

# **Roanoke Valley Urban Tree Canopy Analysis**

August 13, 2010

Shane Sawyer, Regional Planner III  
Roanoke Valley-Alleghany Regional  
Commission

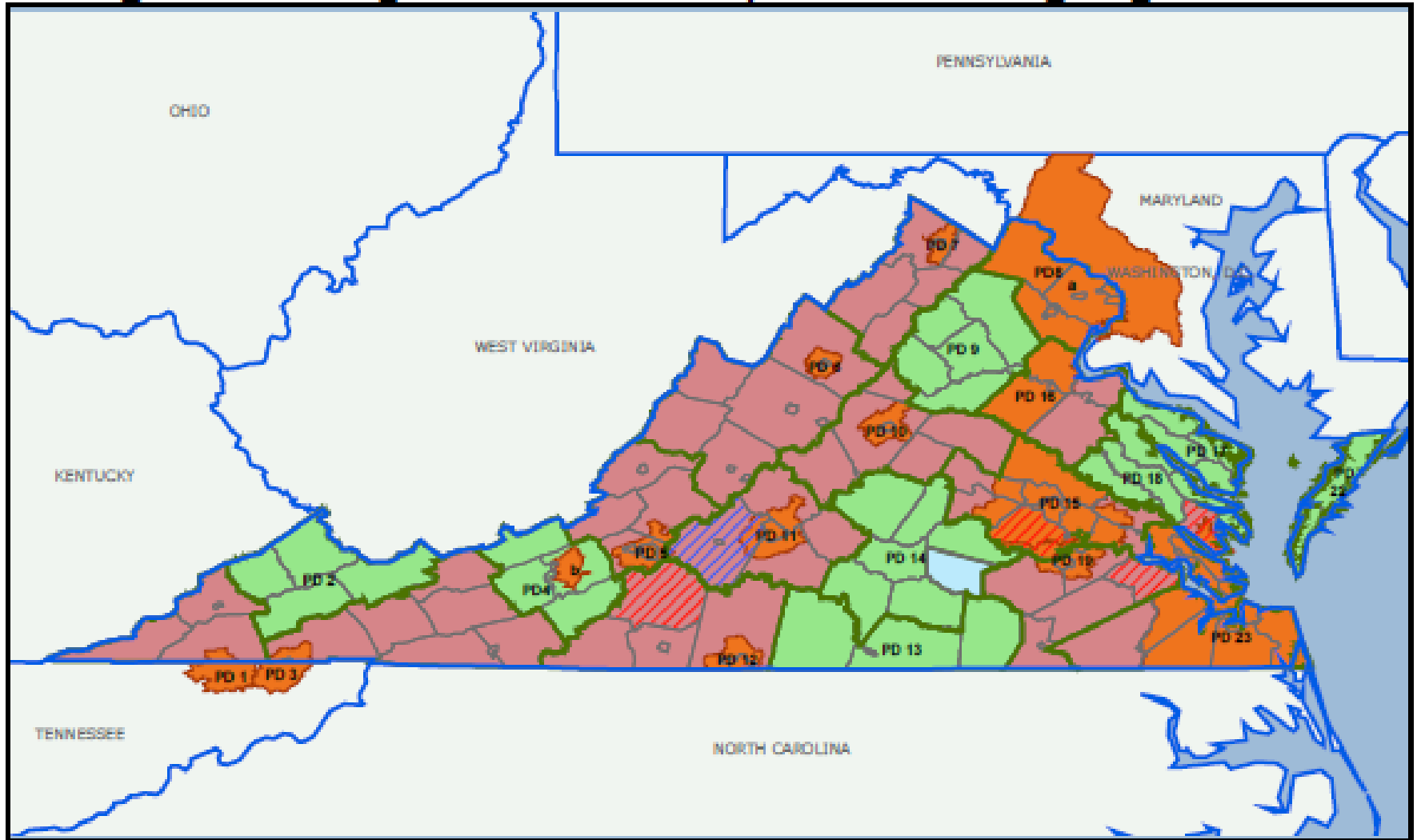
# PDCs and MPOs

- Planning District Commissions – 21 PDCs or Regional Commissions
- Roanoke Valley Alleghany Regional Commission - RVARC (formerly known as the 5<sup>th</sup> PDC)
- Member governments include the counties of Botetourt, Craig, Franklin, Roanoke; the cities of Roanoke and Salem; and the towns of Rocky Mount and Vinton
- RVARC also staffs the Roanoke Valley Area Metropolitan Planning Organization (RVAMPO)

# PDCs and MPOs

- Roanoke Valley Area Metropolitan Planning Organization (RVAMPO)
- Federal law requires the formation of an “MPO” for any urbanized area with a population of more than 50,000; currently 14 MPOs in Virginia
- RVAMPO was created in 1979 to plan and budget the use of federal transportation dollars in the Roanoke region
- Includes the cities of Roanoke and Salem, the Town of Vinton, and portions of Botetourt and Roanoke Counties

# Virginia Planning Districts & Metropolitan Planning Organizations



- MPO Boundaries
- PDCs with MPO Areas
- Rural PDCs (No MPO)
- Dual PDC Membership
- Dual MPO Membership
- No PDC/MPO Membership

- PD1 Kingsport MPO
- PD3 Bristol MPO
- PD5 Roanoke Valley Area MPO
- PD6 Harrisonburg-Rockingham MPO
- PD7 Winchester-Frederick MPO
- PD10 Charlottesville-Albemarle MPO
- PD11 Central Virginia MPO

- PD12 Danville MPO
- PD15 Richmond MPO
- PD16 Fredericksburg MPO
- PD19 Tri-Cities MPO
- PD23 Hampton Roads MPO
- a National Capital Region TCB
- b Blacksburg-Christiansburg-Montgomery MPO

Notes: Chesterfield County is a member of PDC 15 & PDC 19 | Franklin County is a member of PDC 5 & PDC 12  
 Gloucester County is a member of PDC 18 & PDC 23 | Surry County is a member of PDC 19 & PDC 23  
 Bedford County is member of the Roanoke & Lynchburg MPOs | Nottoway County is not a PDC or MPO member



# Benefits of UTC

- water quality improvement
- conserving energy
- lowering city temperatures
- reducing air pollution
- enhancing property values
- providing wildlife habitat
- facilitating social and educational opportunities
- providing aesthetic benefits

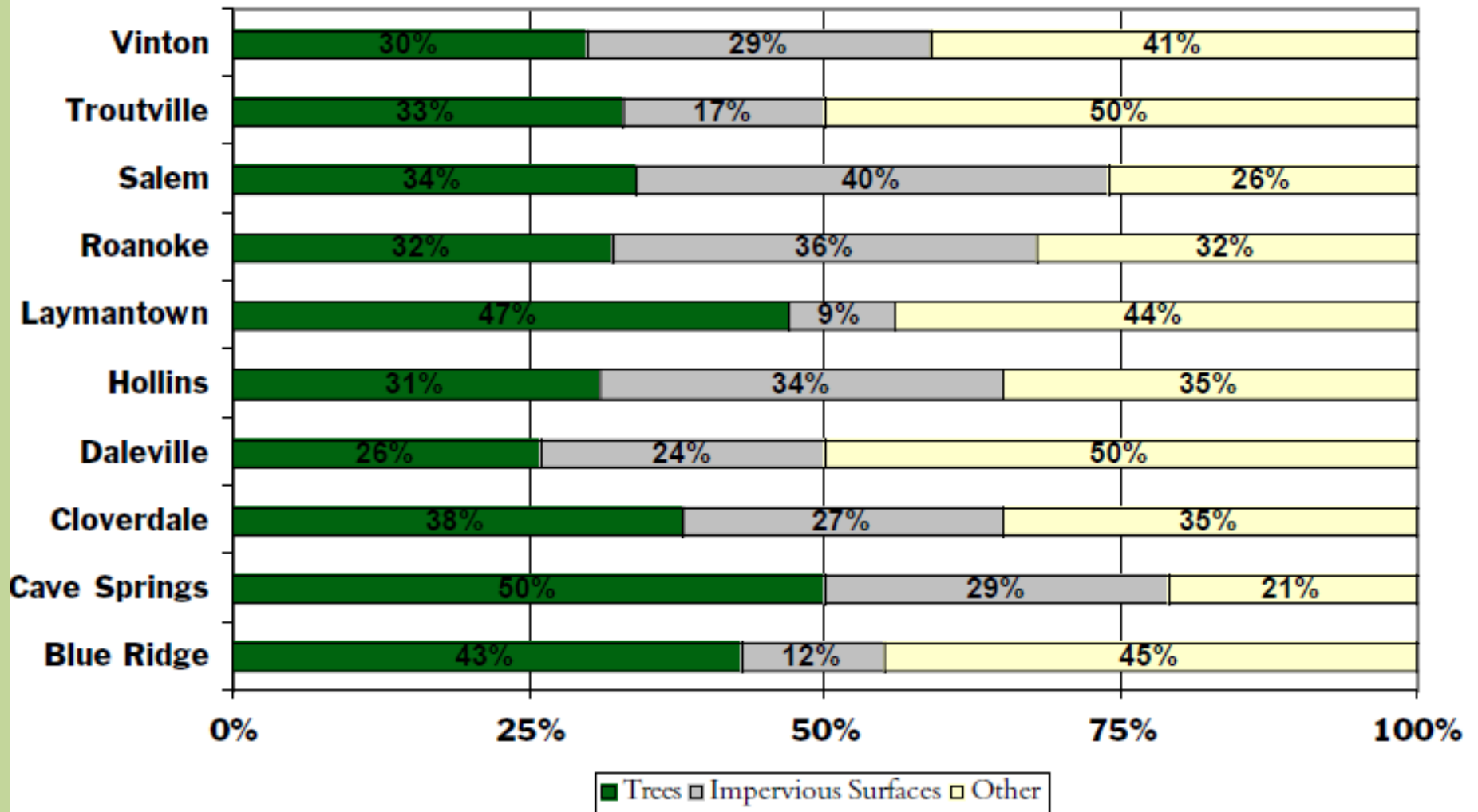
# Previous UTC Analyses

- Urban Ecosystem Analysis Roanoke, Virginia (American Forests 1998)
- Urban Ecosystem Analysis (American Forests 2002) - follow-up of previous study with data for individual communities
- Utilized CITYgreen software and Landsat satellite imagery (30-meter resolution)
- assessed the loss of tree canopy and its associated values using Landsat satellite images spanning a 24-year period from 1973 to 1997
- 1998 report indicated the tree cover in the Roanoke Valley declined from 40% to 35% between 1973 to 1997

# Previous UTC Analyses

- Ecosystem Analysis (1998 and 2002) tree canopy percentages are NOT directly comparable to Roanoke Valley Urban Tree Canopy Analysis (2008) percentages
- Different study area geographies
- Higher resolution (greater accuracy) of NAIP imagery (1-meter resolution) vs. Landsat imagery (30-meter resolution)

# Urban Ecosystem Analysis Roanoke, Virginia (2002)





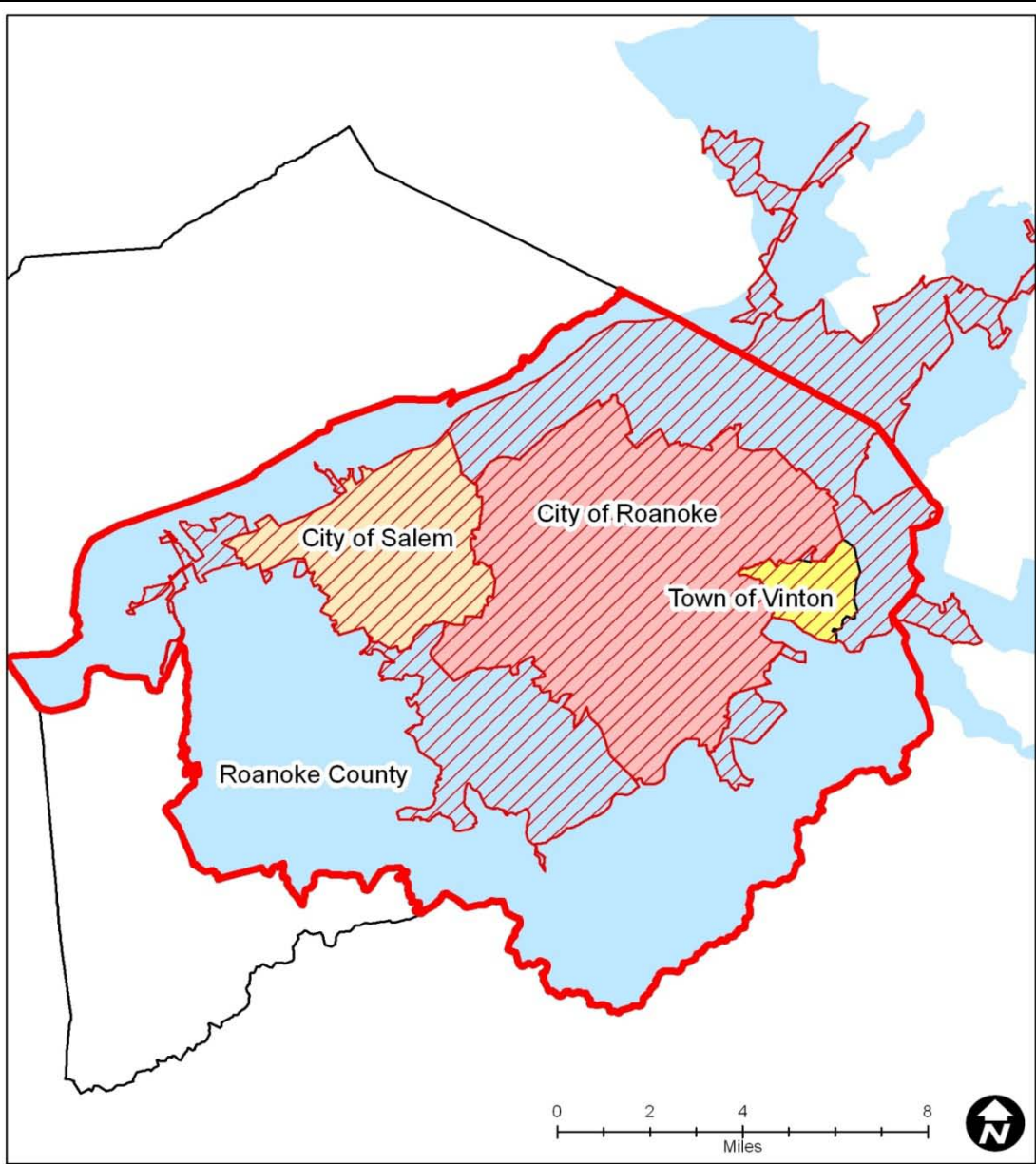
# Urban Ecosystem Analysis Roanoke, Virginia (2002)

## Roanoke Area Communities' Land Cover and Ecological Benefits




Community	Acres	% Trees	% Imper-vious	% Open Space	% Water	Air Pollution lbs. Removed Annually	Air Quality Value Annual	Retention volume (cubic ft.) required to mitigate loss of trees	Stormwater Control Value (One time Saving)
Blue Ridge	4,044	43	12	44	0	188,430	\$465,022	9,586,412	\$19,172,824
Cave Springs	7,567	50	29	21	0	410,041	\$1,011,930	19,988,536	\$39,977,072
Cloverdale	1,999	38	27	35	0	82,629	\$203,919	4,879,829	\$9,759,658
Daleville	1,219	26	24	49	1	33,743	\$83,275	1,725,370	\$3,450,740
Hollins	5,549	31	34	35	0	182,471	\$450,316	9,176,742	\$18,353,484
Laymantown	2,104	47	9	43	1	107,094	\$264,296	5,199,729	\$10,399,458
Roanoke	27,481	32	36	32	0	948,839	\$2,341,617	64,002,536	\$128,005,072
Salem	9,307	34	40	26	1	335,904	\$828,970	19,152,257	\$38,304,514
Troutville	568	33	17	50	0	19,948	\$49,319	892,891	\$1,785,782
Vinton	2,037	30	29	41	1	66,040	\$16,978	3,993,711	\$7,987,422
Total Study Area*	117,741	47	22	30	0	5,907,631	\$14,579,297	313,258,248	\$626,516,496

# Roanoke Valley Urban Tree Canopy Analysis

- UTC analysis covers the cities of Roanoke and Salem, the Town of Vinton, and MPO portions of Roanoke County
- Funded by Water Quality Improvement Fund, Regional Grant Program - Virginia Department of Conservation and Recreation provides funds (WQIA of 1997), administered by the Virginia Department of Forestry
- Purpose of the WQIF is to provide water quality improvement grants to local governments, soil and water conservation districts and individuals for point and nonpoint source pollution prevention, reduction and control programs
- WQIF focuses on non-point source pollution



**Roanoke Valley  
Urban Tree  
Canopy Analysis**

-  Roanoke Valley UTC Study Area
-  Roanoke Census-defined Urbanized Area (2000)
-  MPO 2035 Study Area

# UTC Methodology

- Utilize NAIP aerial photography, Geographic Information System (GIS) technology, and other spatial data (roads, building, parcels, etc.) to "classify" land cover
- Resulting land cover "classification" data layer (i.e., GIS shapefile) available to conduct additional analysis, assist participating localities in setting urban tree canopy goals, and developing a ways to achieve UTC goals

# UTC Work Products

- Land cover classifications (i.e., existing UTC)
- Identification of “Possible UTC” areas
  - Possible UTC – Vegetation
  - Possible UTC - Impervious
- Identification of areas not suitable for UTC (i.e., building footprints)
- Local government urban tree canopy goals setting
- GIS spatial data files for additional analysis or analysis of other “geographies”

# Application of UTC Data

- Baseline Existing UTC known (reports)
- Lots of data to work with
  - Can re-summarize for different areas
  - Can make maps for specific areas
- i-Tree can generate estimates (based on species) of ecosystem services, benefit/cost ratios, etc - NONSPATIAL
- CITYgreen can generate estimates (based on landcover values) of ecosystem services - SPATIAL

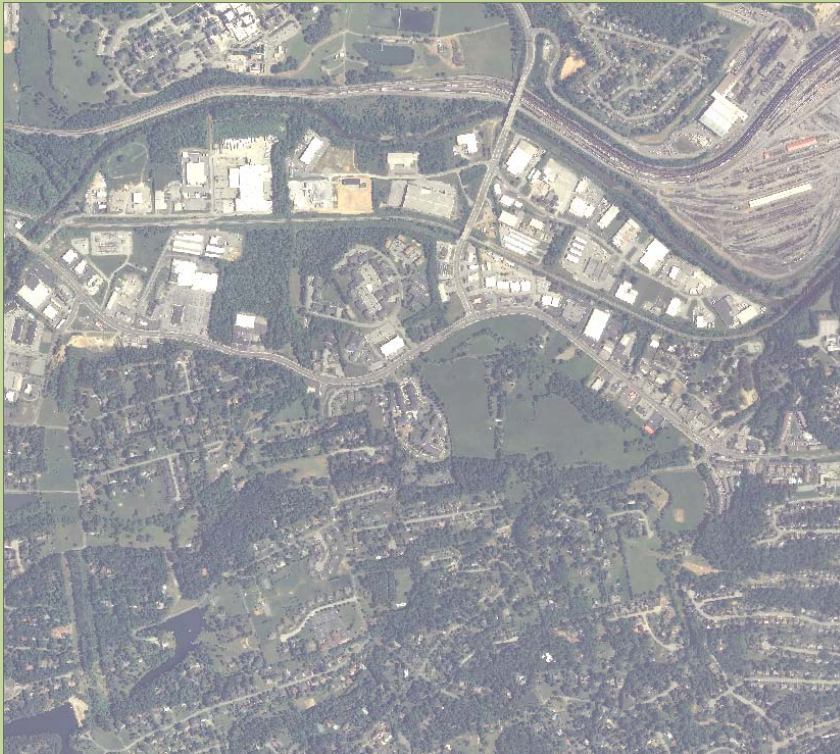
# NAIP Imagery

- National Agriculture Imagery Program
- Administered by the USDA Farm Service Agency
- aerial imagery acquired during the 2008 agricultural growing seasons in the continental U.S. (i.e., leaf on period for trees)
- One-meter resolution
- Spectral resolution includes natural color (Red, Green and Blue, or RGB); four bands of data: RGB and Near Infrared available for some areas



# NAIP

2008 NAIP imagery used for classification (roanoke.img)



Symbolized using Bands 1,2,3



Symbolized using Bands 4, 3, 2





## URBAN TREE CANOPY ASSESSMENT DATA REQUIREMENTS

### BUILDINGS

Building footprints consisting of unique polygons for each structure. Gaps between features may exist.



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
Shape_Length	Double
Shape_Area	Double

### ROADS

Road polygon boundaries. Each road polygon should fall within a PROW polygon, but the layers are separate. Gaps between features may exist.



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
Shape_Length	Double
Shape_Area	Double

### PROW

Polygon boundaries for the Public Rights-of-Way. This typically consists of all non-parcel land, excluding water. Gaps between features may exist.



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
Shape_Length	Double
Shape_Area	Double

### LAND COVER

Polygons delineating land cover types according to the coding scheme in the legend. Gaps should not exist between features.

	1 = Canopy
	2 = Grass
	3 = Impervious
	4 = Water



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
LandCover	Short Integer
Shape_Length	Double
Shape_Area	Double

### PARCELS

Property parcel boundaries that contain a unique parcel ID and the land use type. Gaps may exist between features



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
Parcel_ID	Long Integer
LandUse	Text
Shape_Length	Double
Shape_Area	Double

### GEOGRAPHIES

Geographical polygon boundaries by which to summarize the data such as neighborhoods or watersheds. Each geographical element must have a unique code.



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
Geo_Code	Long Integer
Shape_Length	Double
Shape_Area	Double

# UTC Terminology

- **UTC:** Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.
- **Land Cover:** Physical features on the earth mapped from satellite or aerial imagery such as trees or water
- **Existing UTC:** The amount of UTC present within parcel boundaries
- **Possible UTC:** The amount of land that is theoretically available for the establishment of tree canopy within parcel boundaries. Possible UTC excludes areas covered by tree canopy, roads, buildings, and water. It is the combination of Possible UTC - Vegetation and Possible UTC - Impervious

# Land Cover Classifications

- Tree canopy
- Non-tree vegetation
- Impervious
- Non-building impervious
- Building Impervious
- Water

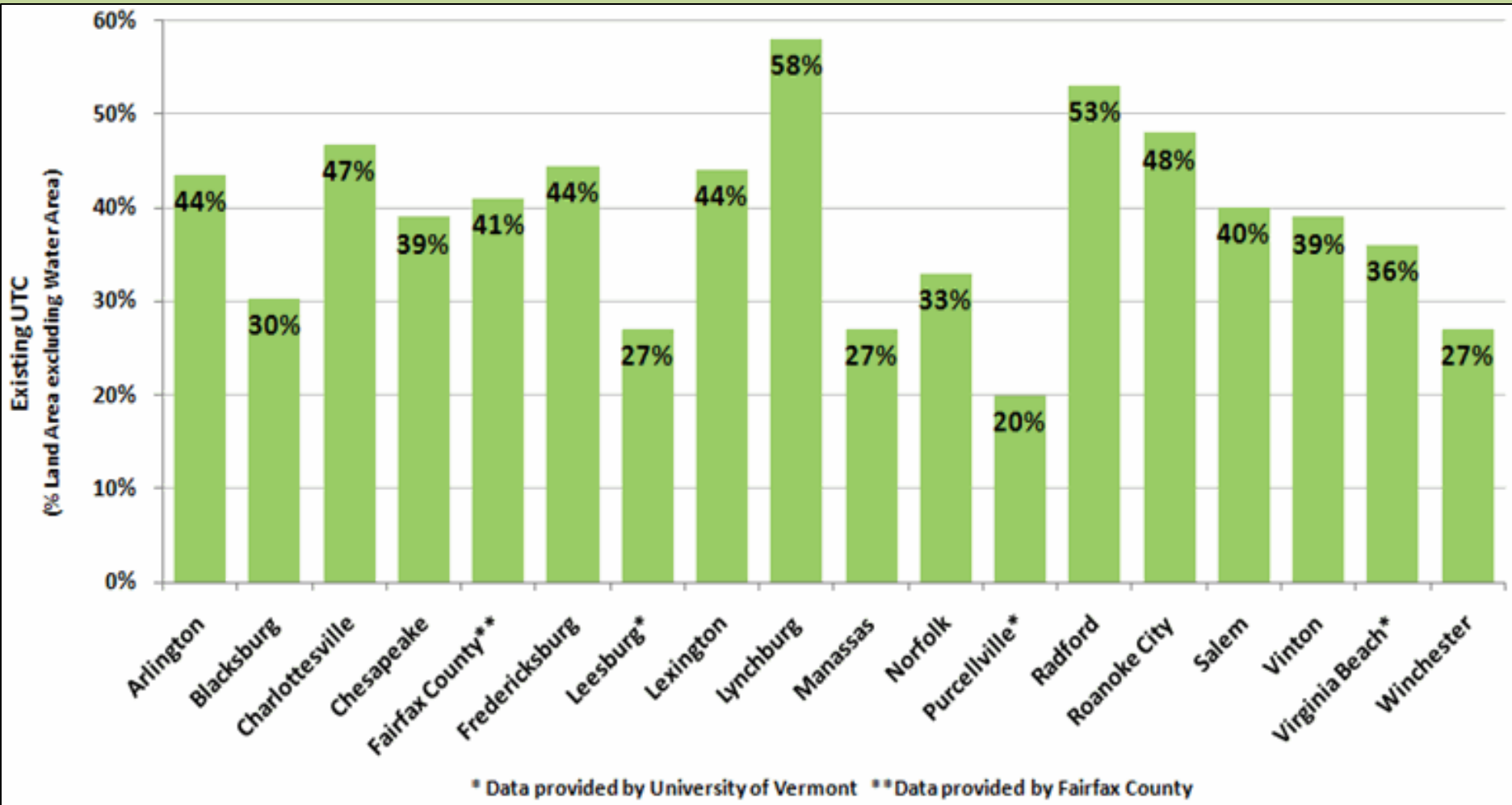
# UTC Land Cover Terminology

- **Possible UTC - Vegetation:** The amount of land that is theoretically available for the establishment of tree canopy in non-tree vegetation areas within parcel boundaries. This excludes areas covered by tree canopy, impervious surfaces, and water.
- **Possible UTC - Impervious:** The amount of land that is theoretically available for the establishment of tree canopy in impervious areas within parcel boundaries. This includes impervious areas (roads, parking lots, and sidewalks) except for buildings.

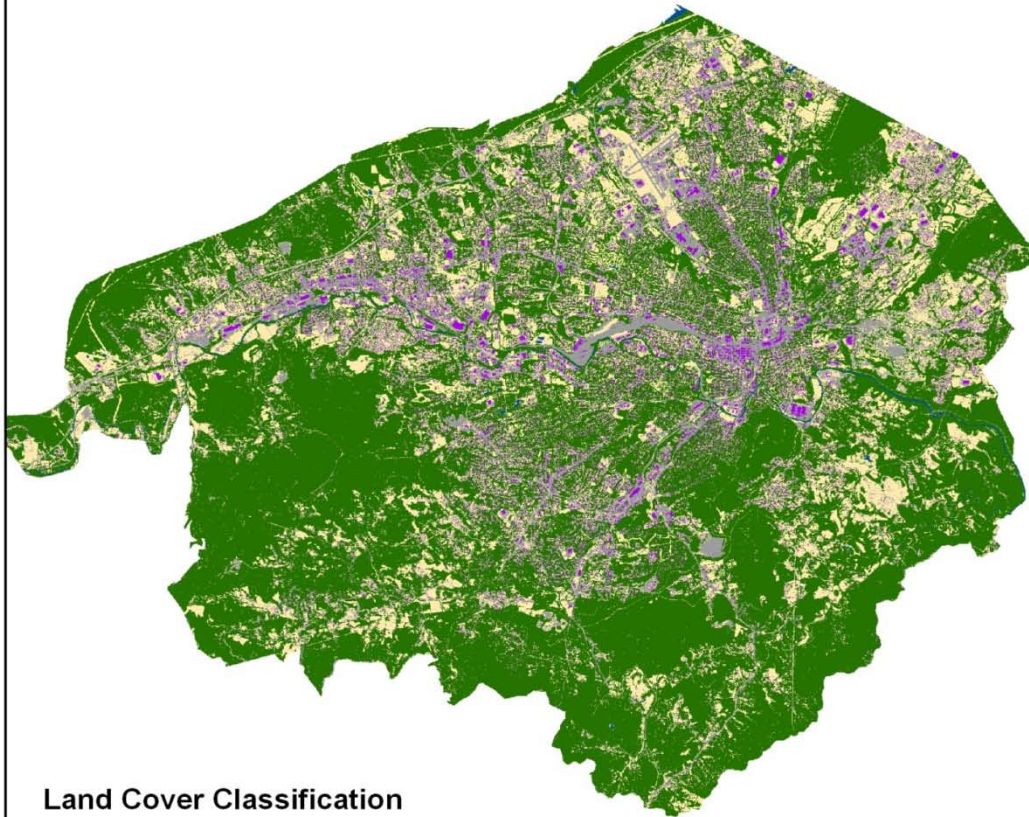
# Existing UTC

- RVARC = 62%
- City of Roanoke = 48%
- City of Salem = 39%
- Town of Vinton = 38%
- Roanoke County
  - Urbanized area 51%
  - MPO study area = 69%
- American Forest and DOF generally consider 40 percent UTC to be indicative of a healthy urban forest.

# Urban Tree Canopy in Virginia Localities

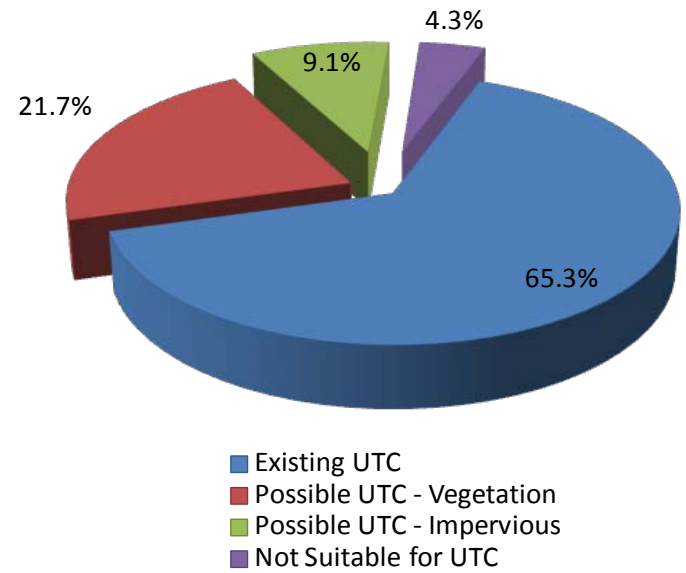
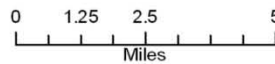


# RVARC Existing Land Cover



## Land Cover Classification

- Water
- Non- Building Impervious
- Non- Tree Vegetation
- Tree Canopy
- Building Impervious



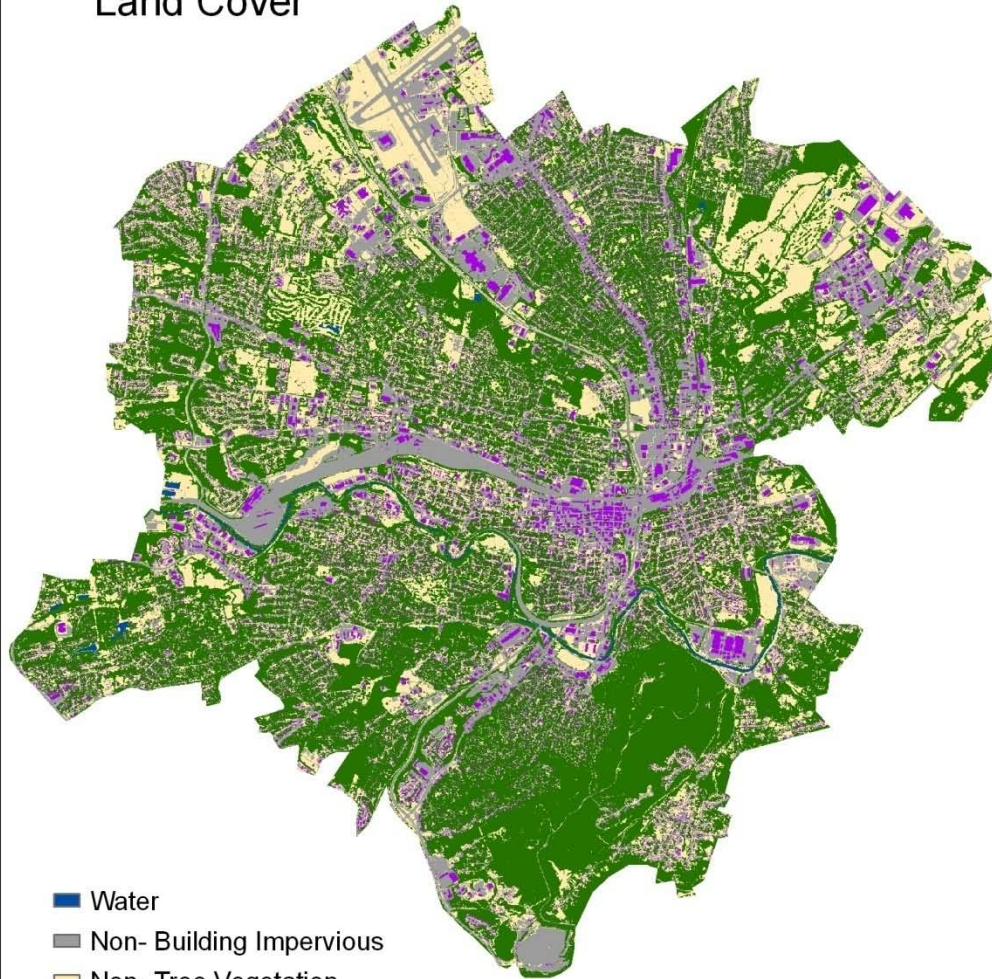
# RVARC Area – UTC Summary

UTC Classes	Existing UTC		
	Acres	% Total Area	% Land Area
Tree Canopy	74,064	61.6%	61.8%
Non-Tree Vegetation	26,007	21.6%	21.7%
Non-Building Impervious	15,537	12.9%	13.0%
Buildings Impervious	4,286	3.6%	3.6%
Water	399	0.3%	0.3%
<b>Total Area</b>	<b>120,292</b>	<b>100%</b>	<b>100%</b>

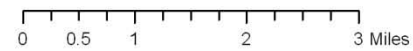
UTC Parcel Metrics	Acres	% Parcel Land Area
Parcel Land Area	108,121	100%
Existing UTC	70,555	65.3%
Possible UTC	33,324	30.8%
Possible UTC - Vegetation	23,514	21.7%
Possible UTC - Impervious	9,811	9.1%
Not Suitable for UTC	4,684	4.3%



# City of Roanoke Land Cover



- Water
- Non- Building Impervious
- Non- Tree Vegetation
- Tree Canopy
- Building Impervious

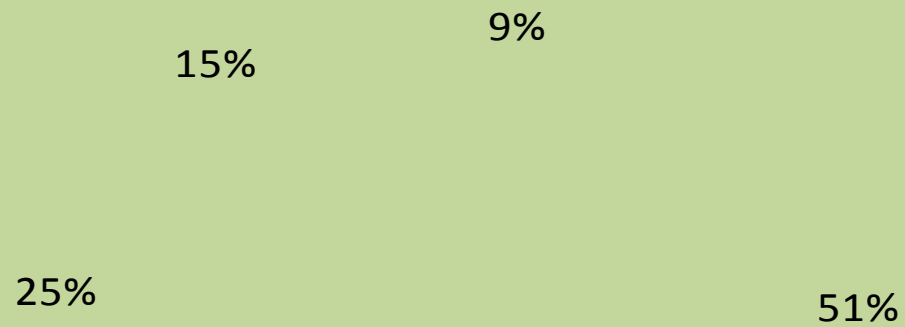


# City of Roanoke

UTC Classes	Existing UTC		
	Acres	% Total Area	% Land Area
Tree Canopy	13,146	47.9%	48.1%
Non-Tree Vegetation	6,616	24.1%	24.2%
Non-Building Impervious	5,758	21.0%	21.0%
Buildings Impervious	1,836	6.7%	6.7%
Water	105	0.4%	0.0%
<b>Total Area</b>	<b>27,461</b>	<b>100.0%</b>	<b>100.0%</b>

UTC Parcel Metrics	Acres	% Parcel Land Area
Parcel Land Area	22,331	100%
Existing UTC	11,553	51.7%
Possible UTC	8,980	40.2%
Possible UTC - Vegetation	5,634	25.2%
Possible UTC - Impervious	3,346	15.0%
Not Suitable for UTC	1,941	8.7%

# City of Roanoke

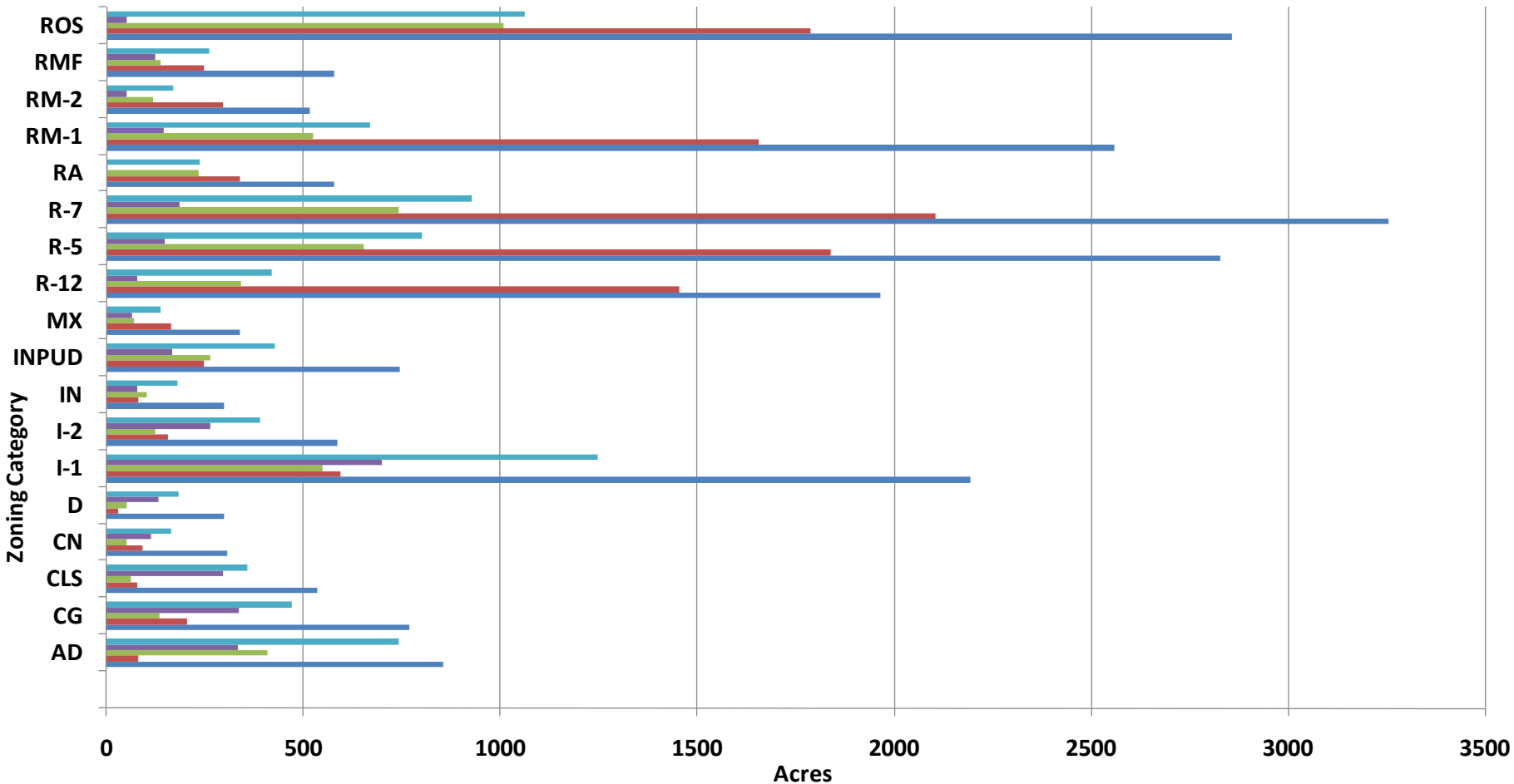


Existing Utc  
Possible UTC - Vegetation  
Possible UTC - Impervious  
Not Suitable for UTC

# City of Roanoke

## UTC by Zoning Category

Possible UTC Area   Possible Area-Impervious   Possible Area-Vegetation   Existing UTC Area   Land Area

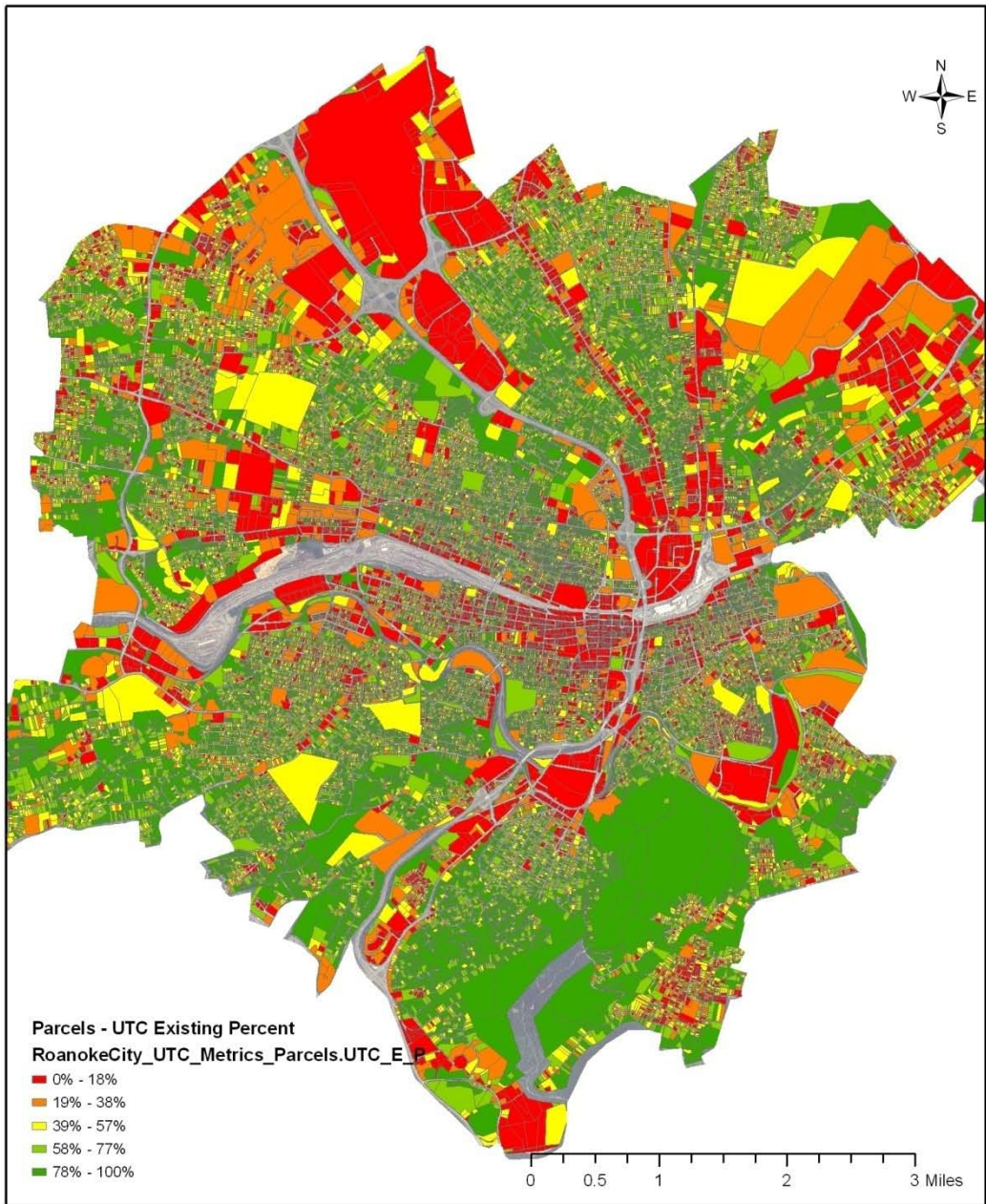


# Local UTC Goals

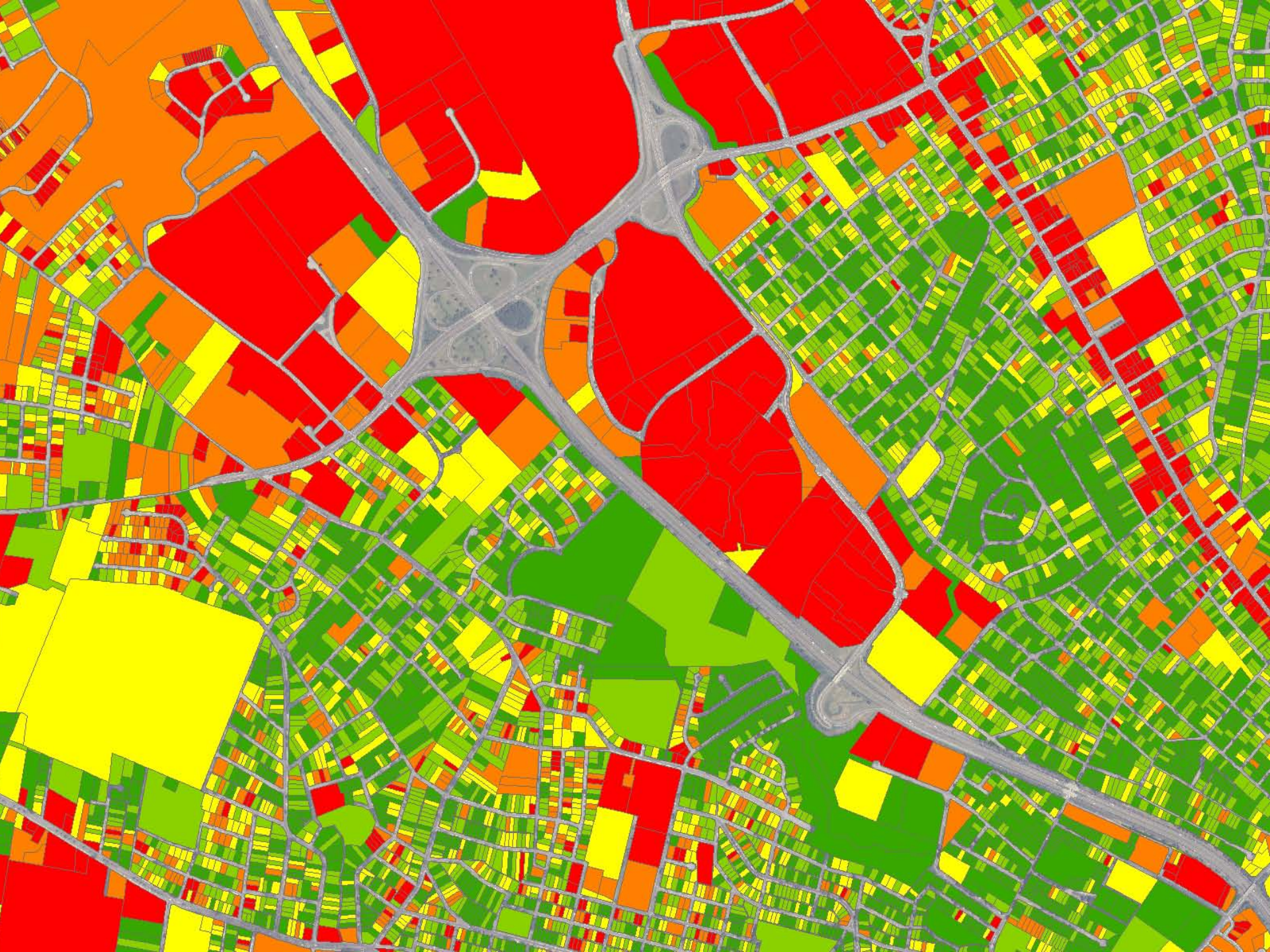
- City of Roanoke = 50% (at least maintain current level because already above 40%)
- City of Salem = 44%
- Town of Vinton = 44%
- Note: DOF requires that UTC goal set by localities must be at least 5% higher than the existing UTC to cover the possible margin of error in land cover classification

# Local UTC Goals and Possible UTC

- Very limited amount of land identified as Possible UTC is owned by local governments
- Vast majority of Possible UTC is located in the residential zoning categories (i.e., private landowners)









# Application of UTC Data

- City of Roanoke (and City of Winchester) selected for additional analysis (Virginia Tech and DOF)
- i-Tree ECO - Summer 2010
- i-Tree Street (completed for City of Roanoke in 2007)

# i-Tree

- <http://www.itreetools.org/>
  - “i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools.”
  - FREE
  - NON-SPATIAL
- | <u>Applications</u> | <u>Utilities</u>  |
|---------------------|-------------------|
| i-Tree Eco          | i-Tree Vue (Beta) |
| i-Tree Streets      | i-Tree Storm      |
| i-Tree Hydro (Beta) | i-Tree Species    |

# i-Tree Eco

- adaptation of the Urban Forest Effects (UFORE) model
- designed to use field data from complete inventories or randomly located plots throughout a community along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities.

# i-Tree Streets

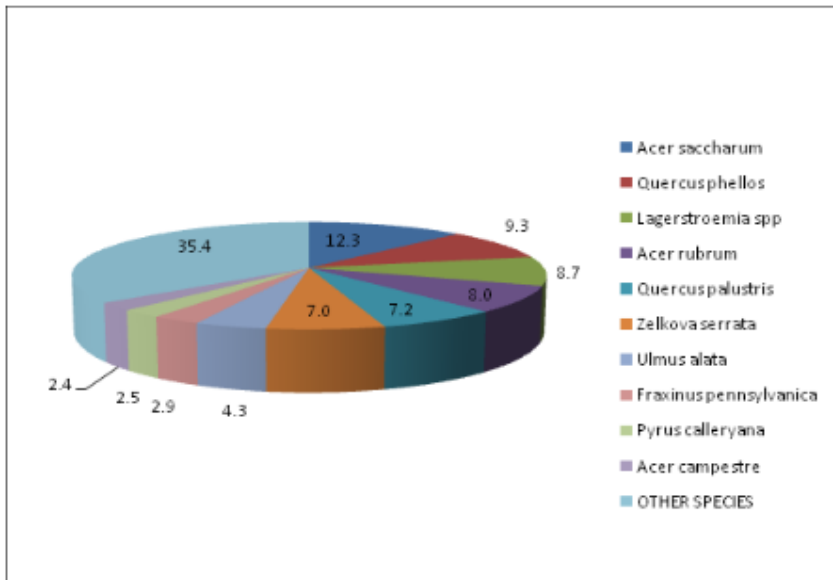
- Focuses on street trees
- Quantifies & puts dollar value on the annual environmental & aesthetic benefits of street trees
  - Uses field data
    - Requires a complete or sample street tree inventory
  - Uses benefit prices (e.g. price of 1 kilowatt-hour of electricity), budget info, data on city infrastructure

# i-Tree Streets- Example Results

## Richmond

### Species Distribution of All Trees (%)

3/25/2010

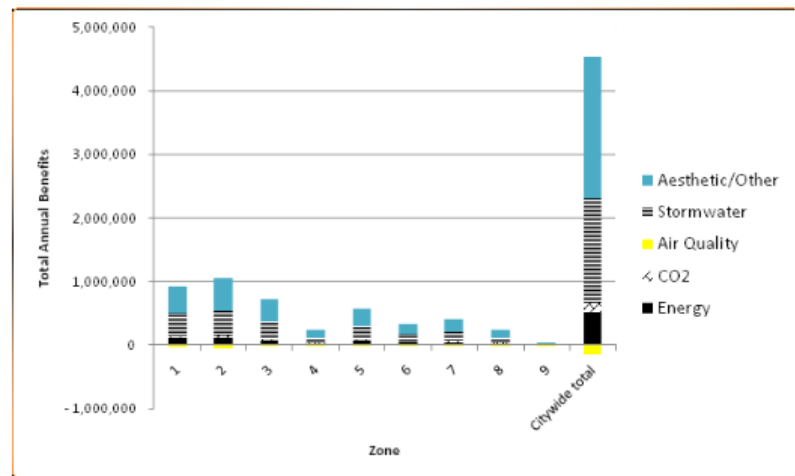


Species	Percent
Acer saccharum	12.3
Quercus phellos	9.3
Lagerstroemia spp	8.7
Acer rubrum	8.0
Quercus palustris	7.2
Zelkova serrata	7.0
Ulmus alata	4.3
Fraxinus pennsylvanica	2.9
Pyrus calleryana	2.5
Acer campestre	2.4
OTHER SPECIES	35.4
Total	100.0

## Richmond

### Total Annual Benefits of All Trees by Zone (\$)

3/25/2010



Zone	Energy	CO <sub>2</sub>	Air Quality	Stormwater	Aesthetic/Other	Total Standard (\$)	Total Error	% of Total \$
1	107,600	31,121	-42,417	363,998	428,821	889,123	(+143,937)	20.3
2	121,082	34,006	-46,245	389,770	503,832	1,002,446	(+243,378)	22.8
3	79,138	24,255	-21,910	261,204	365,572	708,259	(+292,589)	16.1
4	27,950	8,203	-1,656	76,390	126,357	237,245	(+61,285)	5.4
5	71,729	21,323	-2,015	198,494	279,282	568,812	(+98,282)	13.0
6	37,638	11,442	-10,124	115,604	175,573	330,133	(+64,544)	7.5
7	46,969	14,010	-16,589	147,305	202,461	394,155	(+39,169)	9.0
8	26,876	8,044	-6,290	80,146	124,963	233,738	(+30,003)	5.3
9	2,719	875	-1,284	9,297	13,272	24,879	(+7,702)	0.6
Citywide total	521,701	153,278	-148,529	1,642,207	2,220,132	4,388,789	(+339,273)	100.0

# Air Quality and Non-Attainment

- Ozone (O<sub>3</sub>) and Particulate Matter (PM)
- Roanoke MSA is currently a successful Ozone Early Action Compact/ Plan area
- Roanoke MSA is currently barely in attainment for Ozone with a three year average of 74 parts per billion (ppb) based on a National Primary Standard of 75 ppb or lower.
- National Ozone Standard is scheduled to be lowered in August 2010, presenting a challenge to continued Ozone attainment for the Roanoke MSA
- the Roanoke MSA is currently in compliance with EPA's PM 2.5 annual standards of 15 micrograms per cubic meter (ug/m<sup>3</sup>) but is trending upward toward non-compliance

# WQIF Regional Grant Program

## Funding Availability

- designed to restore and/or improve riparian health through the use of tree plantings or other vegetative techniques and may include non - CREP riparian buffer tree planting, stream restoration and stabilization, rain gardens and bio swales.
- proposals accepted from private citizens, local units of government, approved non-profit organizations, civic groups, educational institutions, or community volunteer groups which meet the specific program objectives.
- Grants will be awarded as they are received, evaluated for compliance with the program and approved. Funds will be allocated on a first come first serve basis.

# WQIF Regional Grant Program Funding Availability

Barbara White

Urban & Community Forestry Partnership Coordinator

900 Natural Resources Dr, suite 800

Charlottesville, VA 22903

434-220-9041

[Barbara.White@dof.virginia.gov](mailto:Barbara.White@dof.virginia.gov)



# Questions or Comments?

Contact:

Shane Sawyer, Regional Planner III  
Roanoke Valley-Alleghany Regional Commission  
313 Luck Avenue, SW  
Roanoke, VA 24016  
Phone/Fax: 540.343.4417 / 540.343.4416  
Email: [ssawyer@rvarc.org](mailto:ssawyer@rvarc.org)

[www.rvarc.org](http://www.rvarc.org)

[www.rvarc.org/utc](http://www.rvarc.org/utc)