Water Availability Analysis for GI Implementation

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RESEARCH QUESTION

How does a *water budget*/water availability analysis *influence* the size, location, & type of Green Infrastructure (GI) techniques used to *maximize stormwater capture* in pursuit of a *50% reduction* of potable water use for landscaping on the *Durango Campus*?

GOALS

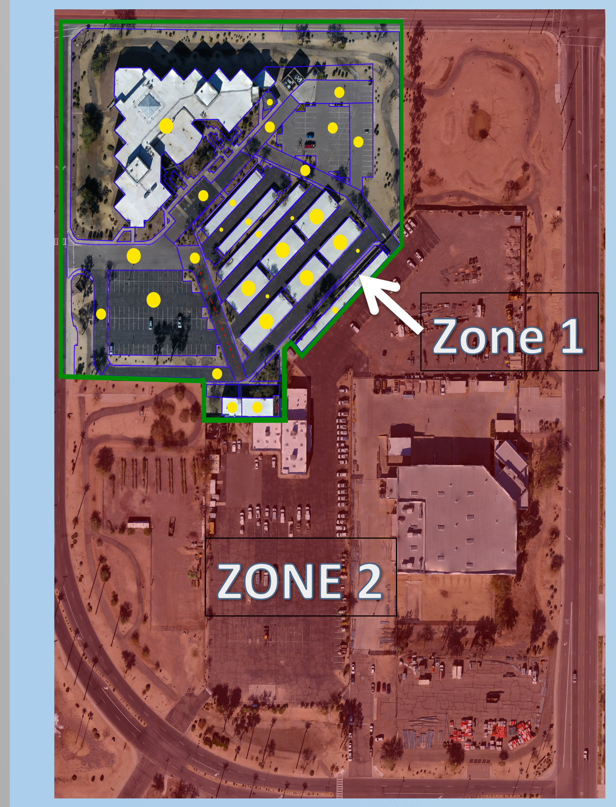
- Determine relative stormwater volumes available on District Campus for water harvesting opportunities
- Reduce potable water use for District landscaping by 50%, per District Strategic Goals
- Increase awareness of GI/LID techniques as effective alternative stormwater management and flood risk reduction tools in Maricopa County

METHODS

- Perform literature review of GI/LID and water conservation strategies
- Collect rainfall and storm size/frequency data from FCDMC rain gages and agency resources
- Use Aerial imagery, survey data, and CAD programs to determine mini watershed locations, surface materials, and flow paths
- Use Excel, CAD and Microstation to show mini watershed areas and associated rainwater volumes for existing conditions.

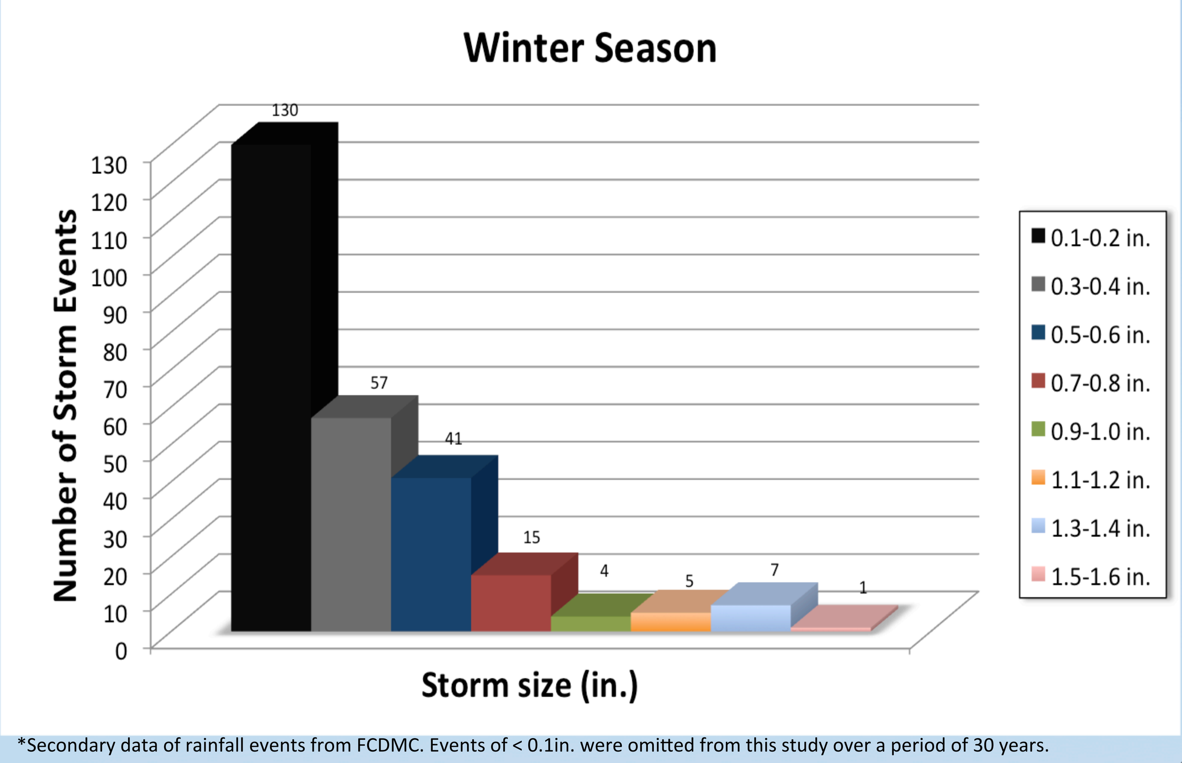
A **mini watershed** can be defined as a discrete surface area within a site that contributes runoff to a particular point.

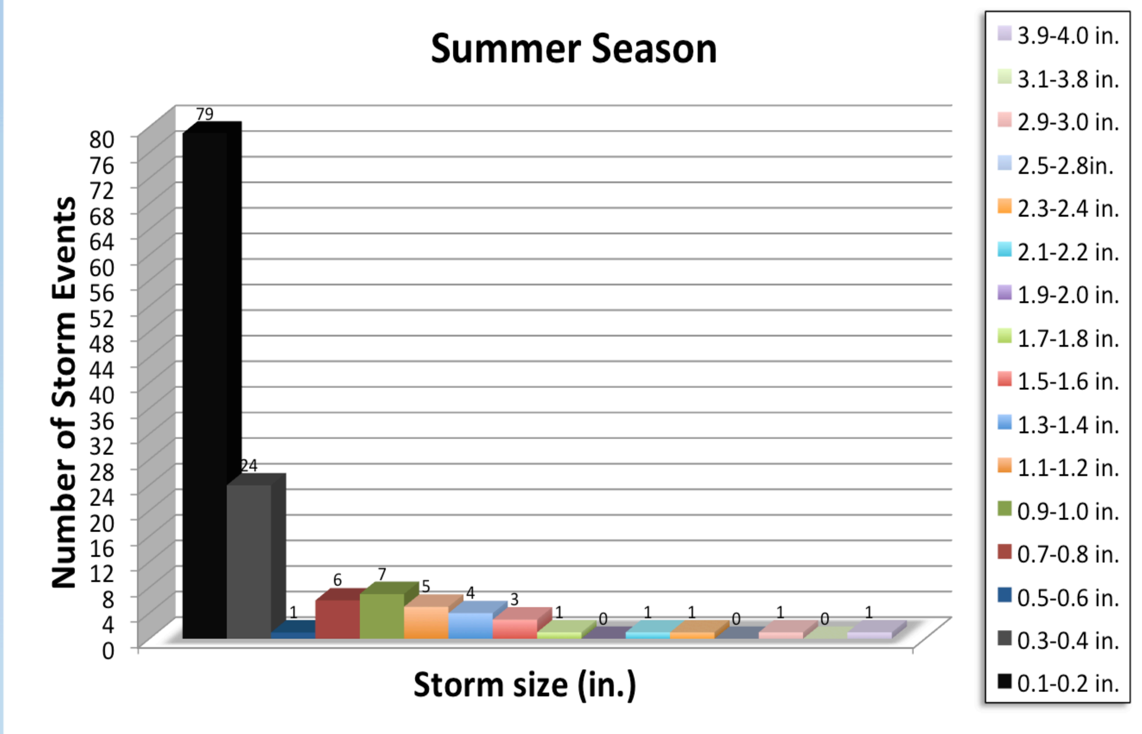
A **water availability analysis** for this project can be defined as a suite of information gathered on rainfall volumes, seasonal variation of rainfall events, runoff flow patterns, and 'mini watershed' delineations to determine the amount and timing of storm water available for potential re-use on a particular site.



*Miniwatershed Analysis
*Zone 2 not evaluated
■ = Miniwatersheds
● = Impervious surface

SEASONAL VARIABILITY DATA ANALYSIS



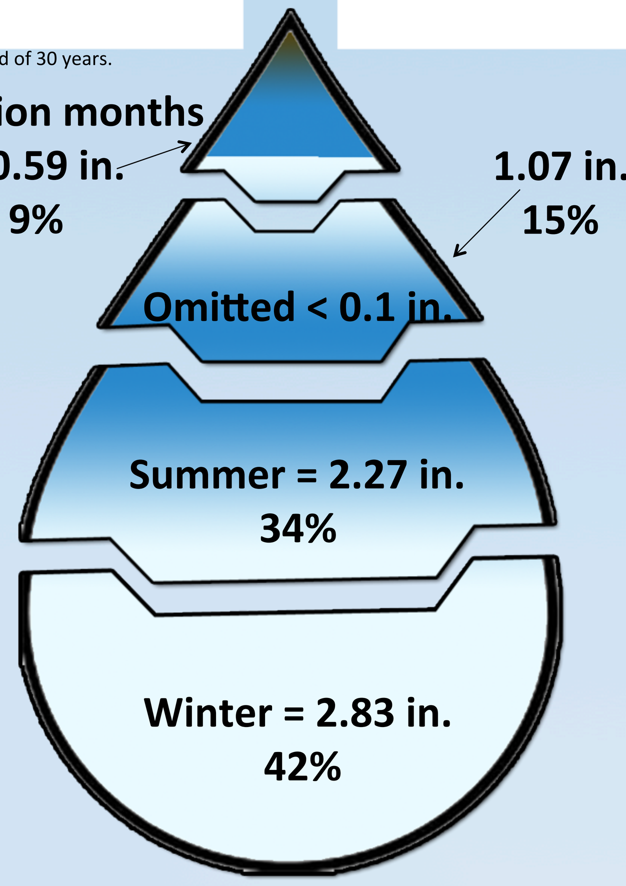


*Secondary data of rainfall events from FCDMC. Events of < 0.1in. were omitted from this study over a period of 30 years.

When implementing GI/ LID techniques, seasonal rainfall variability should be considered. Timing and quantity can influence the following:

- Direct reuse of water
- Stored water volume and capacity.
- The types of GIs needed.
- The sizing of such GIs.

The graphs above represent the number of storm events vs. the size of those events (volume) over 30 years of data following our bimodal rainfall pattern. Based on information collected the following results were found:

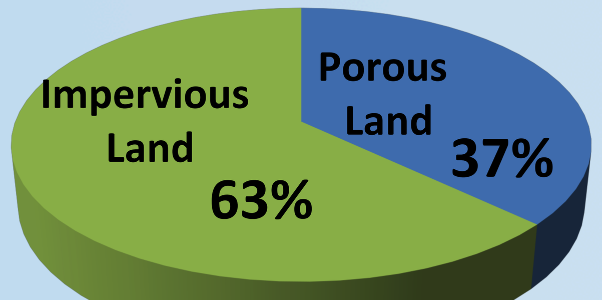


- Winter season had significantly more storms overall (260 events) vs the Summer season (151 events).
- Summer season had larger storms based on single-event volume and "outlier" storms however the winter season had a more wet season overall.

This defines two important points:

- The summer season has a tendency to produce higher volume storms in shorter periods of time. (flashy)
- The winter season however has a frequency of smaller storms over longer periods of time. (slow and steady)

POROUS vs. IMPERVIOUS



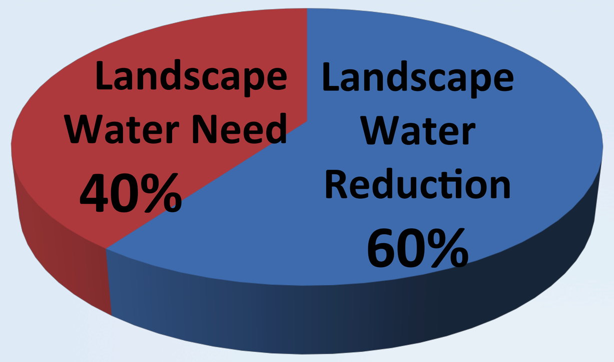
Durango Campus (Zone 1) total land area = 341804 sqft:

- Average rainfall event of 1" = 212,306 gallons.
- 63% of impervious land creates runoff which can be recaptured and utilized. (132,686 gal)

WATER AVAILABILITY

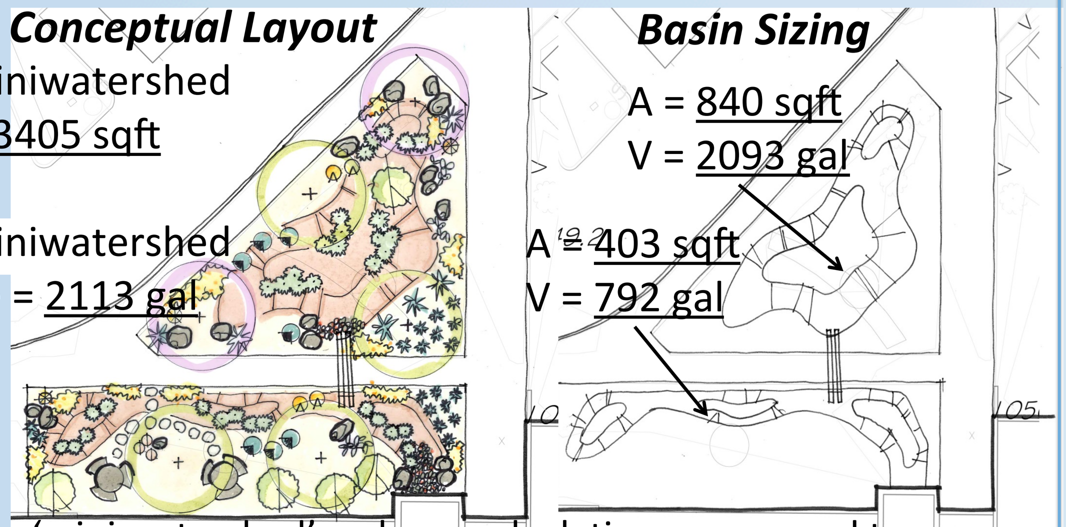
With a total annual potable water usage of landscape at 2,395,900 gal:

- 60% of potable water can be fulfilled with annual rain capture alone.
- 40% (964,054 gal) will still be needed for irrigation annually.



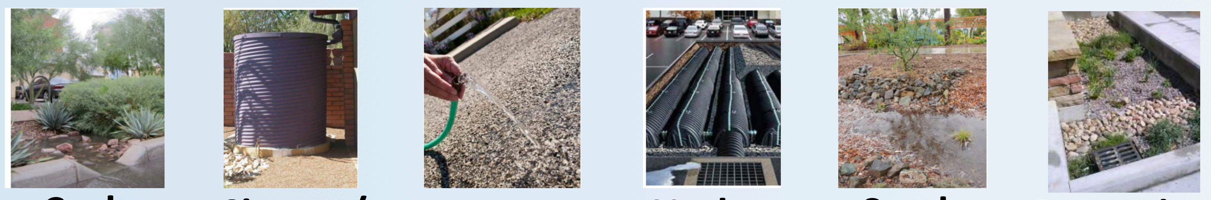
* Average annual rainfall of 30 years = 6.76 in.

TEST SITE



Using one 'mini watershed', volume calculations were used to determine the size of GI/LID techniques. This site allowed for direct reuse water harvesting basins to capture all available rainfall. However, other areas within the Campus are limited in area and require additional techniques (in form of a treatment train) to fully capture available runoff.

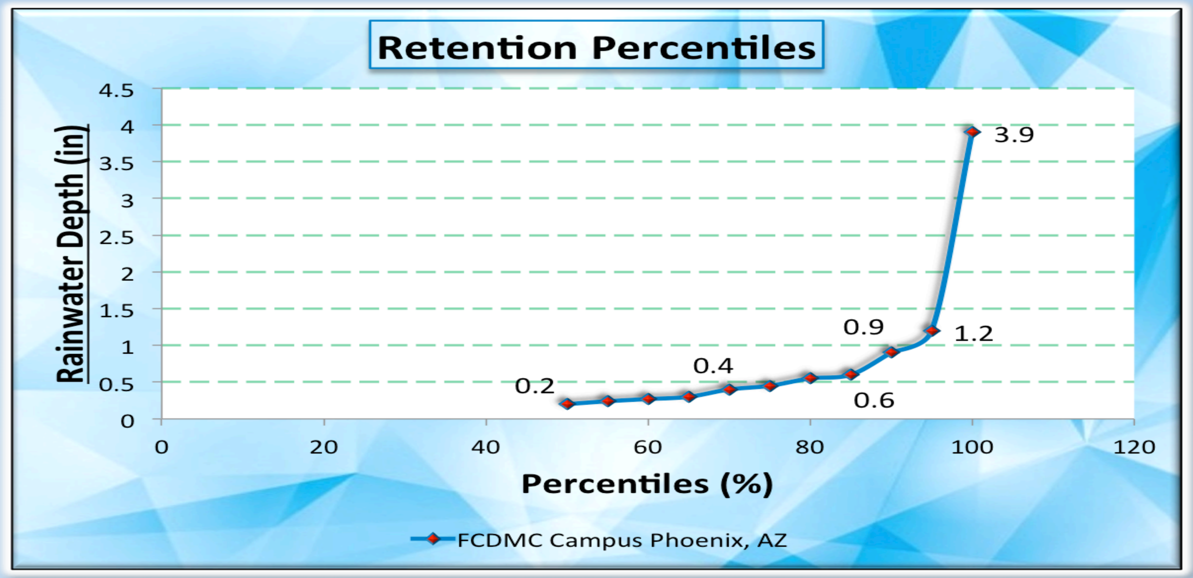
GI/LID TECHNIQUES



Curb Cut | Cistern/ Tank | Porous Pavement | Under-drain | Swale | Retention Cell

Illustrated above are potential GI/LID techniques considered for use on the District Campus. This are not an all-inclusive list, but represent potential target strategies.

CONCLUSION/ IMPLICATIONS



* The Percentile is a calculation of average annual number of storms (30 years data) with depths smaller than or equal to values located on the vertical axis.

* Example: 90% of all storms annually produce 0.9 inches or less of rain.

* Any event where precipitation volume is less than 0.1 inches has been omitted from this study as Watershed Management, EPA, and City of Phoenix have stated that rainfall less than 0.1 inches does not produce runoff and therefore is not considered a storm event.

During this evaluation, it was determined that many GI/LID locations were driven by the need to be co-located within existing planters and landscape areas (porous surfaces) as part of Zone 1. This is out of necessity to accommodate potential surface runoff from impervious areas adjacent to these preferred GI/LID technique locations. Based on the amount of potential available rainfall that can be captured, some GI/LID techniques cannot be sized to accommodate maximum capture from the 1" rainfall event. Therefore, it was important to consider additional techniques, formed as part of a treatment train, to capture remaining flows within a mini watershed system.

So, does a water availability analysis influence the sizing, location, and type of GI? Yes!

Size: determined by attempts to accommodate maximum capture of 1" event with efficiency (not too large) and understand seasonal variation.

Location: understanding where surface runoff flows occur and volumes available within a mini watershed, as well as the overall site, helps determine potential locations to maximize capture.

Type: this has a somewhat mixed result. The District has an interest in testing/studying the effectiveness and suitability of different types of GI/LID techniques, therefore some areas had obvious choices about the specific types of techniques being considered. Where the water availability analysis influenced selection was in areas where volumes were higher than expected and additional treatment types were needed to capture this remaining resource.

REFERENCES

This material is based upon work supported by the National Science Foundation under Grant No. SES-1462086, DMUU: DCDC III: Transformational Solutions for Urban Water Sustainability Transitions in the Colorado River Basin. Any opinions, findings and conclusions or recommendation expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

For their invaluable help throughout this research project, I would like to thank my internship coordinator Harry R. Cooper from the Flood Control District of Maricopa County as well as Landscape Architect Kaylee Colter, CAD Manager Joseph Wagner and Chief Meteorologist Daniel Henz.