

Impacts of Rain Barrels on Surface Water Runoff

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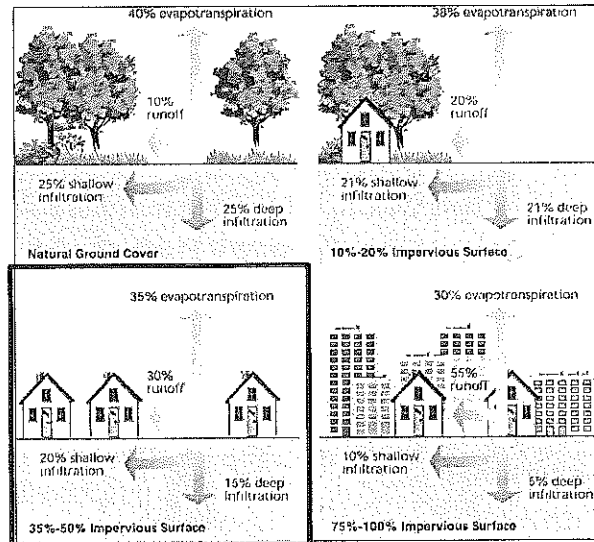
Civil and Environmental Engineering



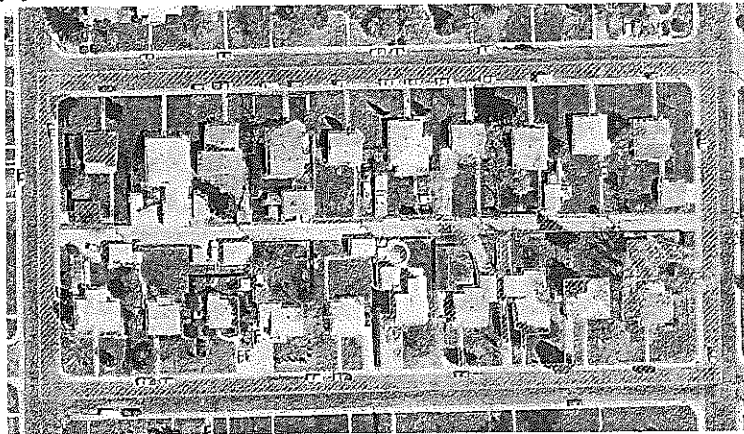
Objectives

- Provide an unbiased assessment of the effects on runoff and infiltration of 100 gallons of rainwater capture capacity for a typical household using defensible scientific methods and Colorado-specific (Denver) climatic conditions

Hydrology in Urban Settings



Typical Urban Lot Characteristics



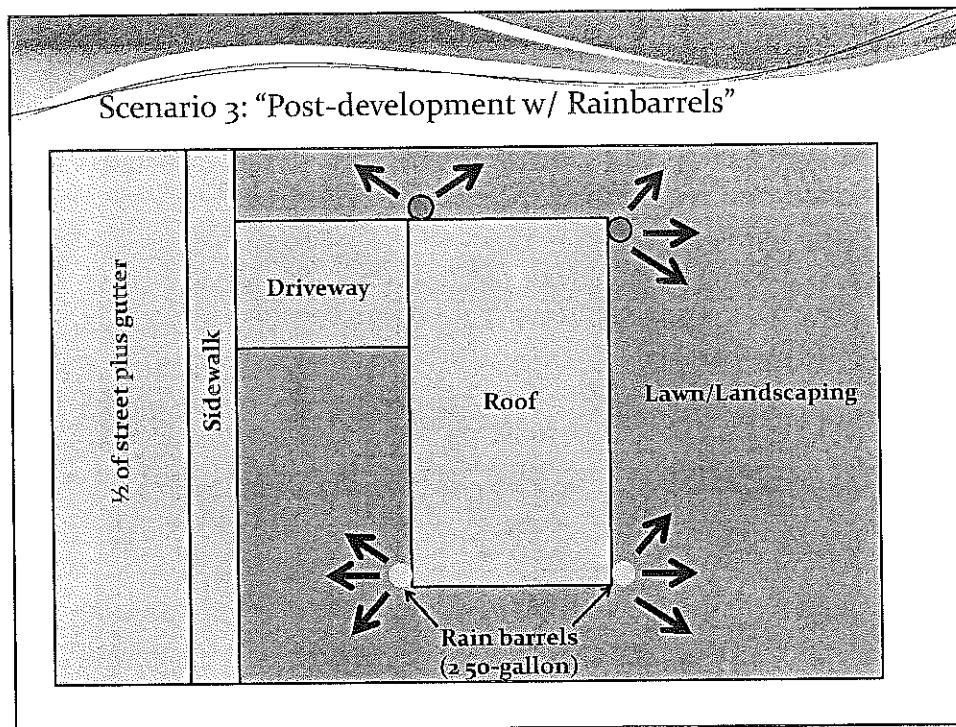
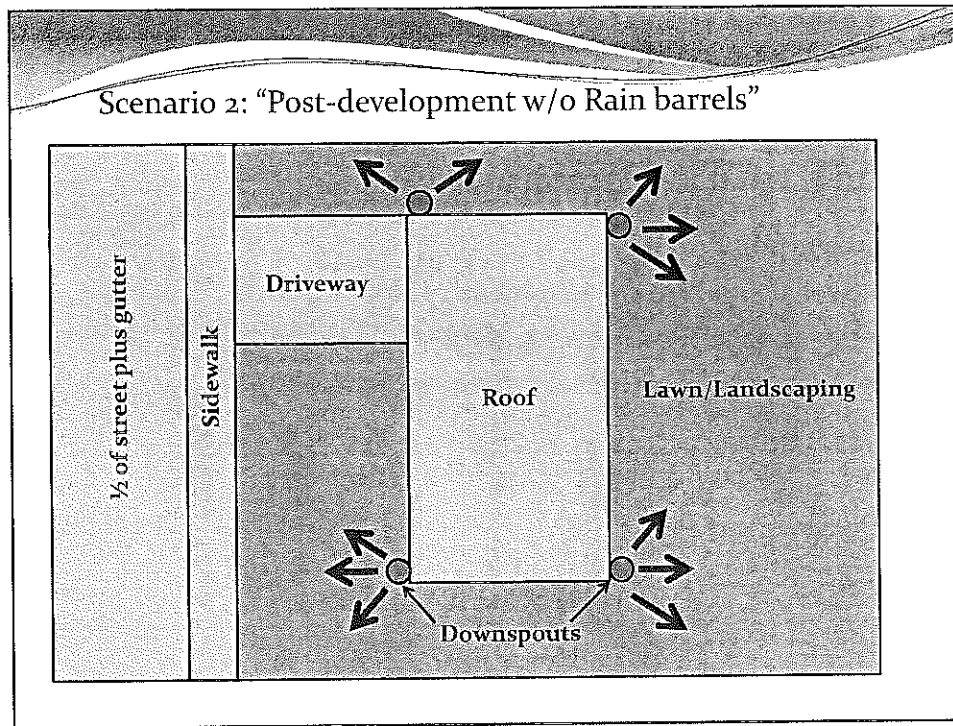
Example Output of GIS Impervious Surface Analysis (Matrix Design Group, 2015)

Technical Analysis

- 3 scenarios
 - Scenario 1: "Pre-development" – Native prairie
 - Scenario 2: "Post-development w/o Rain barrels"
 - Scenario 3: "Post-development w/ Rain barrels"

Scenario 1: "Pre-development" – Native prairie

Pre-development
Native Prairie



Typical Urban Lot Characteristics

- 9,712 ft² total area
- 52% total impervious
 - (1/2 roadway + sidewalk + driveway + rooftop)
- 1,712 ft² rooftop (35% of total impervious area)

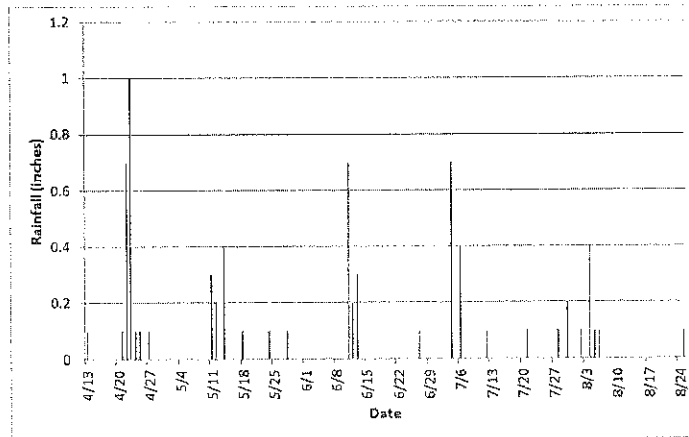
- Sources:
 - City of Fort Collins (GIS Analysis of Assessor Data)
 - Matrix Design Group (GIS Analysis of Denver Impervious Area)

Analysis

- Simulations:
 - Apr 1, 2010-Oct. 1, 2010: Typical rainfall season
 - Aug. 16, 2000: 1-year return storm (1.4 inches of rain)

- Rain Barrel Water Use: Homeowners wait 2 days until using the stored water. All water is applied to landscape/lawn in 1-2 hours.

Recorded Rainfall: Apr-Sept 2010



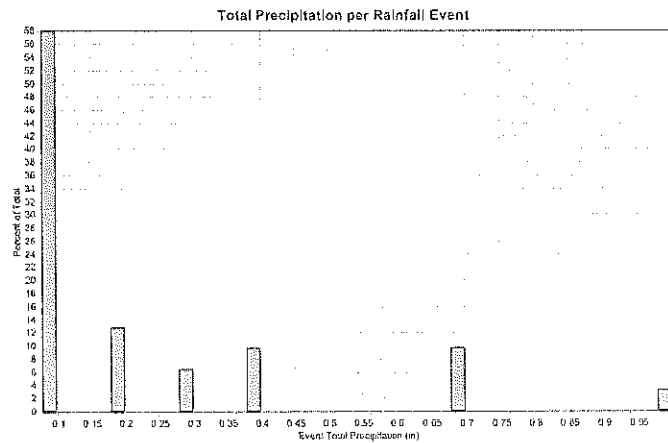
Precipitation Events (31 total)

Analysis Results: Apr-Sept 2010

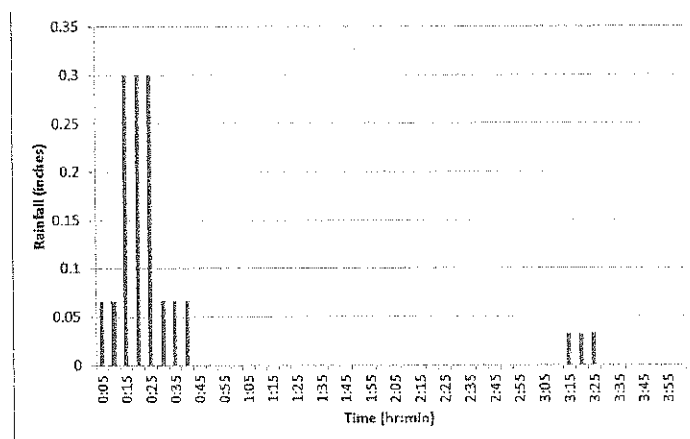
Scenario	Infiltration + Evaporation (gal)	Surface Runoff (gal)
Undeveloped	42,684	1,955
Developed (No Rain Barrels)	31,606	13,033
Developed (With Rain Barrels)	31,606	13,033

Total Precipitation Falling onto lot = 44,639 gallons
 Total Water Captured in Rainbarrels = 1,162 gallons
 Number of Rain Events = 31

Storm Totals: Apr-Sept 2010



1-yr Storm Analysis: 8/16/2000



Precipitation

Analysis Results: 8/16/2000 (1yr storm)

Scenario	Infiltration + Evaporation (gal)	Surface Runoff (gal)
Undeveloped	4,888	3,584
Developed (No Rain Barrels)	2,933	5,539
Developed (With Rain Barrels)	2,933	5,539

Total Precipitation Falling onto lot = 8,472 gallons
Total Water Captured in Rainbarrels = 100 gallons

Rainbarrel Adoption Rates

- Milwaukee Metro Sewerage District: ~ 5%
 - 20,000 rainbarrels distributed over 10 years
 - Service Area ~ 370,000 households
 - pers. comm. with Karen Sands (MMSD)
- Madison, WI: ~ 8%
 - pers. comm. with Bryant Moroder (RainReserve)
- Pierce County, WA: ~6%
 - 300 respondents out of 5000 mailings
 - pers. comm. with Tiffany Odell(Pierce County, WA)

Rainbarrel Adoption Rates

- Overland Park, KS: < 1 %
 - 93 rainbarrels distributed over 5 years
 - Population ~ 180,000
 - pers. comm. with Nico Cantarero (City of Overland Park)
- Shepard Creek Watershed (Cincinnati, OH): ~ 30%
 - 107 out of 350 households targeted
 - EPA-sponsored study using reverse-auction economic incentive technique
 - Thurston et al (2010) - *Environmental Science and Policy*

Conclusions

- Allowing 100 gallons of rainwater storage per household will not decrease surface runoff by any detectable amount on a typical lot
- Development on previously undeveloped land ("greenfield") has a significantly greater effect on surface runoff and infiltration than rainwater storage