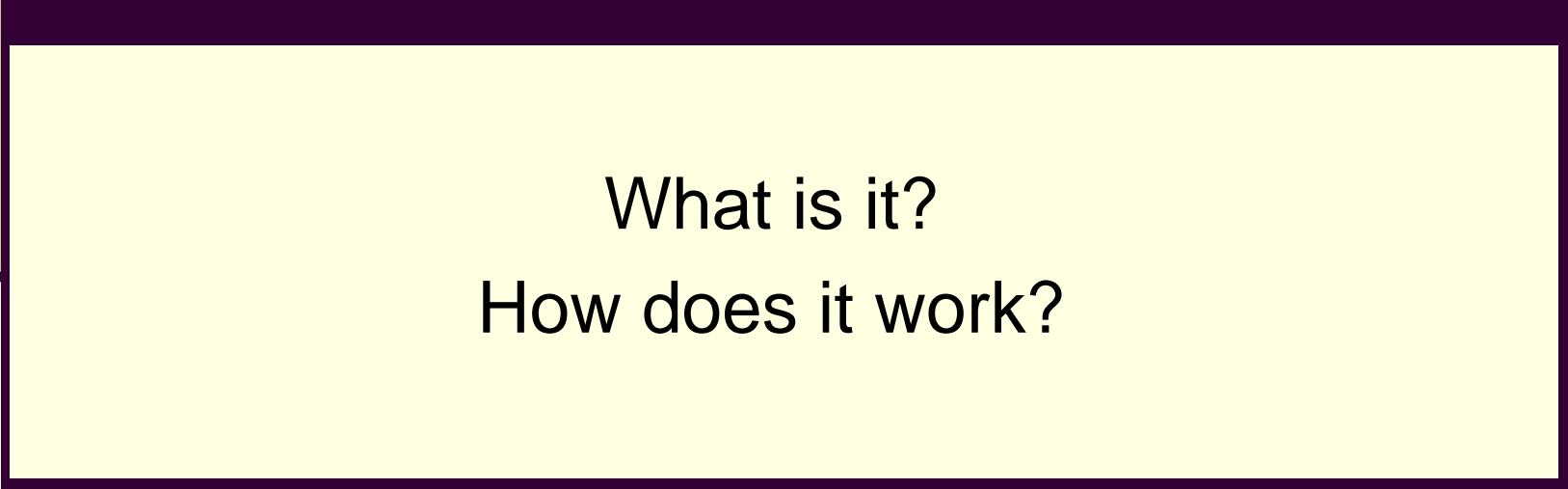




CITYgreen



What is it?
How does it work?

CITYgreen

- Developed by American Forests
- Software module for ArcGIS software
- Initially released in 1996.

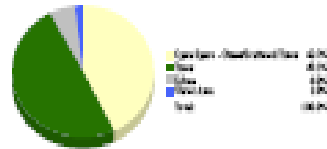
What does it do?

- CITYgreen calculates dollar benefits based on your specific site conditions.
- CITYgreen analyzes:
 - Stormwater Runoff
 - Air Quality
 - Summer Energy Savings
 - Carbon Storage and Avoidance
 - Tree Growth

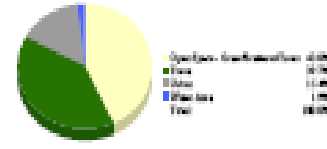
How does it work?

- High-resolution multispectral satellite imagery.
- Landcover type classification.
 - Tree canopy
 - Impervious surface
 - Grass
 - Water
 - Etc.
- CITYgreen uses classification information to calculate data.

Fiedmont Green Study Area 1994 Landcover



Fiedmont Green Study Area 2003 Landcover



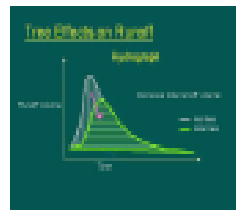
Air Quality Results

Per Acre Annual Yield

Material	1994	2003
Carbon Storage	1,071,419	8,494,429
Nitrogen Demand	12,890,882	11,207,481
Ozone	81,740,849	65,643,368
Particulate Matter	90,811,839	48,610,718
Sulfur Demand	21,820,219	24,813,764
Total	199,416,139	102,189,661

Stormwater Results

Storm Event Hydrograph



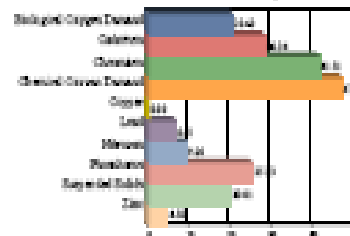
Stormwater Volume Change

Days Under Rainfall	3.22 hrs
Storm Number reflecting conditions in 1994	71
Storm Number reflecting conditions in 2003	74
Additional Storage Volume of stormwater generated due to change in landcover from 1994 to 2003	1,664,863,179 cu ft
Construction cost of retention facilities per cu ft of stormwater	\$2.00
Cost of the construction of retention facilities to store excess volume of stormwater	\$3,329,726,357

Benefits Summary			
Landcover Change (acres)			
Landcover	1994	2003	Change
Total	1,238,743	1,794,096	+14.2%
Open Space	1,831,811	1,943,682	+6.0%
Urban	278,617	694,687	+147.2%
Water	14,111	17,643	+2.5%
Total Acres	4,121,282		
Air Pollution Benefits			
Pollutant Reduced (lb)	189,416,139	182,189,661	-37,213,749
1 Annual	209,874,552	201,854,362	-8,020,190
Carbon Stored (tons)	95,213,376	77,281,668	-17,931,718
Carbon Released (lb)	748,333	681,713	-66,620
Stormwater Benefits			
Additional Storage Volume Needed		1,664,863,179	1,664,863,179
Cost of Retaining Additional Volume of Rainfall		\$3,329,726,357	\$3,329,726,357

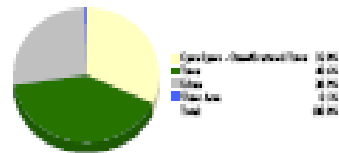
Water Quality Contaminant Loadings

Percent Change in Contaminant Loadings from 1994 to 2003 due to land cover change

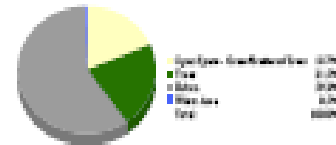


*The stormwater calculations are based on a storm model which includes land quality by ZIP Code, to represent the potential to store water and infiltrate a drainage area. Storm models may vary from ZIP Code. The higher the storm model the more rainfall event. The design storm model is 2.5 in. 6 hours in the volume of the stormwater.

Charlotte, NC 1984 Landcover



Charlotte, NC 2003 Landcover



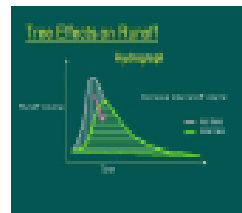
Air Quality Results

Results Reported per Year

Category	1984	2003
Carbon Monoxide	224,407	118,704
Nitrogen Dioxide	381,217	207,071
Ozone	1,380,788	1,217,037
Particulate Matter	1,023,000	890,000
Sulfur Dioxide	729,014	288,000
Total	5,821,499	2,821,812

Stormwater Results

Storm Event Hydrograph



Stormwater Volume Change

Days, 1-inch Rainfall: 3.23 in.	
*Name Member reflecting conditions in 1984	17
*Name Member reflecting conditions in 2003	34
Additional storage volume of stormwater generated due to change in landcover from 1984 to 2003:	288,982,992 cu. ft.
Construction cost of retention facilities per cu. ft. of stormwater:	\$2.60
Cost of the construction of retention facilities to store excess volume of stormwater:	187,146,184

Benefit Summary

Landcover Change (acres)

Landcover	1984	2003	Change
Trees	42,813	23,218	-47.0%
Urban, Corporate, & Other	48,718	29,862	-41.7%
Urban	41,443	91,108	120.9%
Water	118	83	-23.0%
Total Acres	132,812		

Air Pollution Benefits

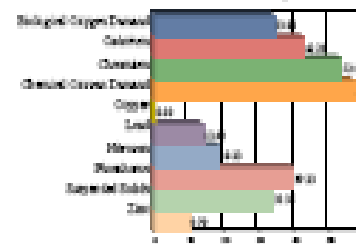
Pollutants Removed (lbs)	1,321,699	1,821,223	+4,809,907
CO Abatement	\$11,071,719	\$6,946,027	-\$4,125,692
Carbon Stored (tons)	2,768,010	1,433,000	-4,275,418
Carbon Sequestered (lbs)	22,000	21,000	-9,000

Stormwater Benefits

Additional Storage Volume (cubic feet)		278,694,997	288,982,992
Cost of Retaining Additional Volume of Stormwater		\$171,608,118	\$187,146,184

Water Quality (Contaminant Loadings)

Percent Change in Contaminant Loadings from 1984 to 2003 due to land cover change



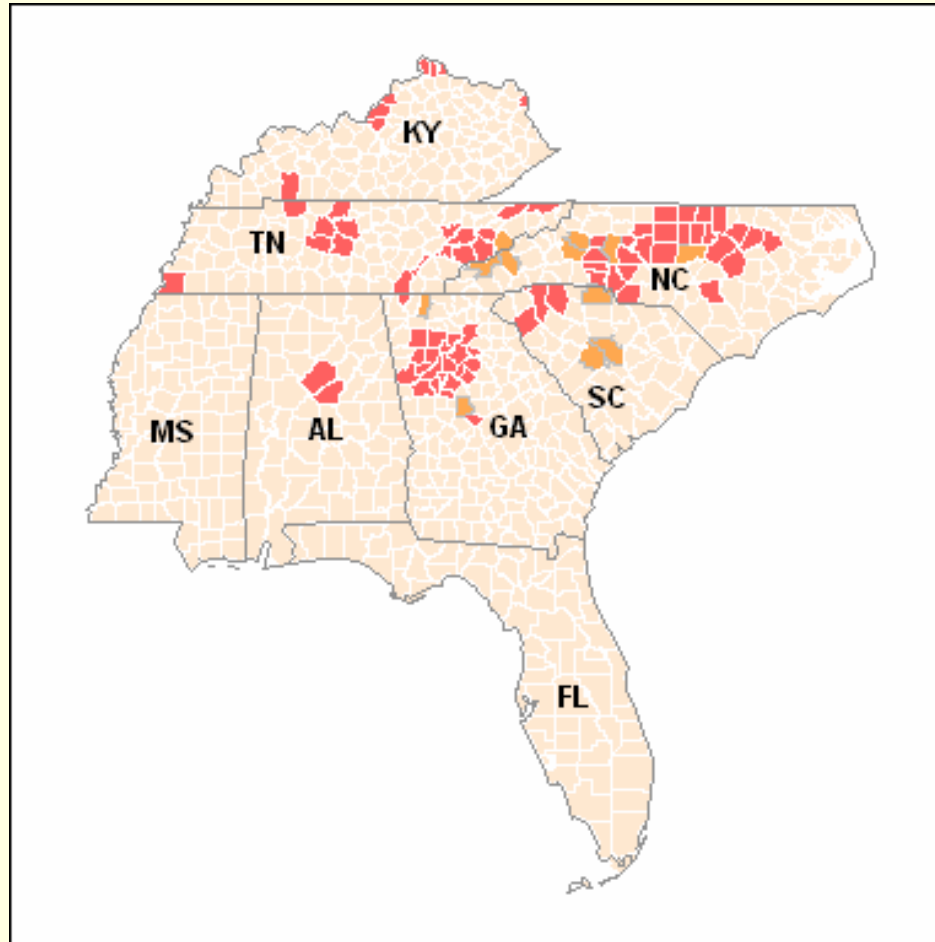
*The economic calculation is based on a cost value which is used for development by the USEPA. It represents the potential for storm water runoff with a change over. Current weather says that this is 100%. The higher the storm water runoff, the more runoff there is. The change in cost could be a decrease in the volume of the storm water runoff.

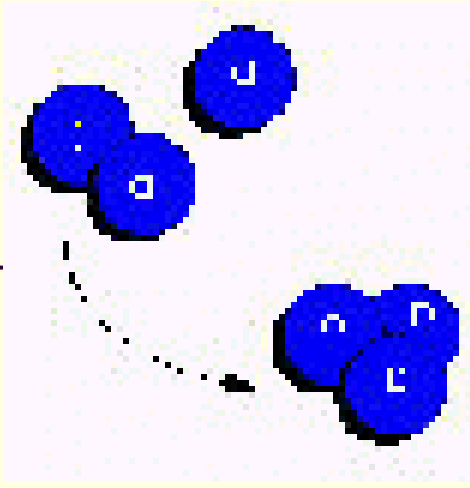


Cost Analysis Related to Local Air and Water Issues

How **CityGreen** can provide a baseline
for local decision-making in the future

Triad Operating Under an EAC for Ozone (EAC = Early Action Compact)





- “Bad” Ozone is produced in the lower atmosphere on hot days when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react with oxygen in the presence of sunlight.
- This photochemical reaction creates Ozone.

Southern Oxidant's Study

(NCSU – updated 9/05)

- “AQM11. ***Thus, destruction of trees in urban and suburban areas increased total VOC emissions. Conversely, urban planning and construction practices that modulate the intensity of urban heat islands (for example, through placement of "green spaces" within the urban core of cities and use of high-reflectivity building materials) aided in ozone pollution abatement by decreasing air temperatures in urban and suburban areas (Cardelino and Chameides, 1990; Meagher et al., 1998).***”
- <http://www.ncsu.edu/sos/pubs/SOSNYCU.pdf>

NOx Reduction Estimates

- Study Area = urban park @ 523 acres
<http://www.co.hunterdon.nj.us/planning/Woodland/Chapter01/1to5.pdf>
- FC = 410 sq. miles (x 640 acres/sq.mile) = 262,400 acres
 - NOx reduction (523 acres @ 9lbs/day)
 - 4,515 lbs NOx per day in FC x 365 days
 - 1,647,975 lbs/year (823 tons) – at similar density

Every 1% reduction in tree cover is roughly equivalent to an extra 8.2 Tons of NOx emissions in FC

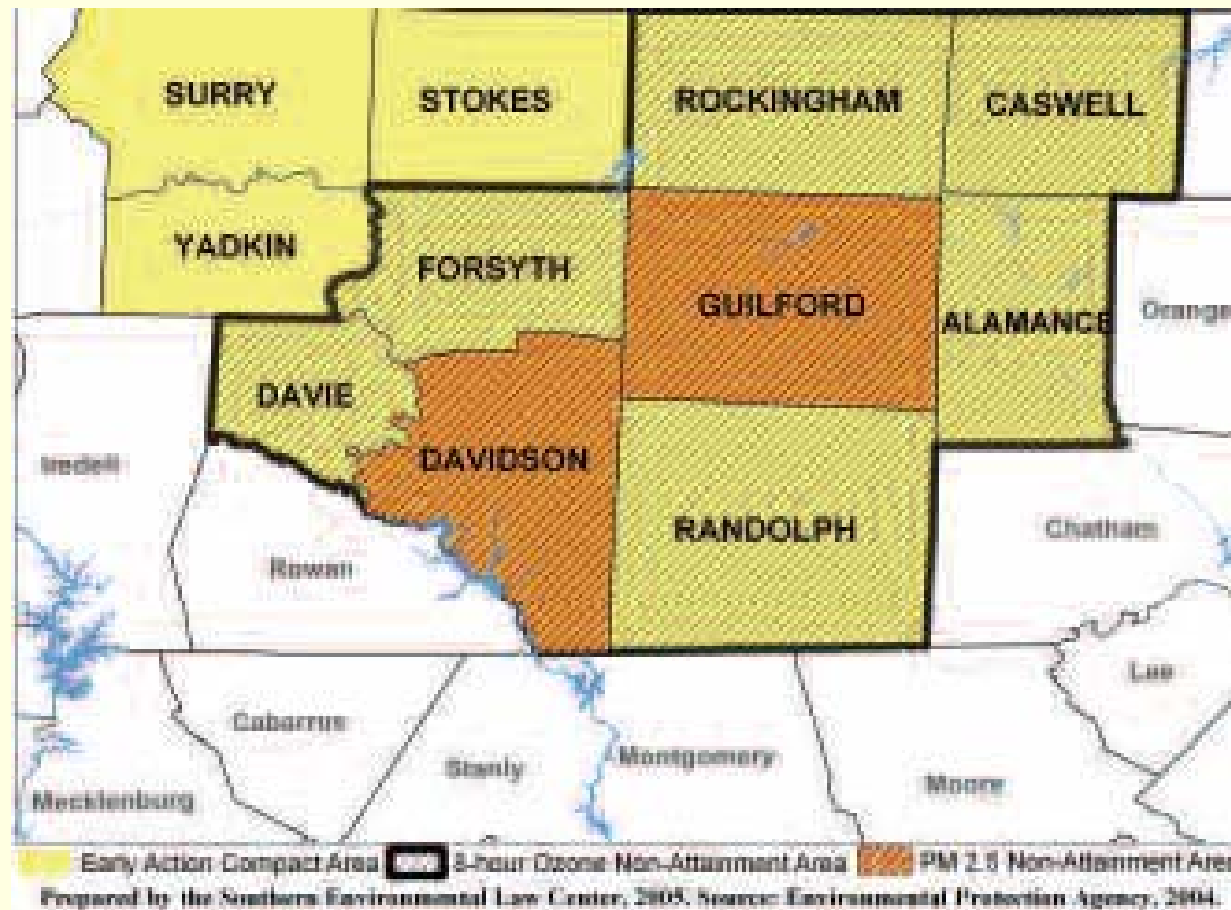
Industry's Cost for NO_x Control (in an attainment or EAC area)

- New Company X – Best Available Control Technology (BACT) for NO_x = Selective Catalytic Reduction (SCR).
- Cost/ton/year = \$2000 - \$10,000
- Every 1% tree cover loss \approx 8.2 tons/year
- @\$6000/ton/year = \$49,200/yr worth of AQ service compared to the Industrial permittees.

If FC became non-attainment for Ozone.

- If (when?) FC becomes non-attainment – then - LAER (Lowest Achievable Emission Rate)
- Eg. Catalytic Oxidation/Absorption @ \$6145 - \$48,663 cost/ton/year
- @ \$48,663 /ton/yr x 8.2 tons (per 1% tree loss) = \$399,680/ yr AQ service compared to Industrial and/or mobile source Community (and citizens)
- + offsets
- CityGreen may provide options – eg. Commit to increased % tree coverage

Triad is approaching non-attainment for Fine Particulate Matter



PM Reduction Estimates

- 48 lbs particulate / 523 acres
- 4390 tons yr / FC
- Every 1% reduction in tree cover is roughly equivalent to an extra 43.9 tons of particulate matter available to be monitored in FC
- Atlanta and other areas are using CityGreen along with TO as implementation strategies to achieve attainment.

Stormwater Control

- **TMDL** (Total Maximum Daily Load) –LID growth techniques can facilitate TMDL development and the long-term implementation of TMDL load allocations and wasteload allocations by better controlling stormwater discharges, reducing the quantity and peak flow of stormwater, and retaining more land in open space and buffers. Moreover, allocations for future growth provide a mechanism to evaluate the patterns of development that will protect water quality and those that will not.
- ***Linking Stormwater Fees to the Size of Impervious Surfaces.*** Local systems could assess fees based on the amount of impervious surface on a property and provide discounts for properties where stormwater is managed effectively on site.
- **Phase II – Post Construction –** LID could be used as a tool to eliminate costly maintenance issues and make the property more cost-friendly to consumers. Any lot that is part of a bigger project exceeding one acre will require post-construction BMPs.

CityGreen – useful down to the acre level for site planning

Summary

- CityGreen can be a valuable resource to future action strategies to avoid draconian EPA measures for non-attainment areas.
- CityGreen can benefit local planning and strategy initiatives to meet CWA requirements (TMDLs, etc.)
- CityGreen can be used by Developers to offset traditional infrastructure costs.
- It would be an invaluable tool for future assessment of current planning initiatives.
- It would give elected officials necessary data to make more informed planning decisions in FC
- Concern – staffing and resources; usefulness is in future evaluations.