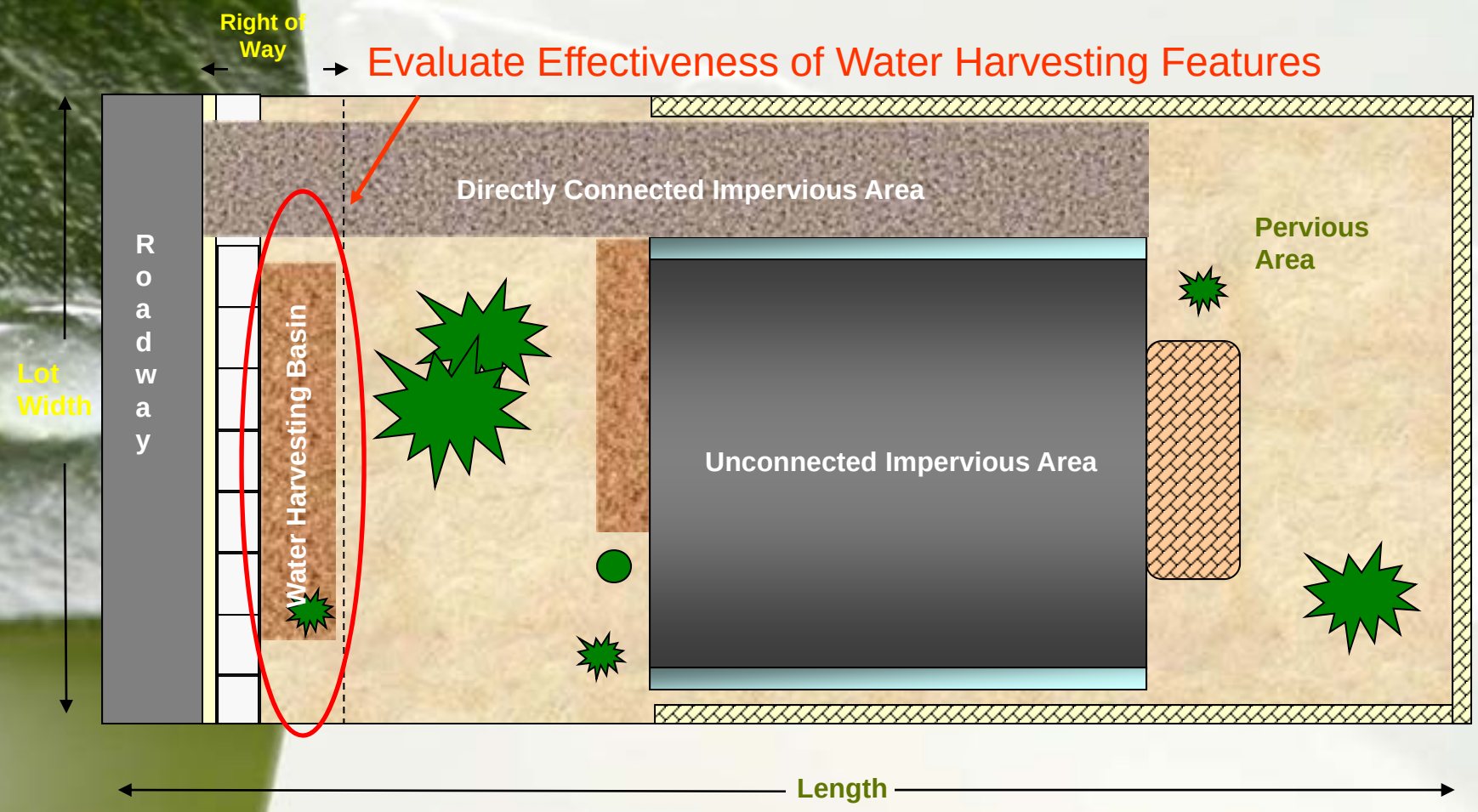
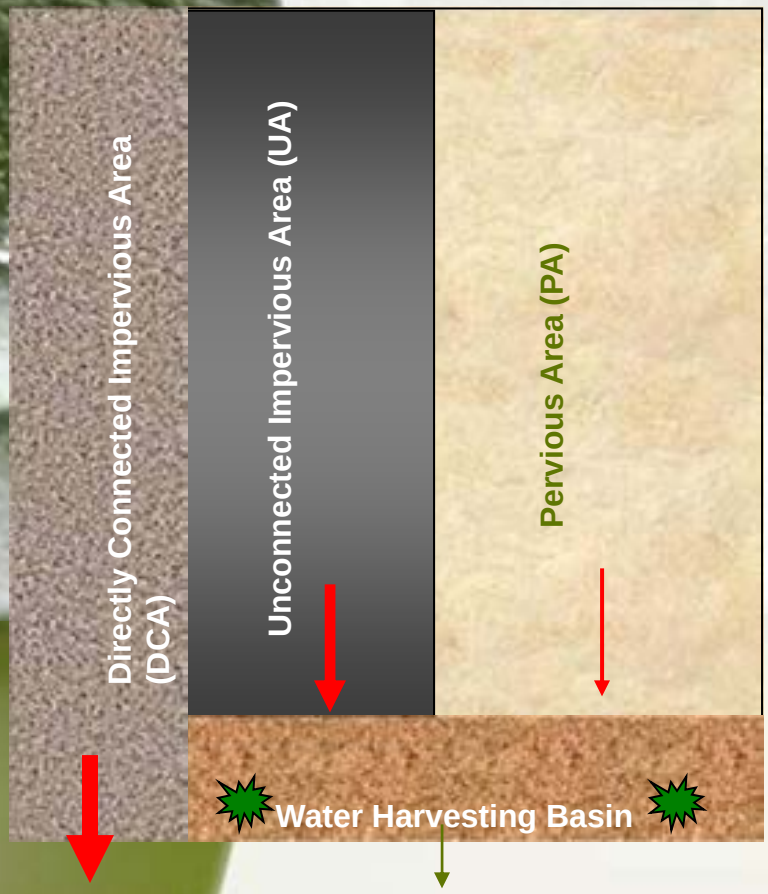


Lot Scale Evaluation (1/5 acre lot example)



Conceptual Model

Conceptual Representation



Mathematical Representation

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Q is the total depth of runoff (inches);
P is the daily rainfall depth of precipitation (inches);
S is the potential abstraction (inches)

$$S = \frac{1000}{CN} - 10$$

CN is the Curve Number.

Rainwater off lot from Directly Connected:

$$Vol_{(DCA)i} = Q_i(f(CN_{DCA}, P_i)]xArea_{DCA}$$

Rainwater in to Water Harvesting Basin:

$$Vol_{(UA)i} = Q_i(f(CN_{UA}, P_i)]xArea_{UA}$$

$$Vol_{(PA)i} = Q_i(f(CN_{PA}, P_i)]xArea_{PA}$$

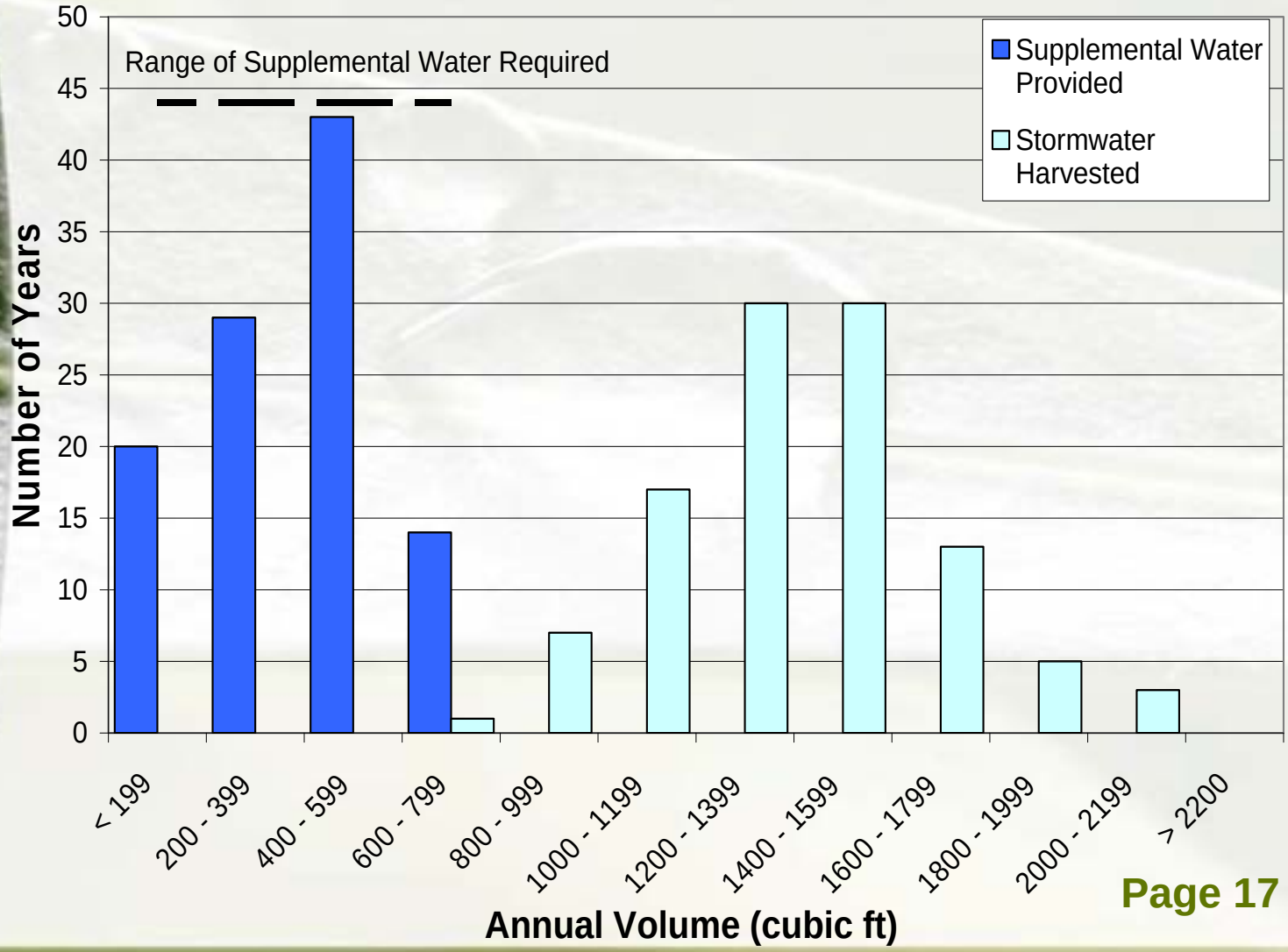
Storage Accounting in Basin:

$$Storage(i) = Storage(i-1) + \Delta Storage$$

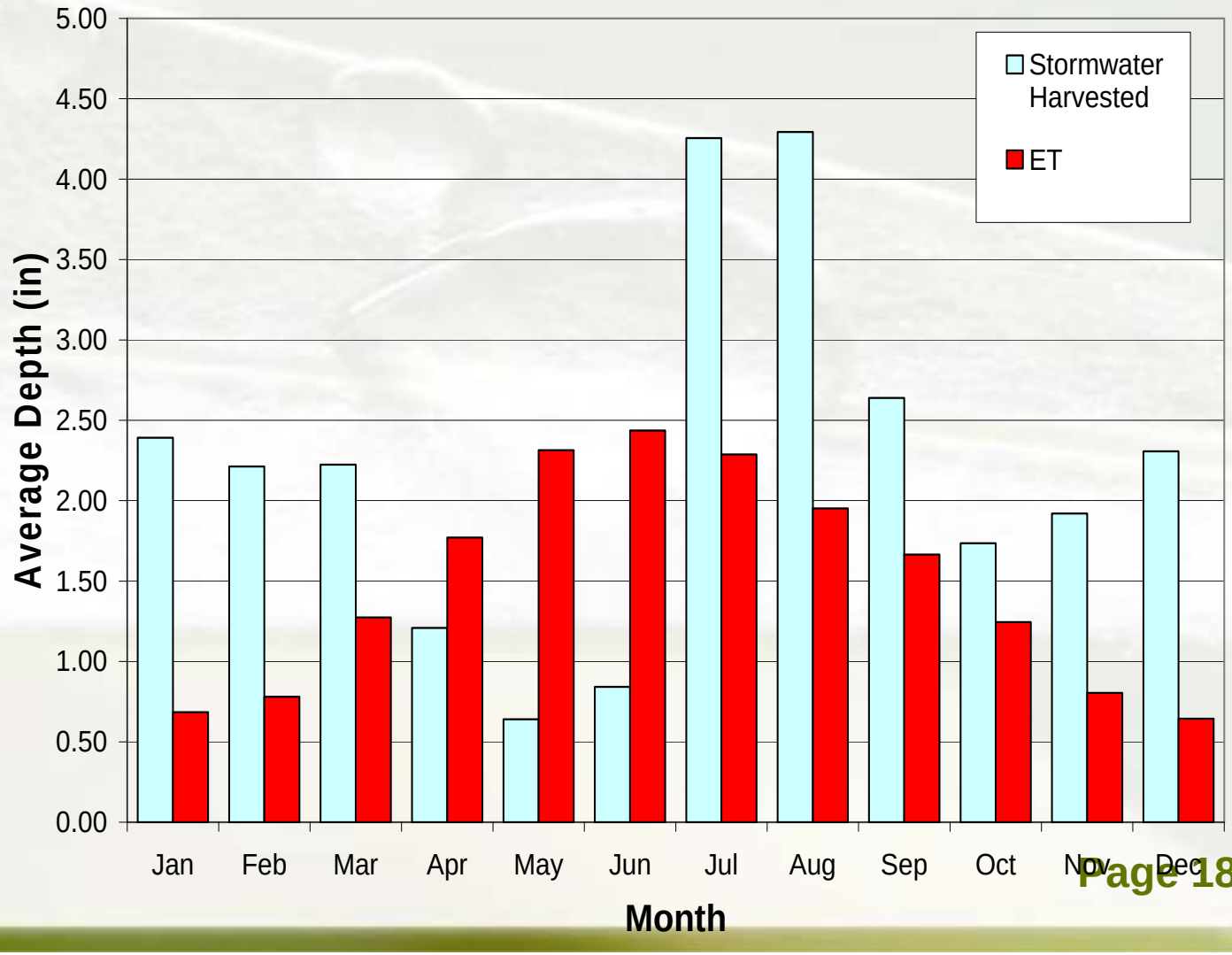
$$\Delta Storage = Rainwater_i - ET_i$$

$$(ETo_{AZmet} * Kc)$$

Supplemental Water Supplied, and Harvested Stormwater from a Water Harvesting Basin on a 1/5 acre lot



Modeled Mesquite Water Requirements (ET) and Water Harvested



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- **Initiatives**
  - Initiatives of LID Working Group
  - Jurisdictional Initiatives
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Joint Effort: LID Working Group Members

Public: Pima Co.

- Regional Flood Control District
- Development Services Dept.
- Dept. of. Transportation

Public: City of Tucson

- Office of Conservation & Sustainable Development
- Dept. of Transportation: Stormwater Division

Education: Univ. of Arizona

- Environmental Research Lab
- Drachman Institute
- Facilities
- Water Research Resource Center
- Biosphere 2

Public: Pima Assoc. of Gov.

Non-Profit/Other

- Watershed Management Group
- Living Streets Alliance
- Imagine Greater Tucson

Professional/Trade

- Norris Design
- Wheat Scharf & Assoc.

Joint Effort – LID Working Group

Products of the LID Working Group

Revised ***Pima County Detention/ Retention Manual***

Neighborhood Scale Water Harvesting Manual

Case Studies Catalogue

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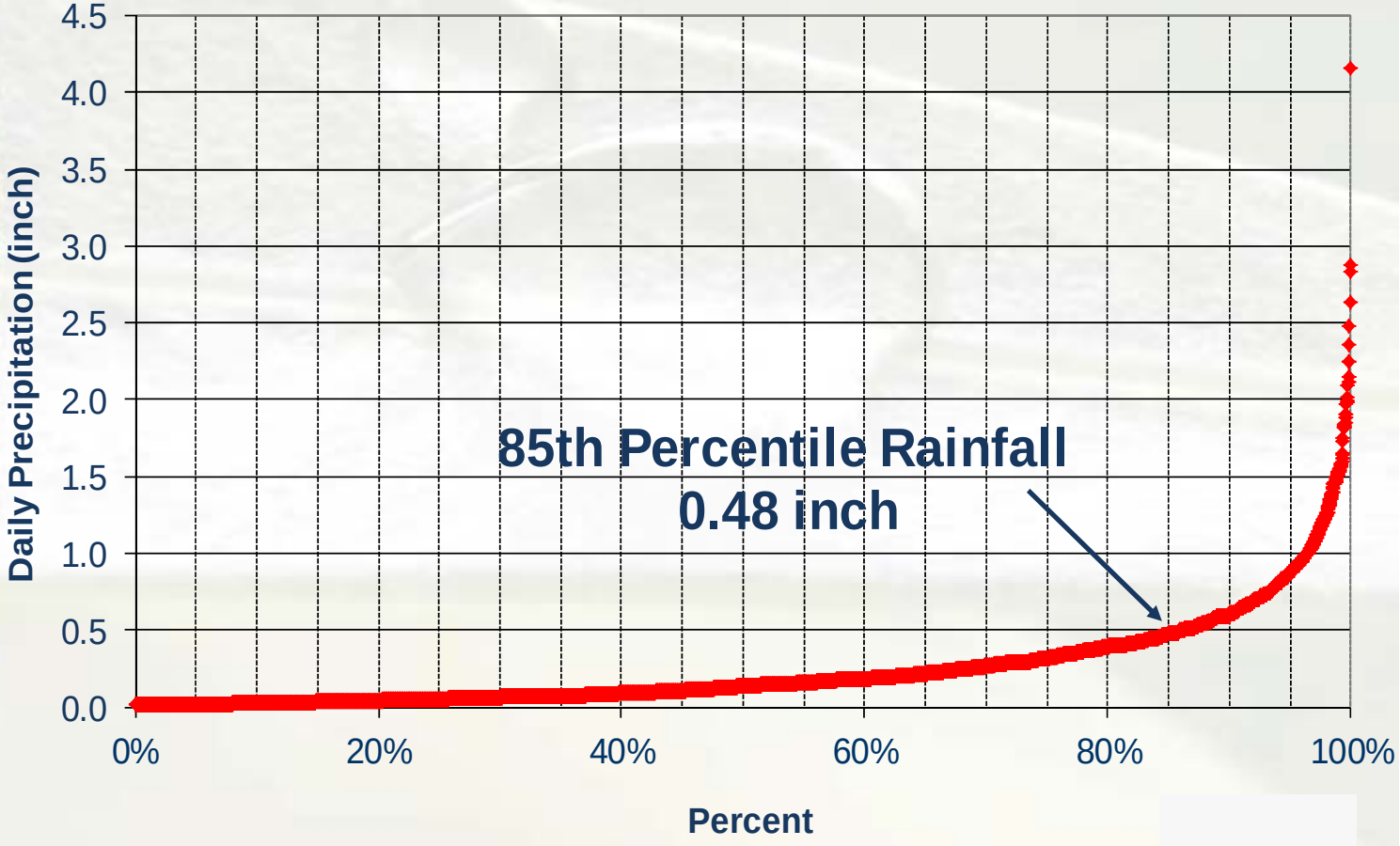
Revised ***Pima County Detention / Retention Manual***	*Neighborhood Scale Water Harvesting Manual*	*Case Studies Catalogue*

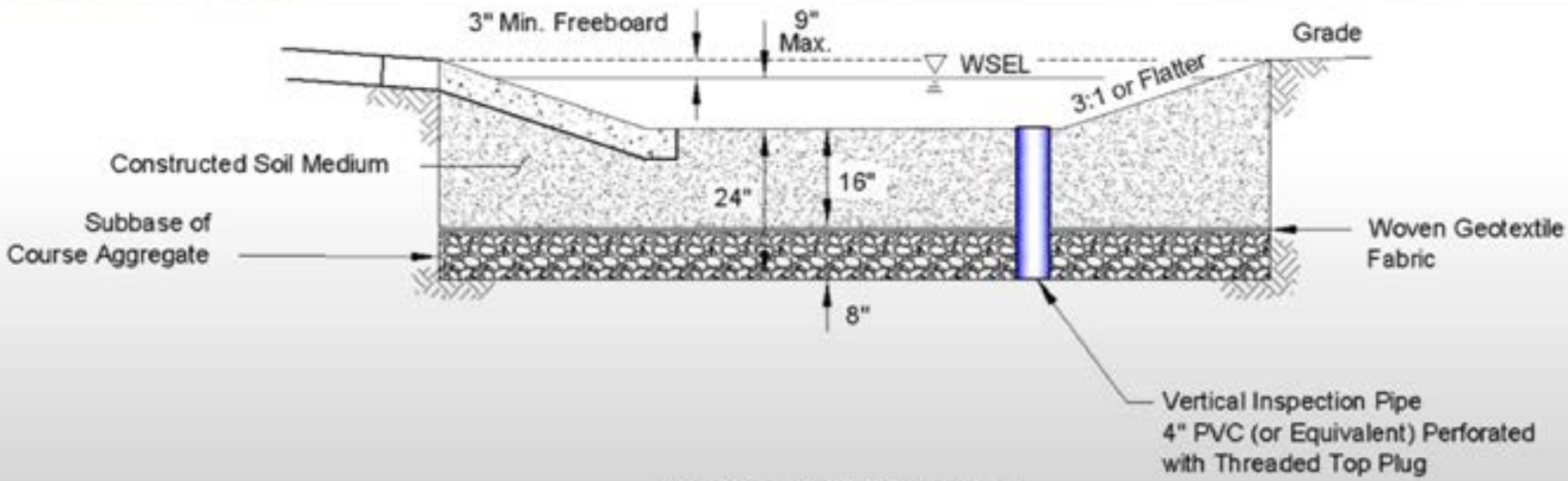
Pima County:

DETENTION–RETENTION MANUAL (Draft)

Replace Retention Requirement with a
'First Flush' Retention Requirement



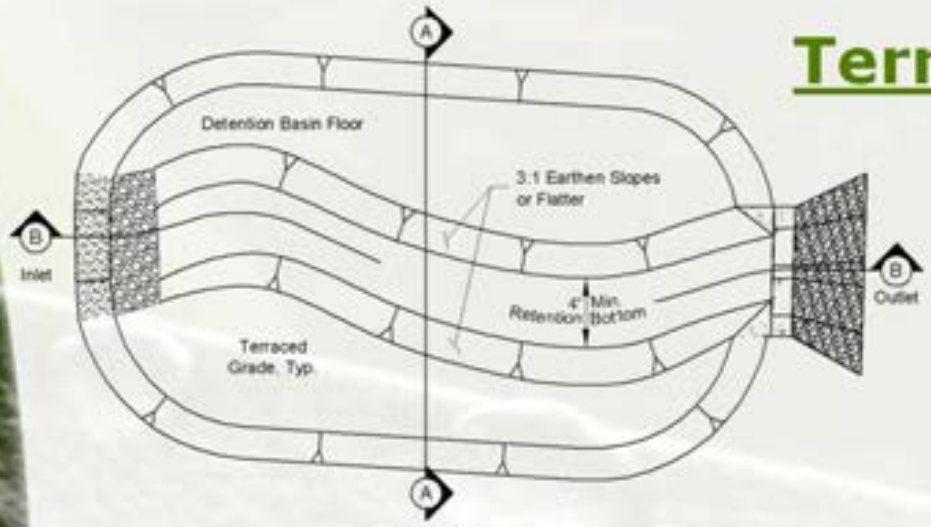
Bioretention Basin



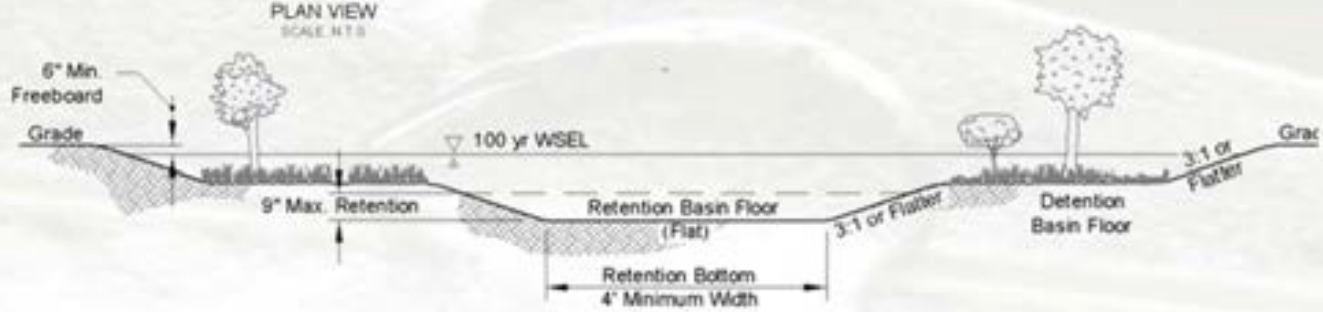
BIORETENTION BASIN

SCALE: N.T.S.

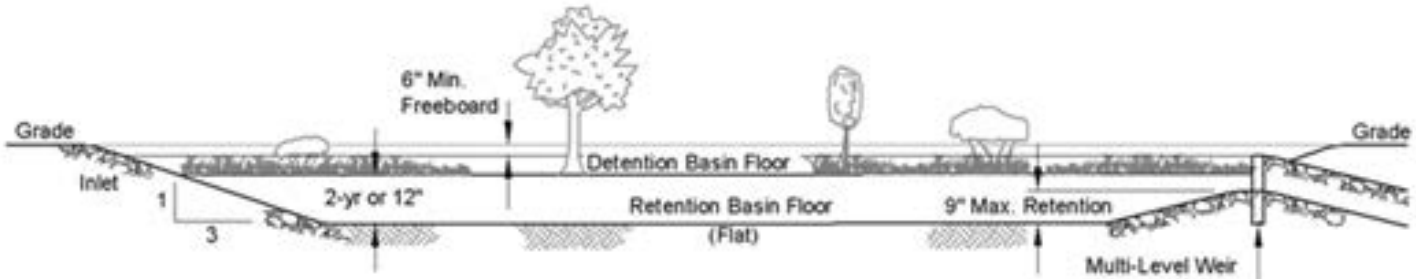
Terraced Detention Basin with Retention



PLAN VIEW
SCALE N.T.S



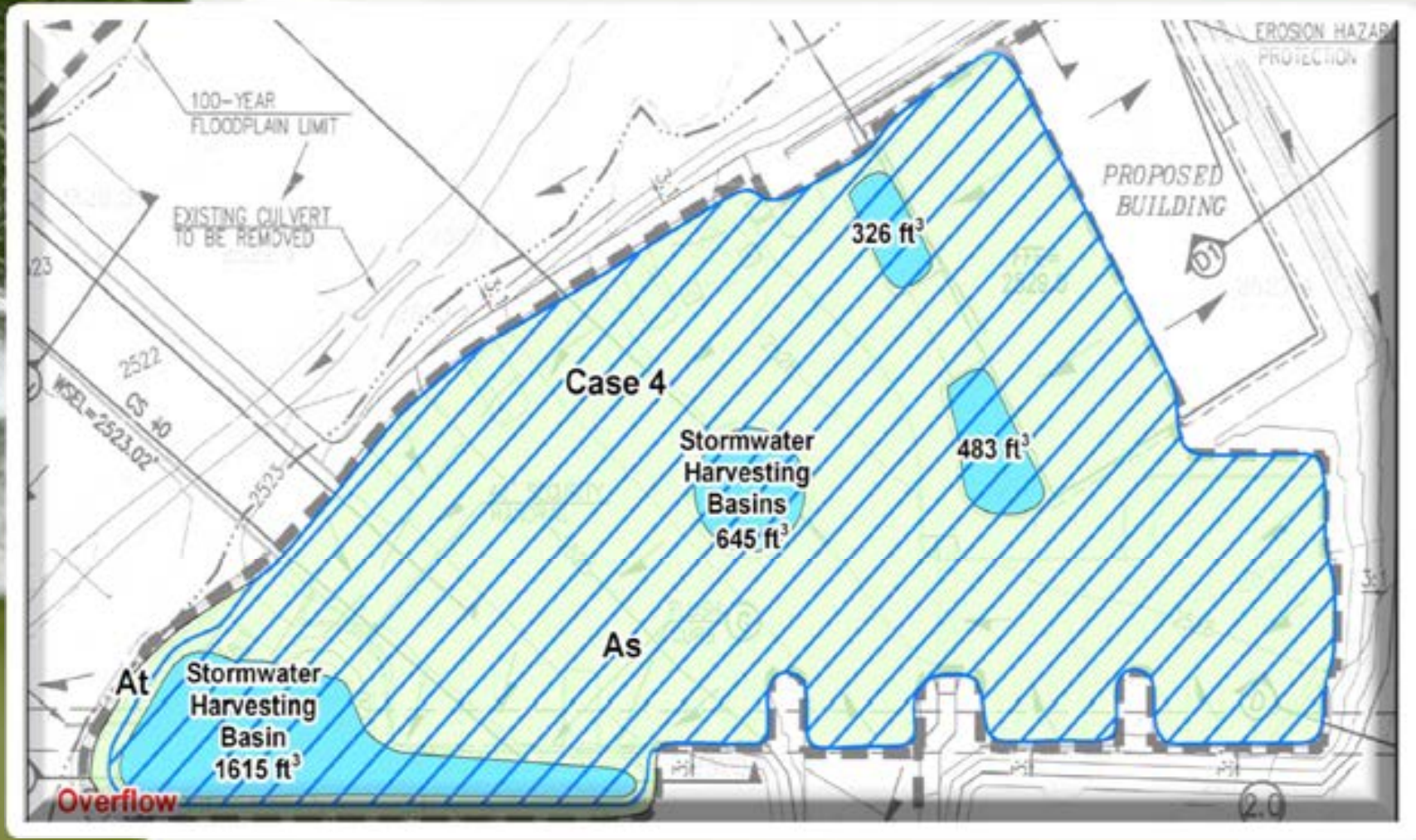
A SECTION
SCALE N.T.S



B PROFILE
SCALE N.T.S

Pima County:

DECENTRALIZED 'FIRST FLUSH' RETENTION



Joint Effort – LID Working Group

Products of the LID Working Group

Revised *Pima County Detention/ Retention Manual*	***Neighborhood Scale Water Harvesting Manual***	*Case Studies Catalogue*

Stormwater Harvesting Guidance Manual

Table of Contents

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ii. How to Use this Manual

1. **Introduction**
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   c. Scope
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   a. Why Use LID?
   b. Low Impact Development and Rainwater Harvesting Terminology
   c. Neighborhood Scale
   d. Local Rainfall Characteristics
   e. Stormwater and Water Quality
   f. The Effect of Development on Soil Infiltration Properties
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      i. Stormwater Design Volume
      ii.
   b. Water Quality and Treatment
   c. Erosion and Sediment Control
   d. Urban Heat Island Mitigation
   e. LID Practice Selection Matrix
      i. Decision Tree
      ii. Integrated Management
      iii. Benefits and Costs
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      i. Clustered Development
      ii. Minimizing Disturbed Areas and Soil Compaction
      iii. Promoting Open Space
      iv. Preserving Natural Flow Paths and Buffers
      v. Conserving and Restoring Sensitive Natural Areas
      vi. Disconnection of Impervious Area

   b. Structural
      i. Stormwater Harvesting Basins
      ii. Swales
      iii. Bioretention systems
      iv. Infiltration Trenches
      v. Dry Wells

Neighborhood-Scale Water Harvesting Manual

Local Priority	Type: Pretreatment	Bioretention	Filtration	Infiltration	Runoff Volume Minimization	End of Pipe	Agency / Jurisdiction	Research Team Member Assignments	City of Santa Barbara
							Document		SW BMP Guidance Manual
							Date of Publication		2008
high							Best (LID) Site Design Practices (Non Structural BMPs)		X
high					O		Natural/Sensitive Area Conservation/Restoration	Stantec (JT)	O
high					O		Impervious Area Disconnection		O
high					O		Minimize Impervious/Disturbed Areas		O
high					O		Cluster Development (Minimize Construction Footprint)		
high					O		Minimize Soil Compaction		
high				O			Protect/Use Natural Flow Paths and Buffers		O
high				O			Promotion of Open Space Design/Natural Infiltration		
high	O						Implement Source Controls		
medium	X		X				Media Filters / Filtration Devices	Eric	X
high	X		X				Sand Filter and Gravel Filters		X
medium	X						Hydrodynamic / Solids Removal Devices		X
medium	X						Oil and Water Separators		
high		X					Bioretention / Rain Gardens	Dave	X
high		X					Tree Pits / Tree Box Filters / Planters	Irene	X
high			X				Xeriscaped Buffers / Filter Strips / Swales	Evan	X
high				X			Dry Wells	Evan	X
high				X			Infiltration Basin / Systems	Stantec (JT)	X
high				X			Infiltration Trench or Gallery		X
high				X			Soil Amendments / Structural Soils	Irene	X
high					X		Porous/Pervious Pavements	Irene	X
high					X		Rainwater Harvesting for Use (Rain Barrel / Cistern)	Irene	X
high					X		Self-Treating Areas (Zero Discharge Microbasins)	Dave	X
high					X		Downspout Disconnection / Redirection	Stantec (JT)	X
high						X	Detention Basin / Gallery / Dry Ponds	Stantec (JW)	X
high						X	Retention Basin	Stantec (JW)	
medium							Diversion Structures / Flow Splitters / Green Outlets	Stantec (JT)	X
high							Source Controls (Non Structural BMPs)		X
?					O		Runoff Volume Minimization	Stantec (JT)	O
?	O						Manage Potential Stormwater Hotspots		
?	O						Roof Runoff Protection		
?	O						Runoff Quality Protection		O

Joint Effort – LID Working Group

Products of the LID Working Group

Revised *Pima County Detention/ Retention Manual*	*Neighborhood Scale Water Harvesting Manual*	***Case Studies Catalogue***

Case Studies Catalogue

Tucson Water: East Side Service Center

Case Studies Catalogue

20-30 Park (Highland Vista Park):

Collector street – residential land use

Native vegetation irrigated with harvested stormwater, reduced ponding and associated mosquito problems

Case Studies

Scott Avenue: Collector street - commercial land uses

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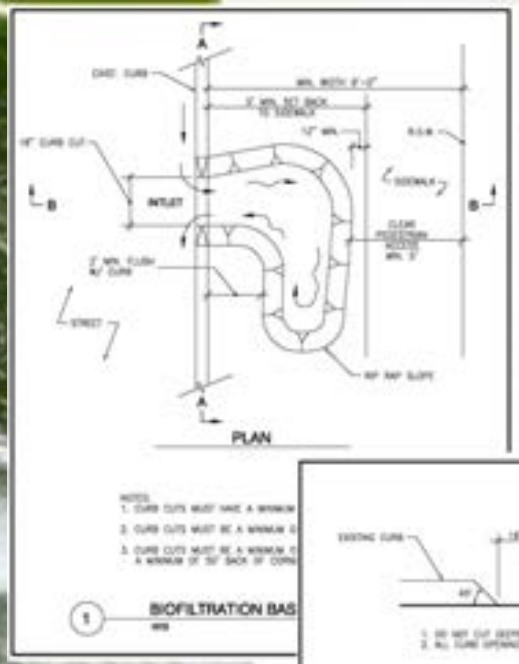
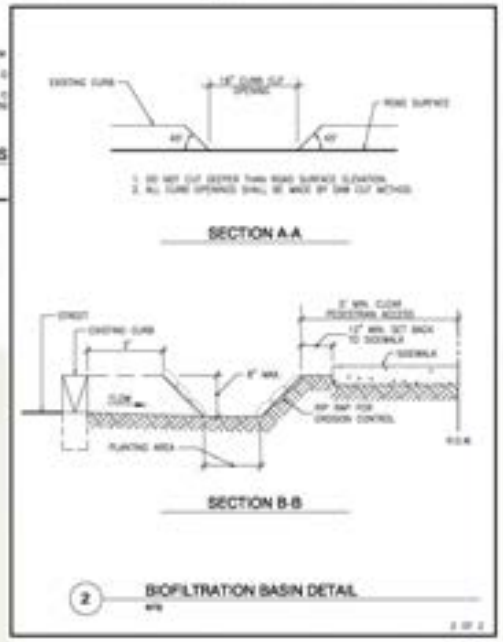
City of Tucson

Ordinanced: Commercial Rainwater Harvesting

City of Tucson

Approved: Curb cut standards





Initiatives of Tucson Water

- Demonstration Projects (13)
- Residential Water Harvesting Rebate Program
  - Required Training
  - Two Levels
    - Implement training concepts.
    - Prepare design to capture 1” rainfall.

Initiatives of Oro Valley

- Rainwater Harvesting Ordinance
- Stormwater Utility

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Summary

Motivation for GI/LID:

- Reduce need for additional groundwater pumping by providing non-potable water source for street landscaping
- Alternative management strategy for residential street stormwater runoff
- Use LID practices to mitigate flooding
- Promote small urban waters restorationMitigate Urban Heat Island

Existing Req'ments:

- The City of Tucson and Pima County have 4 years to determine if how to implement LID.
- Water Harvesting Ordinance requires commercial sites to supply 50% of irrigation need (Tucson).
- Required to consider water harvesting for comprehensive plan ammendments (Pima County).

Next Steps:

- Finalize new Detention/Retention Manual (Pima County).
- Develop City-County Neighborhood Scale Water Harvesting Manual
- Compile Case Studies Catalog

Acknowledgements

- **Dave Stewart** (RFCD) developed the water harvesting credit methodology.
- **Ann Moynihan** and **Patricia Gilbert** (RFCD) led the effort to update the Detention/Retention Manual.
- **City of Tucson Water Harvesting Technical Advisory Committee** assisting to create methodology for Development Standards submittals

Resources

City-County Water Study White Paper on Stormwater

http://www.tucsonpimawaterstudy.com/Reports/Phase2/Stormwater.Mgt.Tech.Paper.pdf

City of Tucson Water Harvesting Ordinance

http://www.tucsonaz.gov/ocsd/sustainability/water/rainwaterharvesting.php

LID Working Group Website

http://rfcd.pima.gov/pdd/lid/workinggroup.htm

AridLID

http://www.aridlid.org/

Questions

Evan Canfield: ***evan.canfield@rfcd.pima.gov***
Irene Ogata: ***irene.ogata@tucsonaz.gov***

Next Steps:

City-County Water-Wastewater Infrastructure & Planning Study

- March 21, 2011 LID Workshop
  Initiate a Dialogue Among Experienced Professionals in a Workshop Setting
- Form LID Working Group of Interested Professionals
- Provide Input to the Planning of 2012 Regional LID Conference
- Identify Motivation for LID / GI in Southwest
- Identify Need for Research/ Design LID Vision for Southwest
- Consider Educational Venues and Target Audience

ctiveness

saves
opers,
ties

- .....in the vast majority
savings ranged from 15
methods were used (EP

- Developers expect ec
increasing the number
costs on stormwater in
2009).