

Regency Centers.

Market at Colonnade Innovative Stormwater Management Plan



Project Location



Source: http://maps.raleighnc.gov/imaps





Project Planning Considerations

- In-fill retail development project site area 6.25 ac. w/ high land costs
- Undevelopable with surface SW pond or wetland explored subsurface options
- Rezoning necessary (O&I-1 to SC-CUD) demanded significant upfront planning
- Strong support from surrounding community and the City of Raleigh
- Met all City of Raleigh standards for SW Quality & Quantity with no exceptions
- Project's innovative approach to SW management was endorsed by NCSU (BAE)
- Received Clean Water Management Trust Fund (CWMTF) grant





Project Master Plan



Source: Regency Centers





Innovative Stormwater Management Plan (ISMP) intended to:

- Collect and Retain the runoff from the 1-inch rainfall on-site
- Treat "first flush" runoff to <u>exceed</u> regulatory requirements
- Detain stormwater runoff to <u>exceed</u> the 2-year and 10-year design storms
- Infiltrate site runoff into underlying soils to recharge groundwater
- Reuse harvested rooftop rainwater to reduce site water usage

Regency Centers. *".....apply an innovative approach to SW management by utilizing proven technologies in conjunction with conventional BMP's....."*



ISMP Components



SIX FORKS ROAD

Single 15-inch RCP Outlet





Rainwater Harvesting Cisterns

- Three cisterns:
 - Single above-ground CorGal[™]
 - Two subsurface StormTrap[™]
- Combined capacity of 43,000 gallons
- Interior reuse in Whole Foods Market
- Exterior reuse on landscaping
- Excess SW infiltration w/in tree save area





Bioretention Area & Surface Bio-swales



- 250 SF Grass-lined Bioretention Area
- 450 LF Bio-swale w/ Under-drain System
- Drip Irrigation w/in Tree Save Area







Subsurface Infiltration System

- Approx. 2,500 LF of gravel/pipe trench
- Typical trench 4' wide by 3.5' deep
- 17 each 125' long infiltration trenches w/ 15" HDPE pipe
- 2 each 190' long manifold trenches w/ 24" HDPE pipe
- Trench invert 11.5' to 16.5' below pavement
- Approx. 15,000 CF of storage
- Underlying soils (sandy loam) allow for infiltration of runoff from 1-inch storm w/in 4 days







Subsurface Detention System

- 135 StormTrap[™] units 350,000 gal.
- Dimensions 65' wide x 185' long x 4' high
- Pre-treatment units provide for removal of grease/oil, sediment, trash and debris
- Supports 2-year and 10-year peak discharge attenuation
- Chamber invert 9.5' to 13.5' below pavement
- Access and inspection manholes
- Single 15-inch RCP site outlet







Monitoring & Results Summary



Source: Google Maps

Low Impact Development Site (Market at Colonnade)

- 6.25 acres
- Approx. 80% Impervious
- Treatment via ISMP

Conventional Development Site

- 6.8 acres
- Approx. 60% Impervious
- Treatment via Dry Detention







Water Quality:

	<u>Conventional</u>	LID	<u>Conv./LID Ratio</u>
TN (lbs./ac./yr.)	4.03	0.13	32
TP (lbs./ac./yr.)	0.48	0.01	52
TSS (lbs./ac./yr.)	86.53	1.39	62
Water Quantity:			
	<u>Conventional</u>	LID	Conv./LID Ratio
Inflow Volume (cf)	6185	7746	0.8
Outflow Volume (cf)	3340	120	27.8
Runoff Reduction (%)	51.4%	98.3%	0.5
Peak Inflow (cfs)	8.15	8.90	0.9
Peak Outflow (cfs)	0.10	0.01	8.6
Peak Reduction (%)	98.7%	99.8%	1.0







Stormwater Construction Costs

SW Component	Construction Cost
Rainwater Harvesting Cisterns	\$111,250
Subsurface Infiltration System w/ Pretreatment	\$181,350
Subsurface Detention System	\$340,000
Bioretention Area	\$10,600
Drip Irrigation System	\$13,250
Integrated Pipe Network	<u>\$70,750</u>

Total: \$727,200





Project Environmental Standing

- Whole Foods Market LEED Gold for Commercial Interiors
- Both retail building LEED Silver for Core & Shell
- Recognitions:
 - COR Environmental Award for Resource Conservation
 - GTSDA Award for Design Excellence
 - GTSDA Award for Exemplary Water Quality Protection
- Public Awareness and Education Campaign







- Integration of known technologies can provide solutions to common stormwater problems
- Even on highly impervious sites harvested stormwater can be utilized
- Volume reduction plays an essential role in nutrient load reduction
- Detention and infiltration promote unprecedented, large-scale groundwater recharge
- Viable solutions to relieve pressure on already overloaded SW networks and receiving streams





- While potentially costly LID can offer workable solutions
- LID approaches to SW are feasible if conditions make sense
- LID designs are functional and reliable when coupled with appropriate O&M inspections and reporting
- Successes are quantifiable in terms of SW quality and quantity
- LID design approaches can be game changing





- Colonnade is representative of an increasing number of in-fill projects
 within the City of Raleigh and the greater Triangle area
- Provides a precedent-setting opportunity for stormwater treatment and infiltration, and groundwater recharge
- Demonstrates the potential for public and private partnerships to develop solutions to complex problems
- Allows the City of Raleigh to consider new performance based standards for stormwater management
- Data publicized and results reported for Regulatory & Public use



Questions???

Publications:

Wilson, C., Hunt, W., Winston, R., and Smith, P. (2014) Assessment of a rainwater harvesting system for pollutant mitigation at a commercial location in Raleigh, NC, USA. Water Science & Technology: Water Supply. In press.

Wilson, C., Hunt, W., Winston, R., and Smith, P. (2014) A Comparison of Runoff Quality and Quantity from a Commercial Low Impact Development and a Conventional Development in Raleigh, NC. Journal of Environmental Engineering. In press.

Mark Peternell and Patrick Smith, Managing Stormwater as a Resource, Urban Land magazine, January/February 2014, <u>http://urbanland.uli.org/sustainability/how-to-manage-stormwater-as-resource/</u>

Regency Centers.







