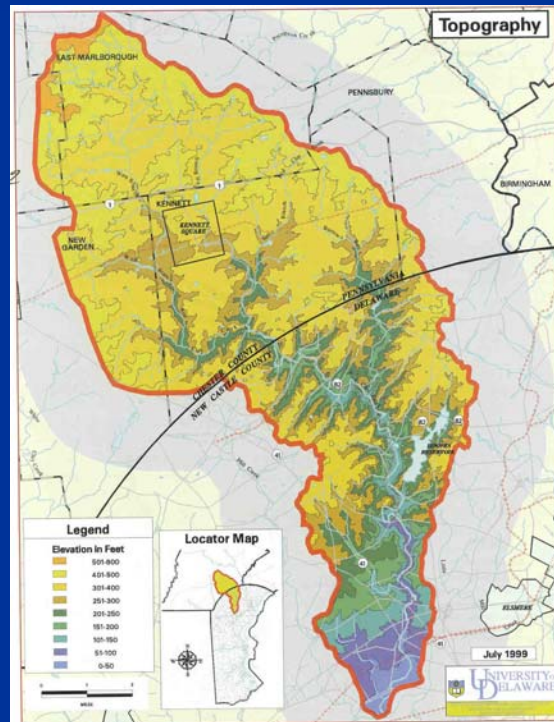


Red Clay Rising

Report to the Delaware Nature Society

October 10, 2006

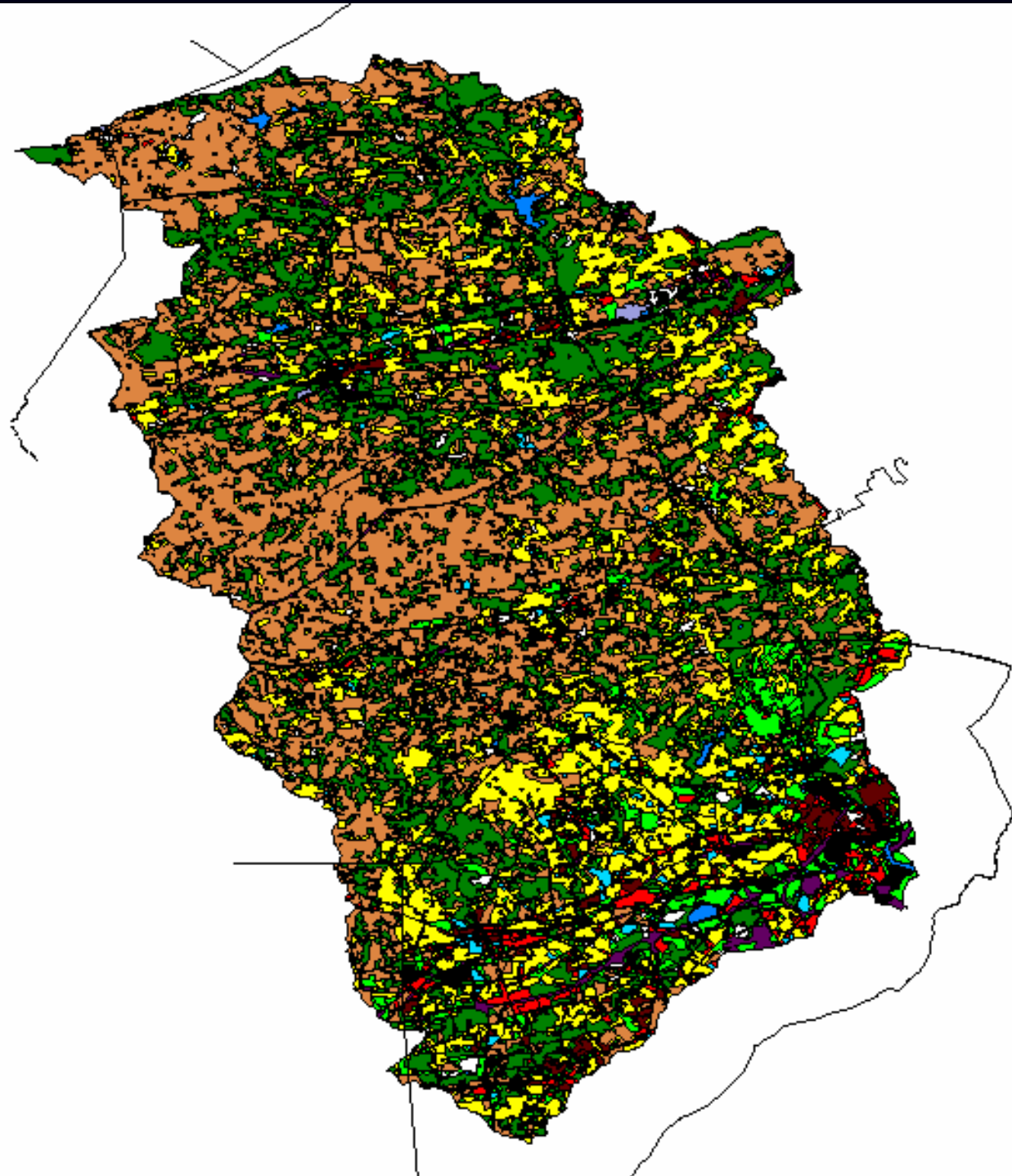




Pre

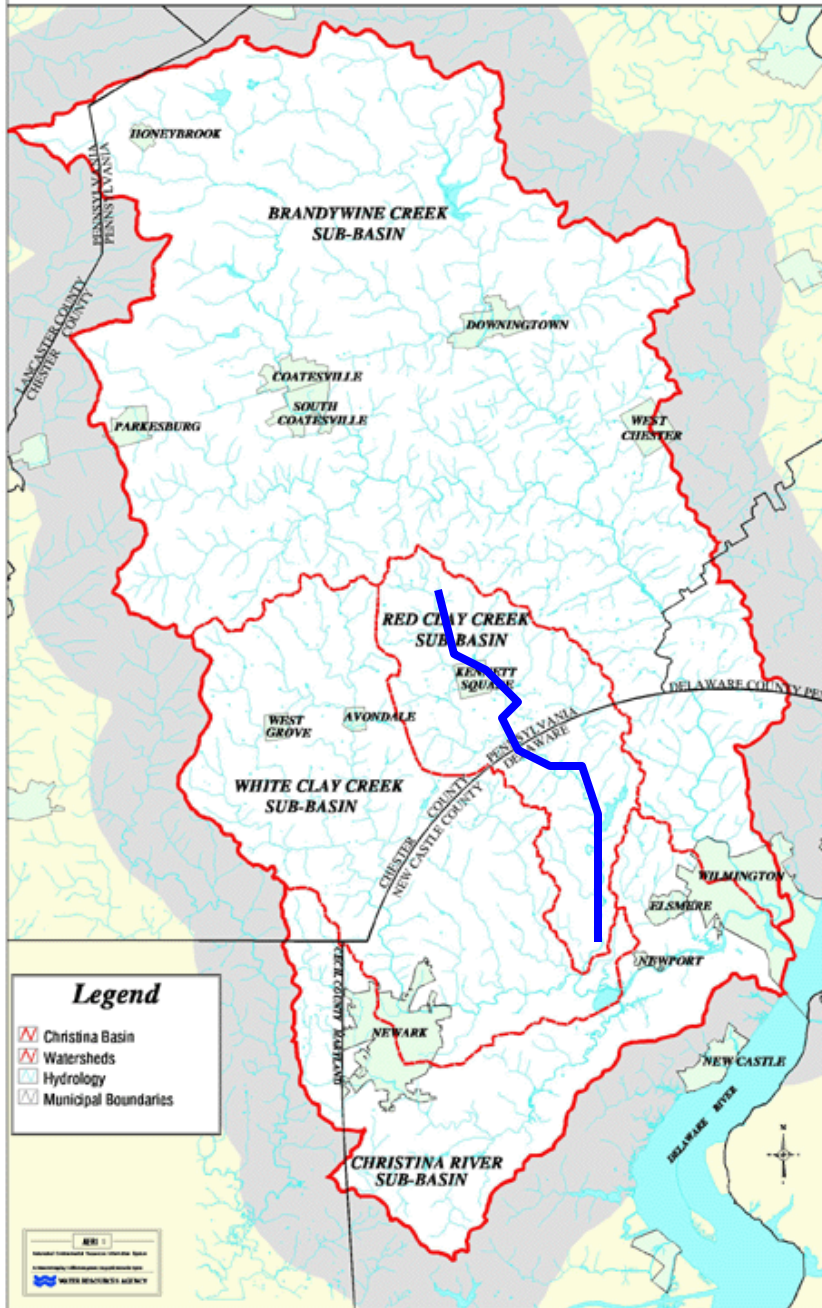
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WR
water
resources age



1995

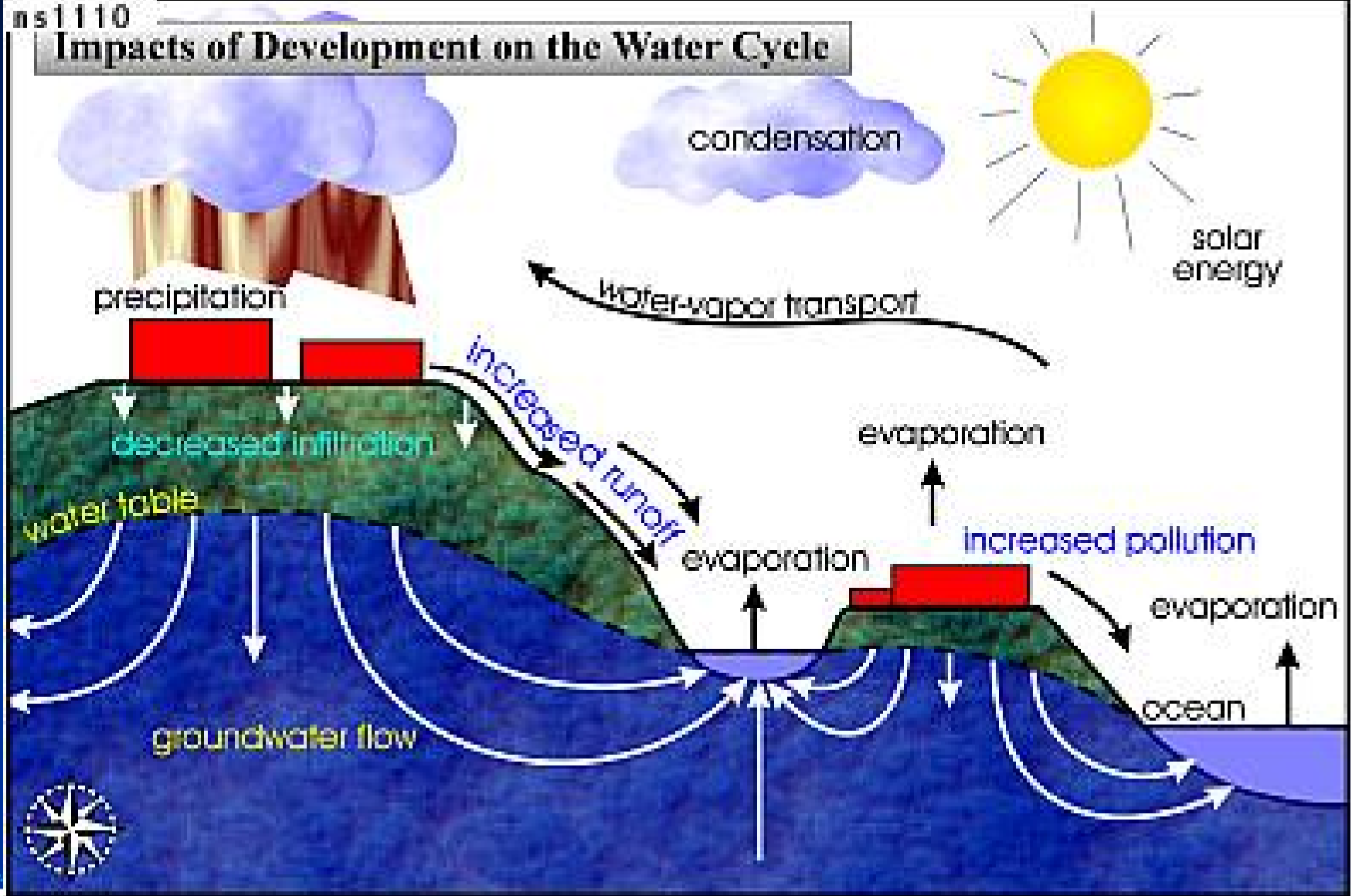
Christina Basin Water Quality Management Strategy *Base Map*

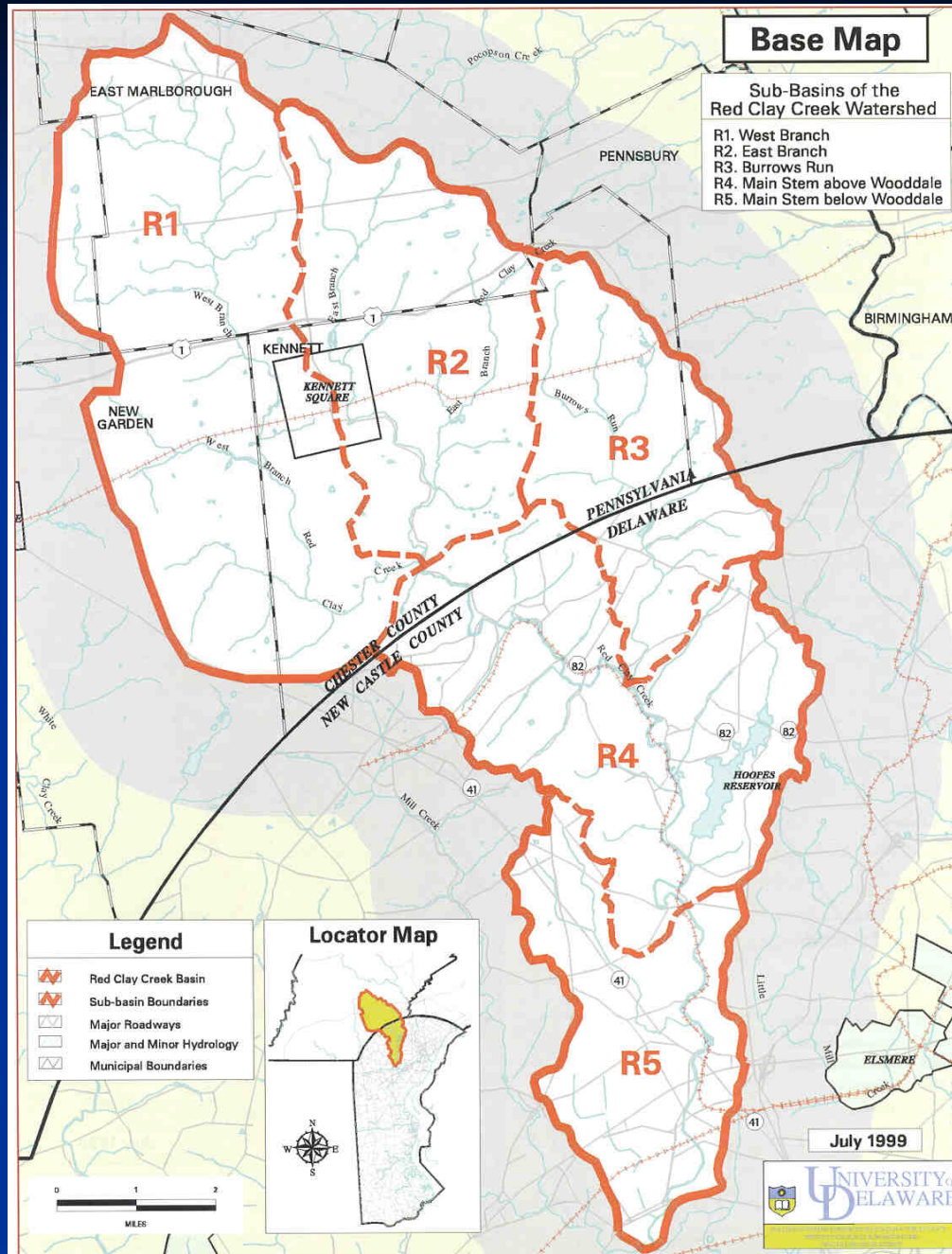


Christina Basin

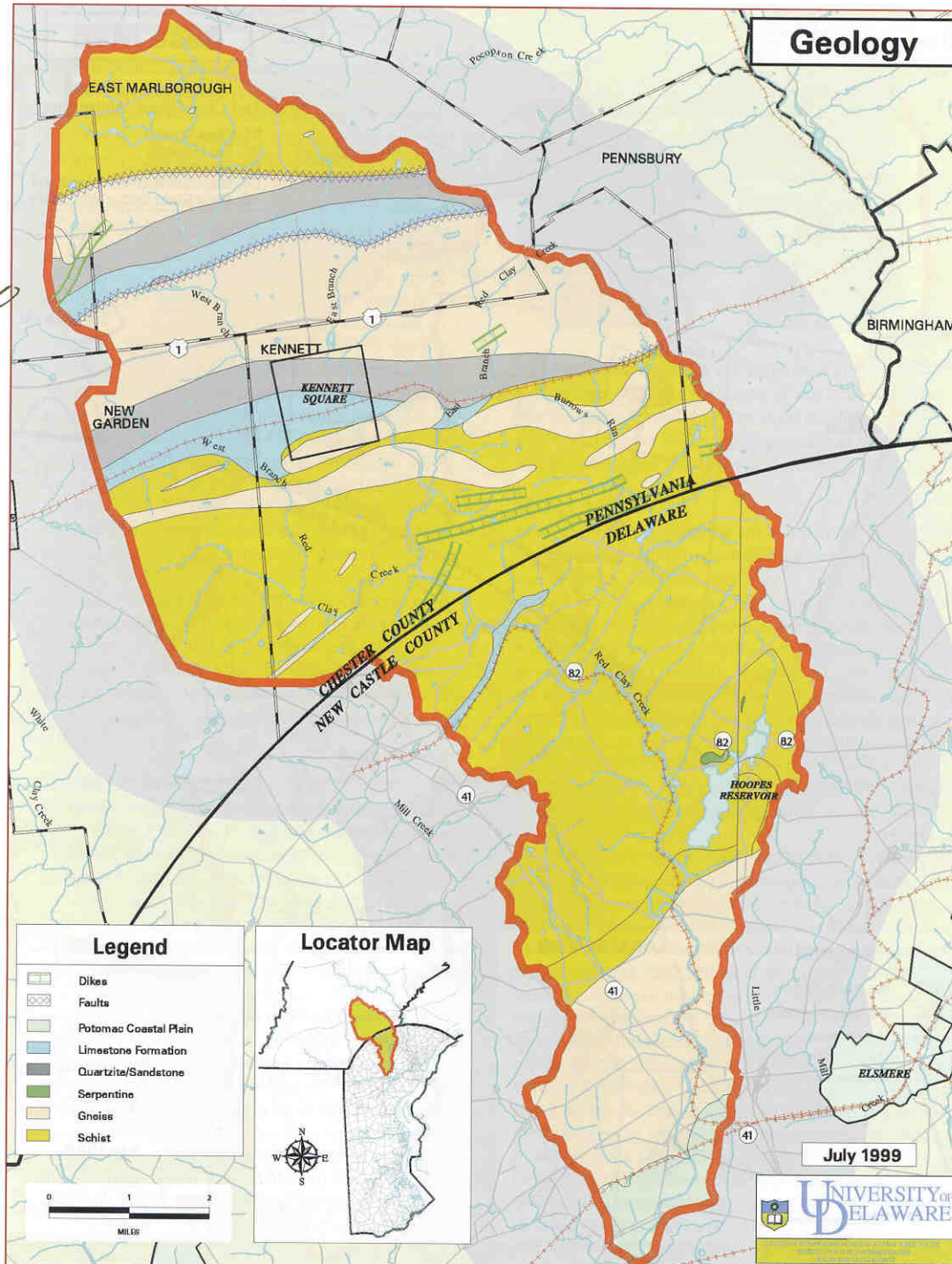
ns1110

Impacts of Development on the Water Cycle

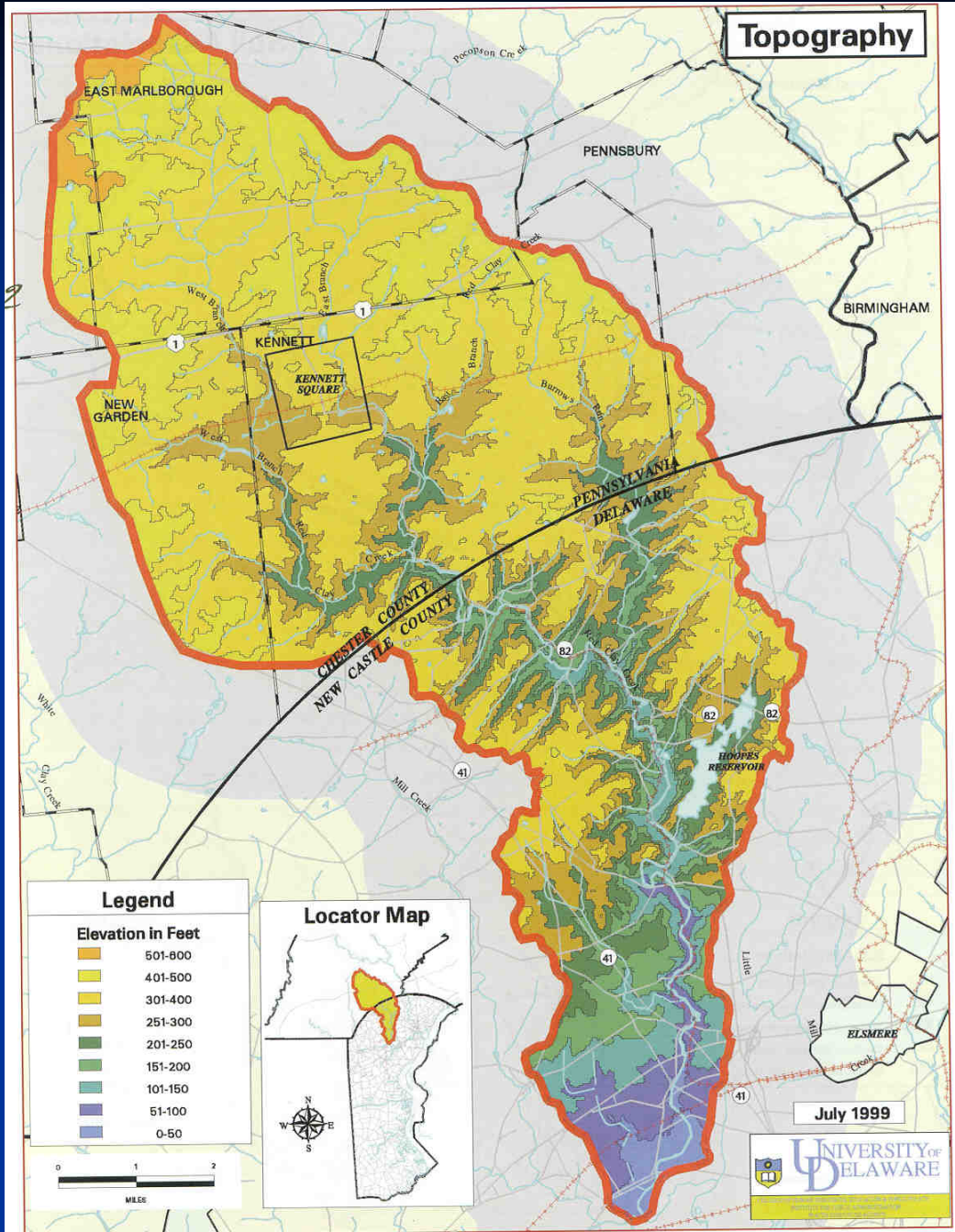


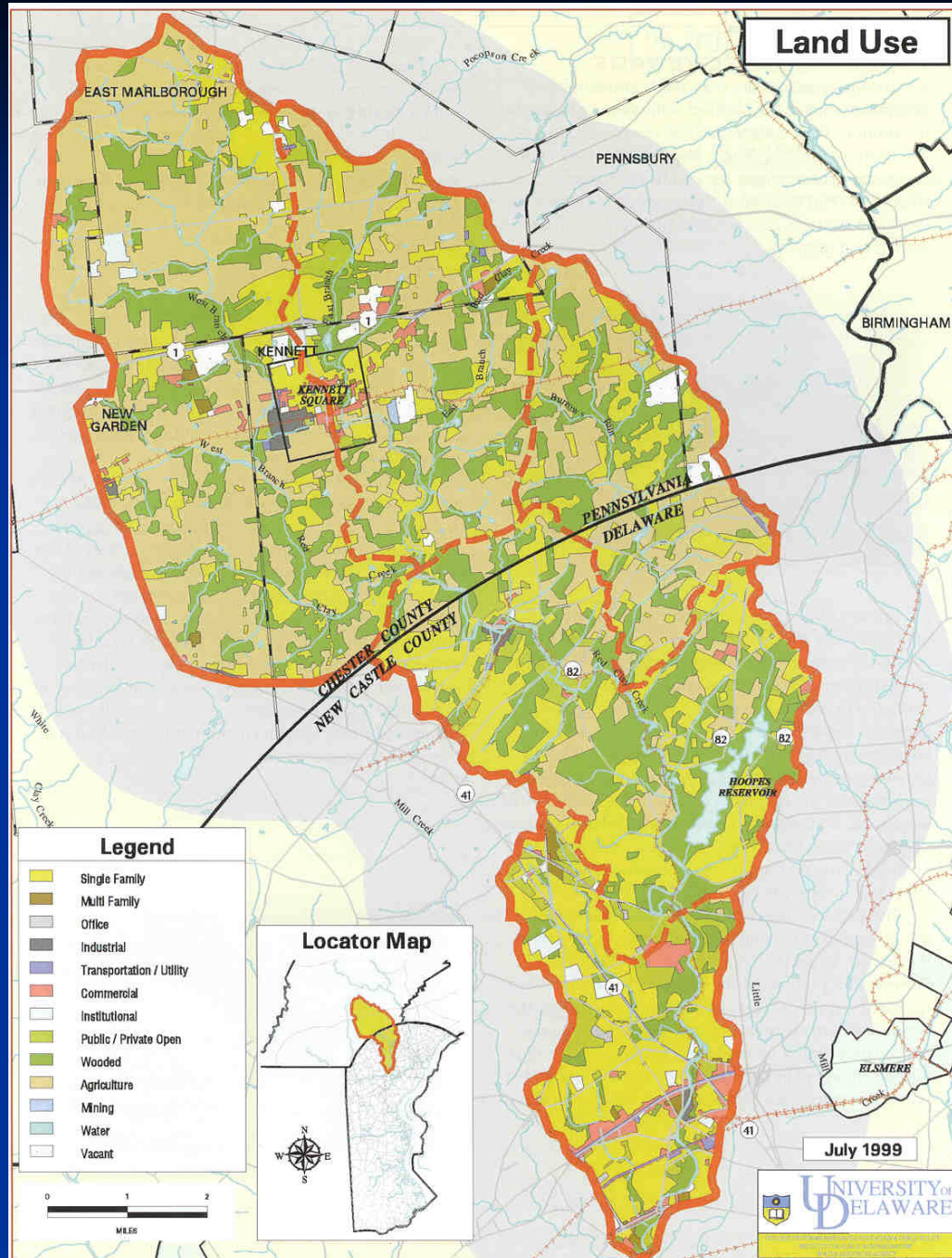


Geology

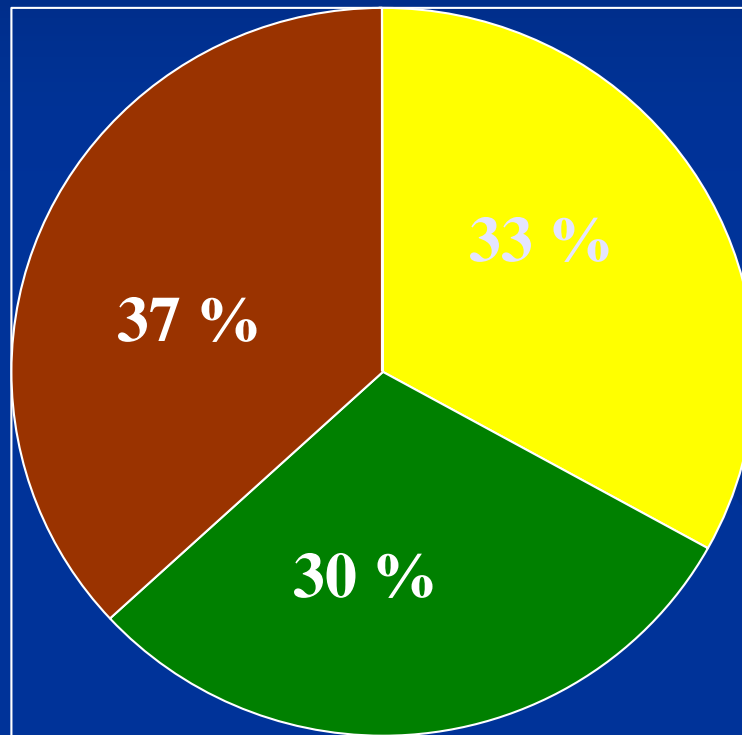


Topography





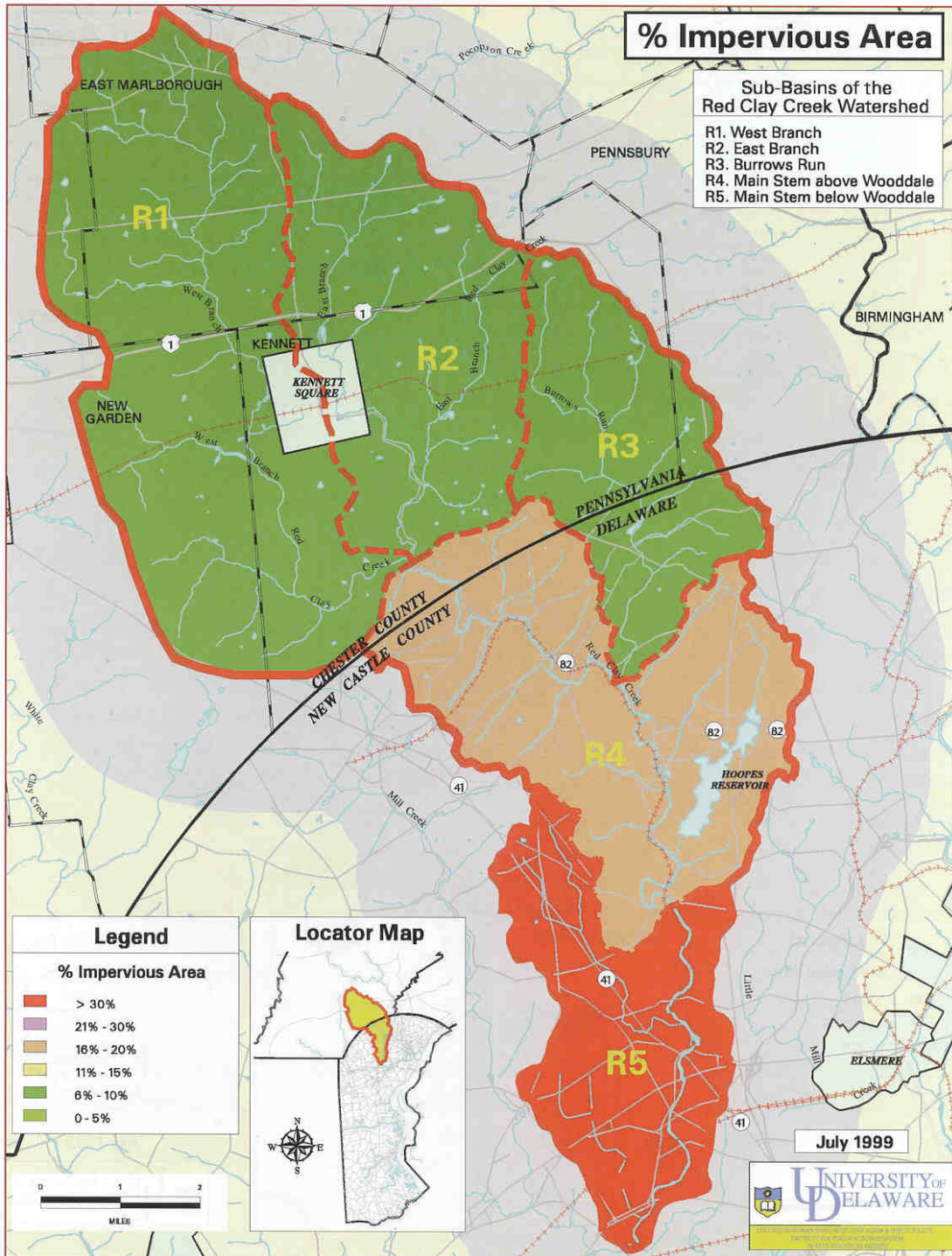
Red Clay Creek Land Use



% Impervious Area

Sub-Basins of the Red Clay Creek Watershed

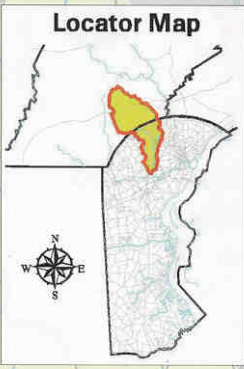
- R1. West Branch
- R2. East Branch
- R3. Burrows Run
- R4. Main Stem above Wooddale
- R5. Main Stem below Wooddale



Legend

% Impervious Area

[Red]	> 30%
[Purple]	21% - 30%
[Orange]	16% - 20%
[Yellow]	11% - 15%
[Light Green]	6% - 10%
[Dark Green]	0 - 5%

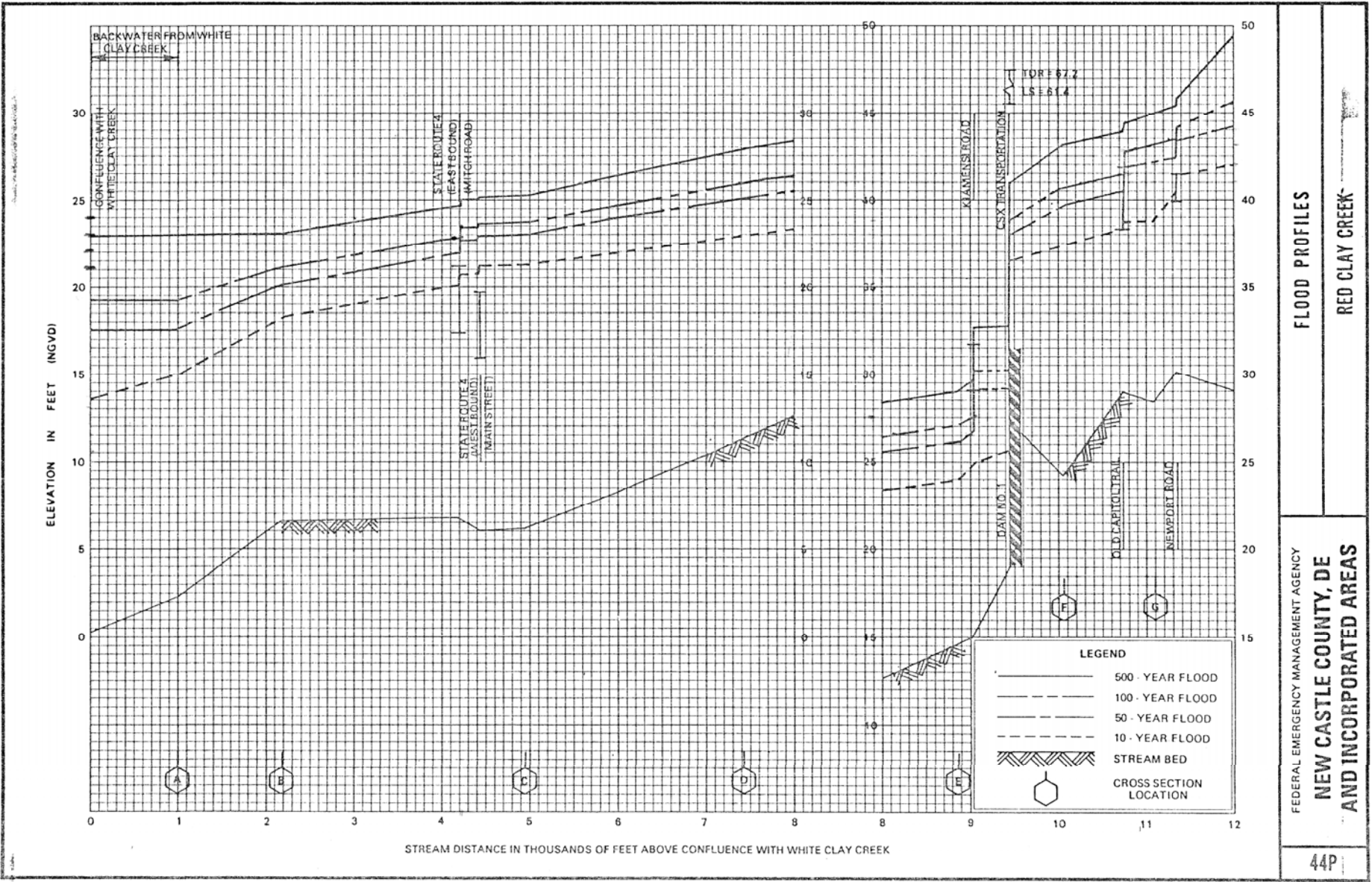


July 1999

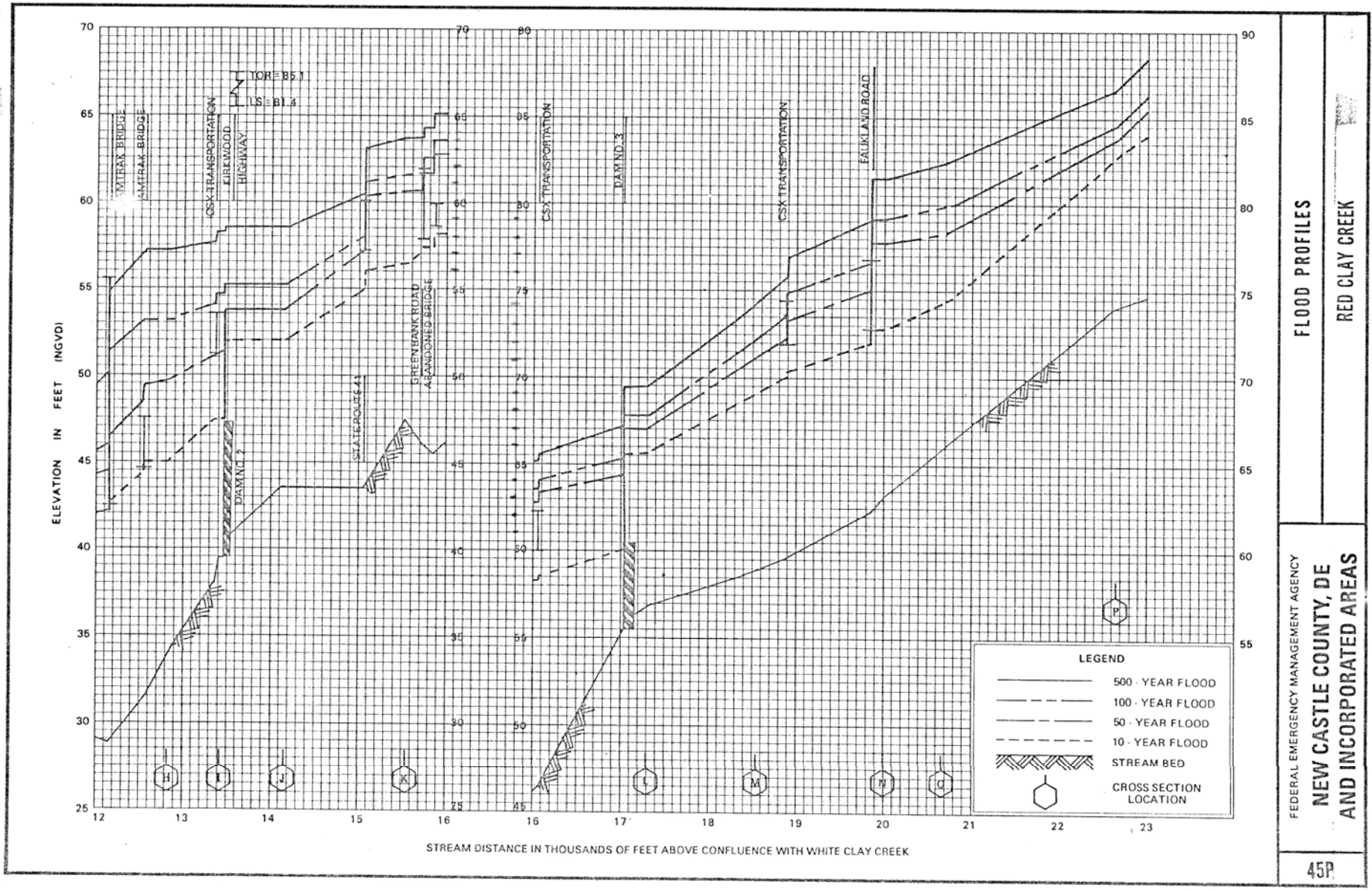


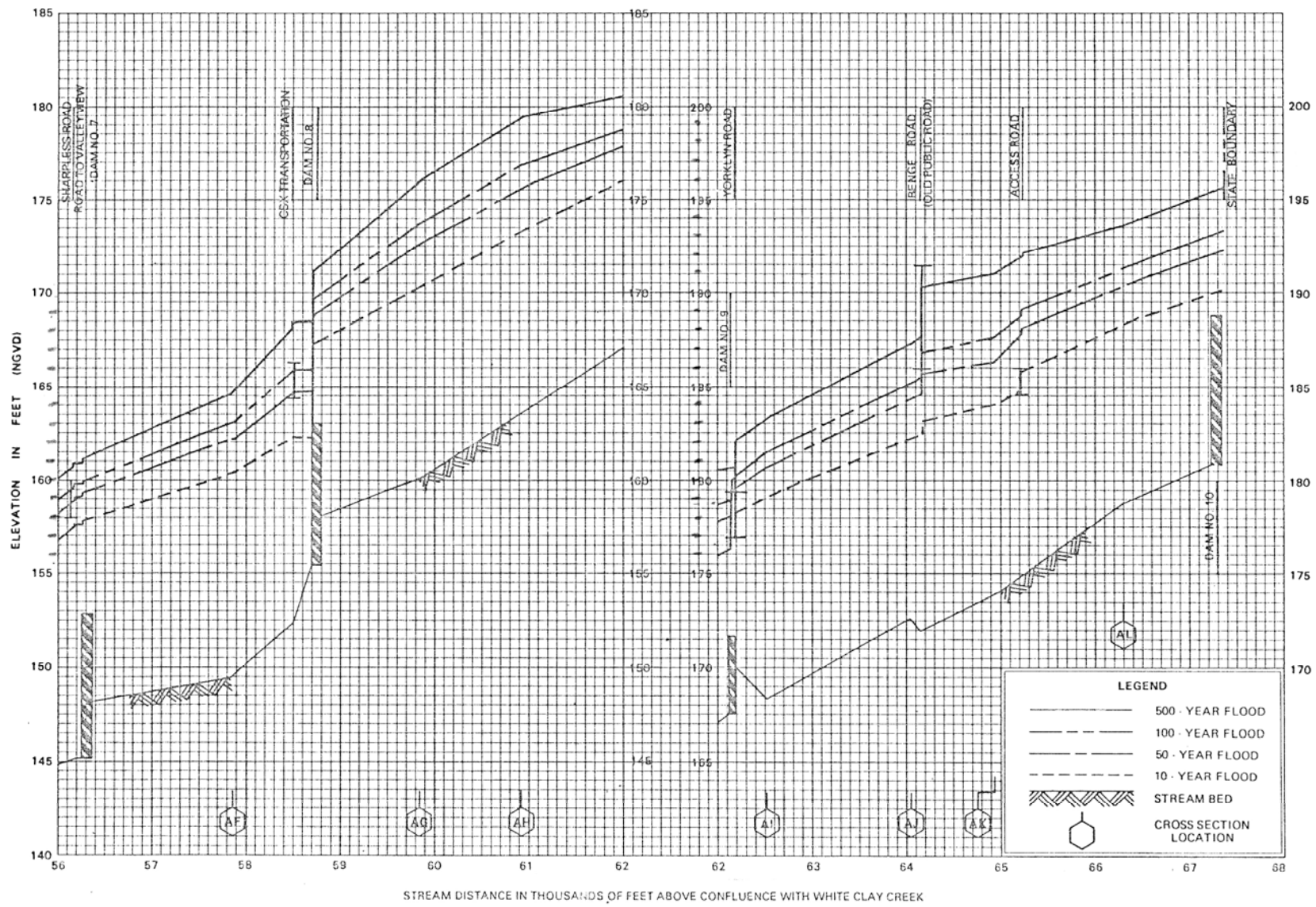
Red Clay Creek Statistics

- Area 54.1 sq. mi.
- Population (2000) 41,308
- Pop. Density 763 p/sq. mi.
- Impervious Cover 14.8 %



10/24/05



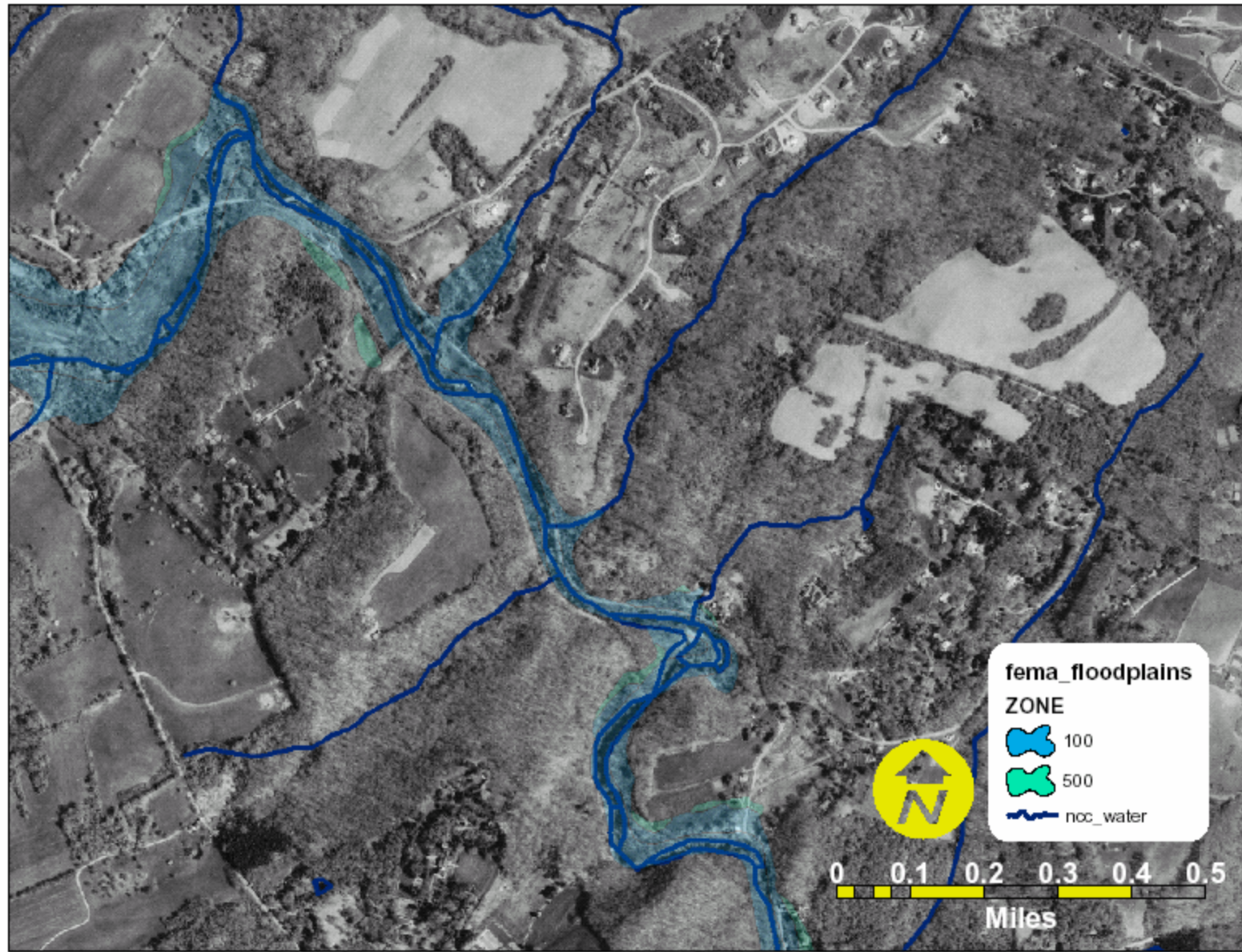


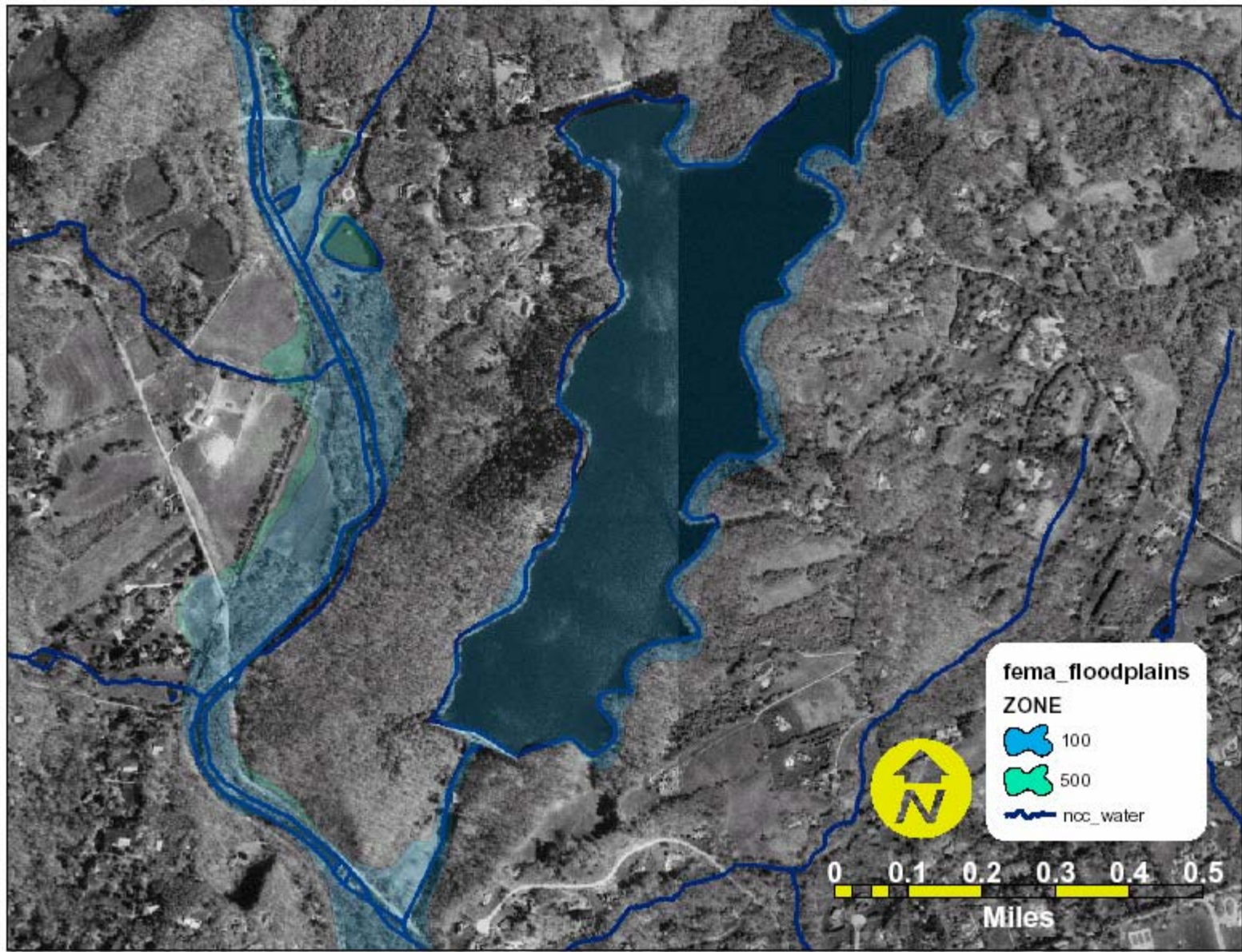
FLOOD PROFILES
RED CLAY CREEK

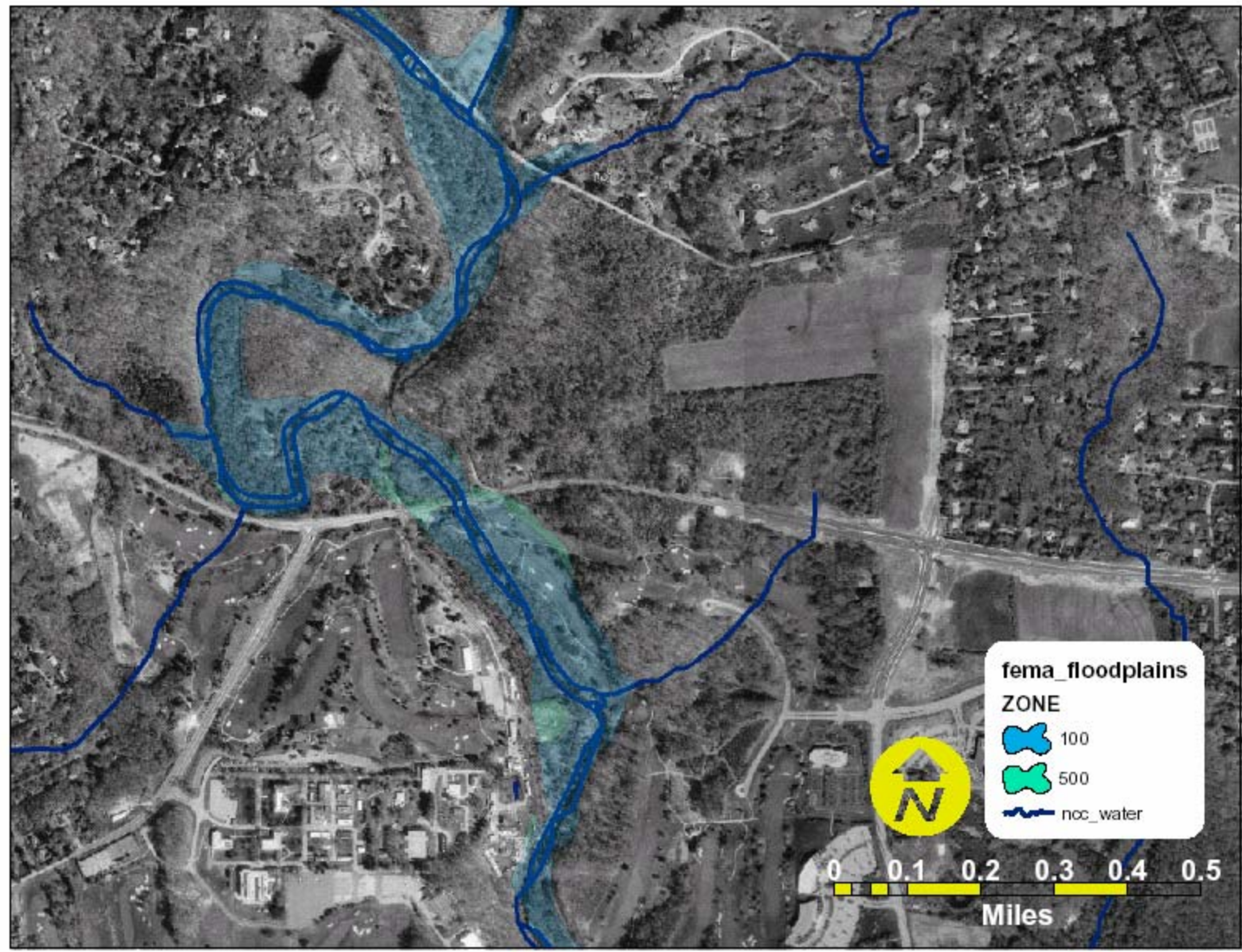
FEDERAL EMERGENCY MANAGEMENT AGENCY
NEW CASTLE COUNTY, DE
AND INCORPORATED AREAS

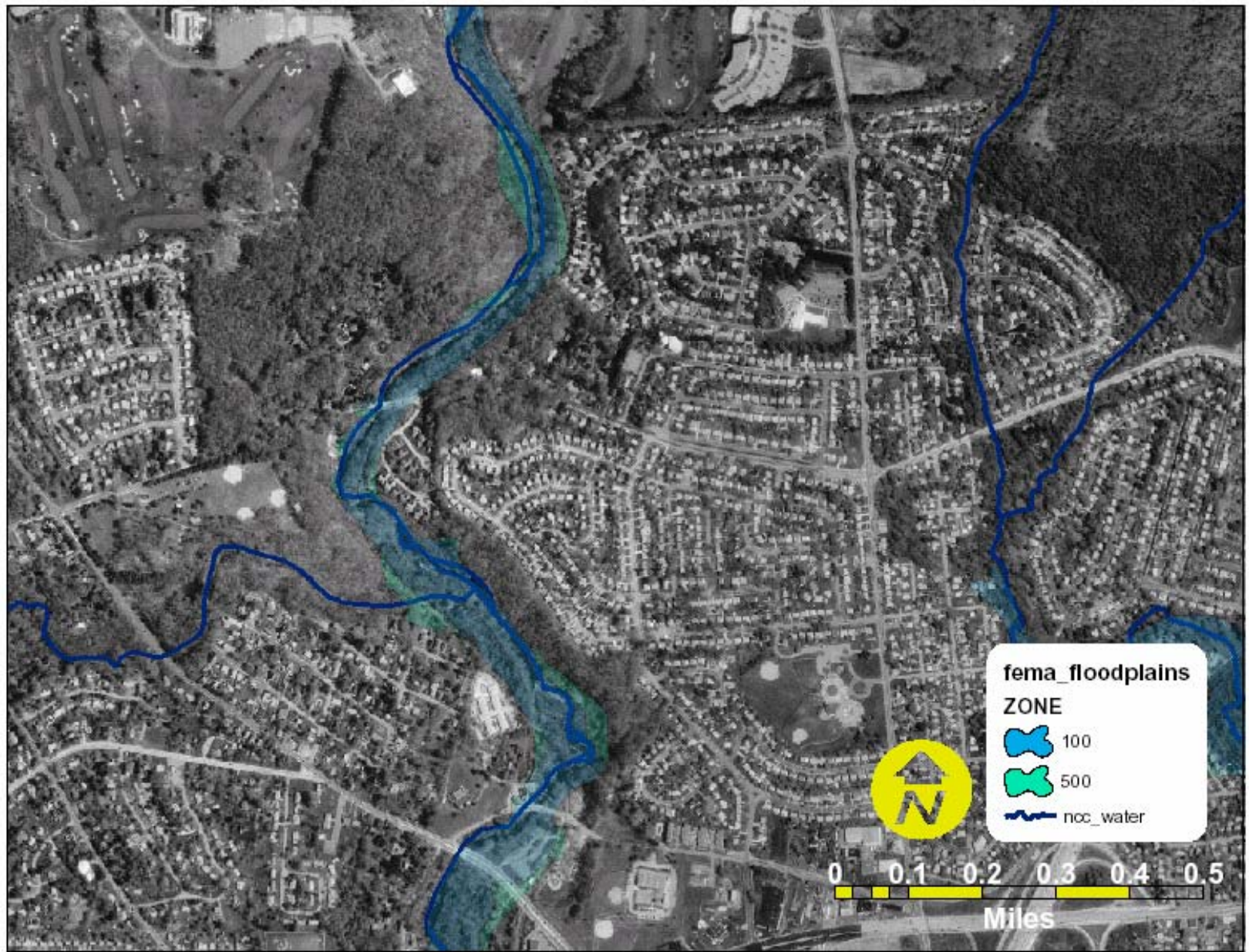




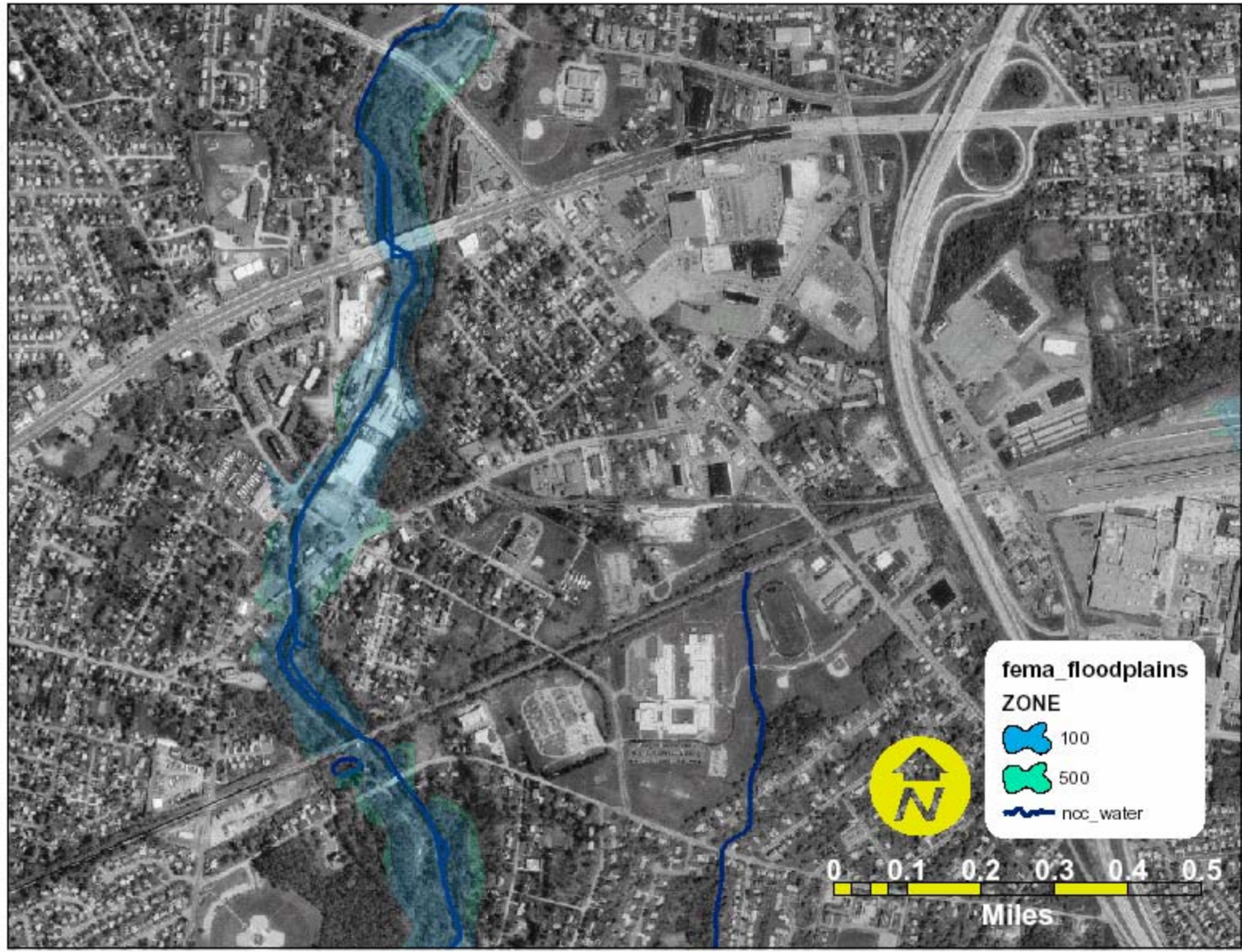


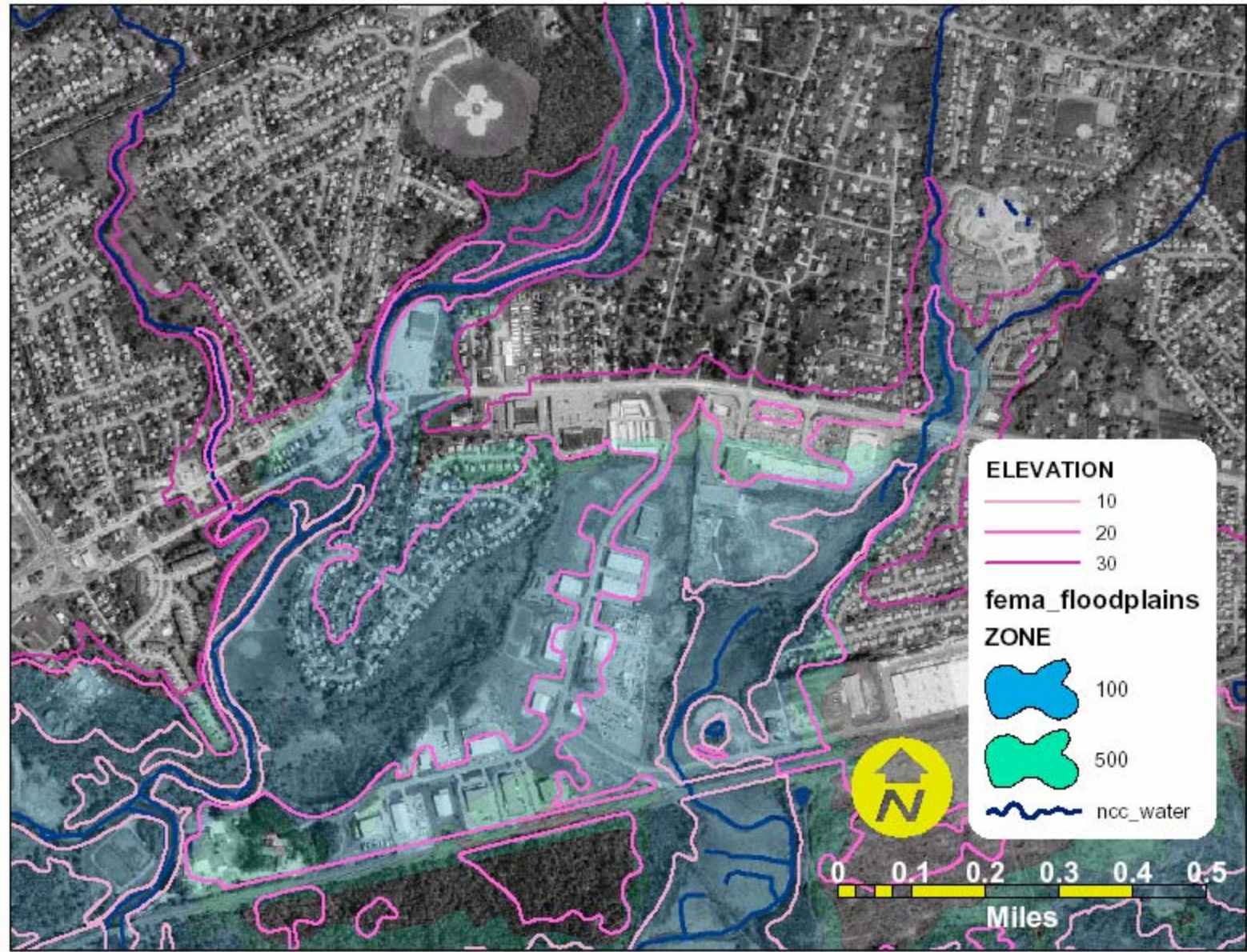






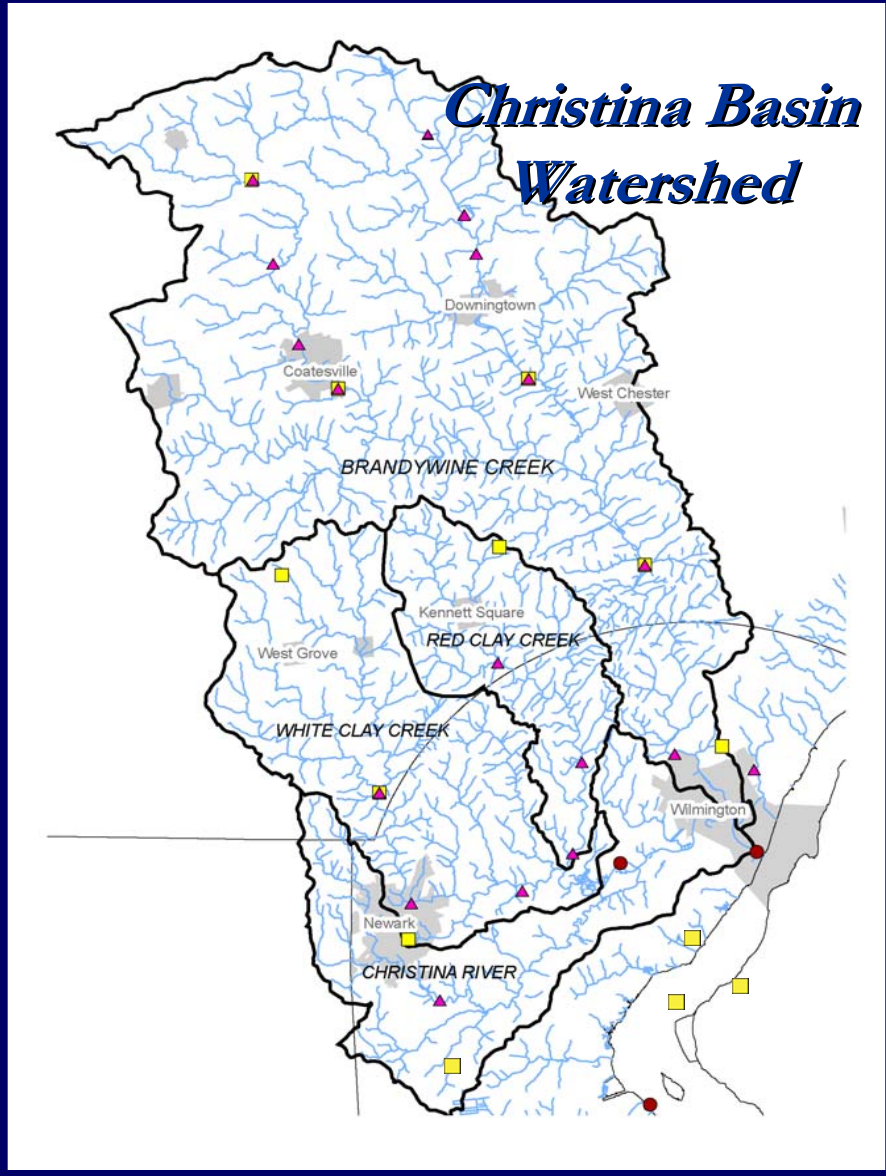




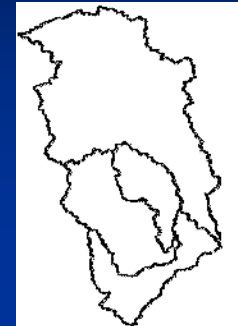


Tropical Storm Henri

September 15, 2003



Drainage Basins



Streamgages



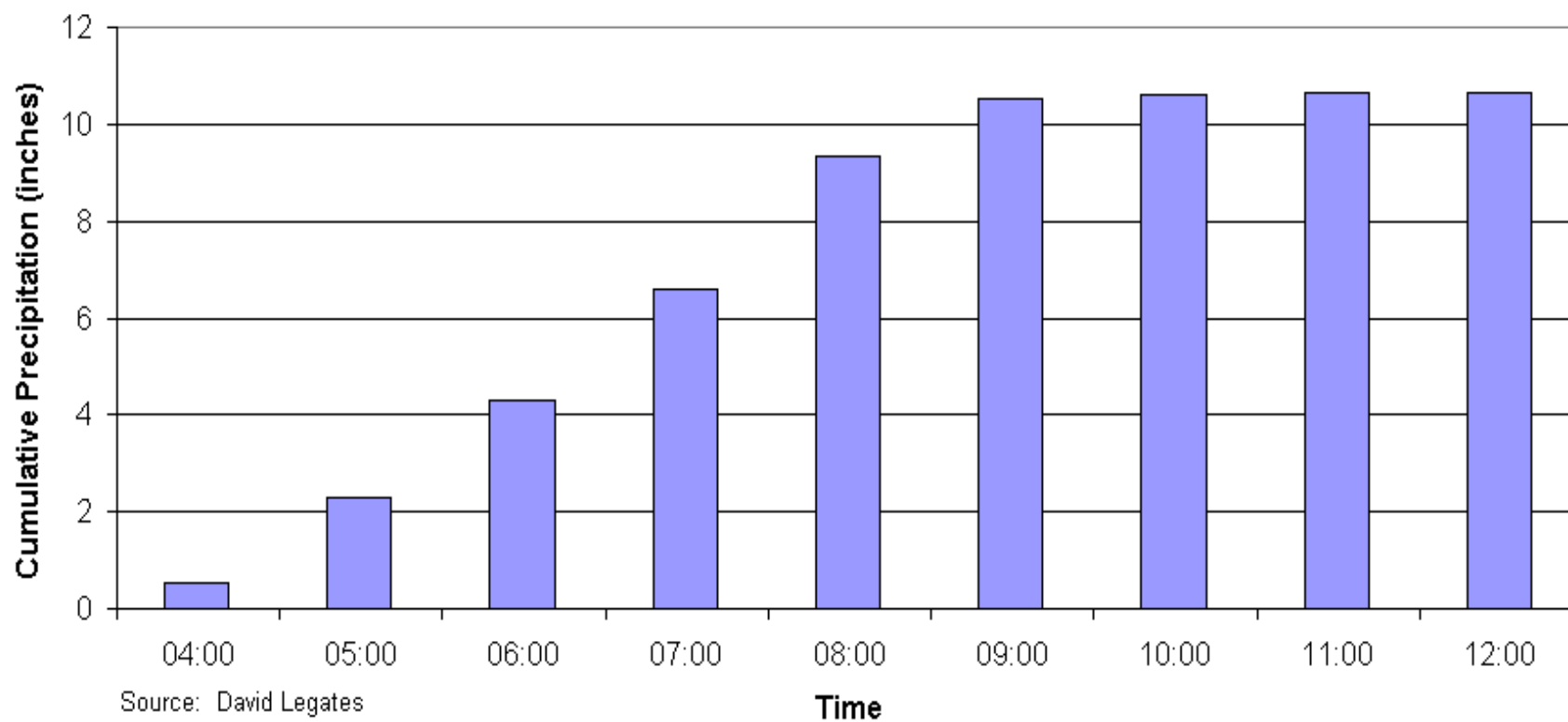
Precipitation Stations



Tide Gages

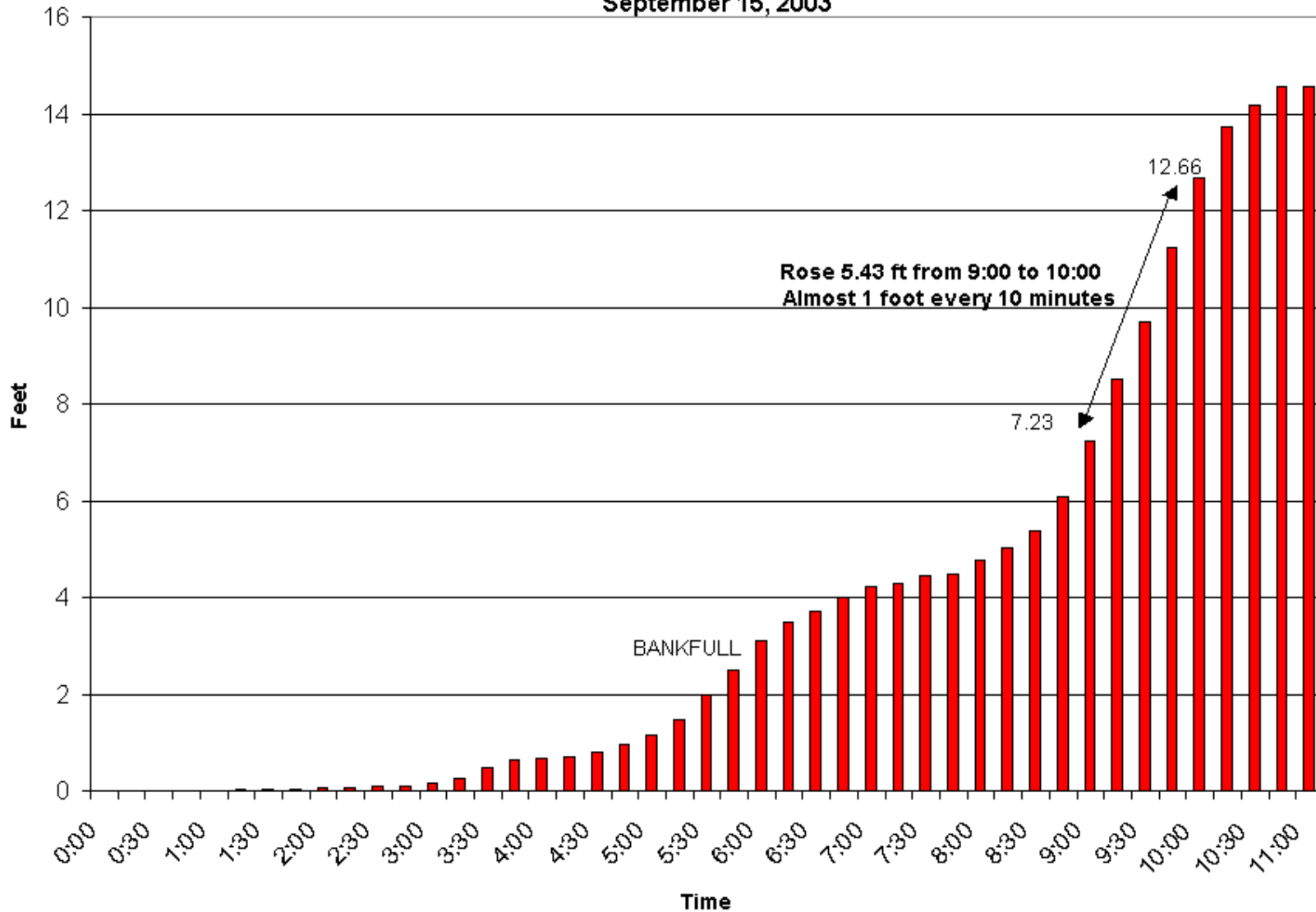


DELAWARE GEOLOGICAL SURVEY
Estimated Precipitation from Doppler Radar Near Kennett Square, PA
September 15, 2003



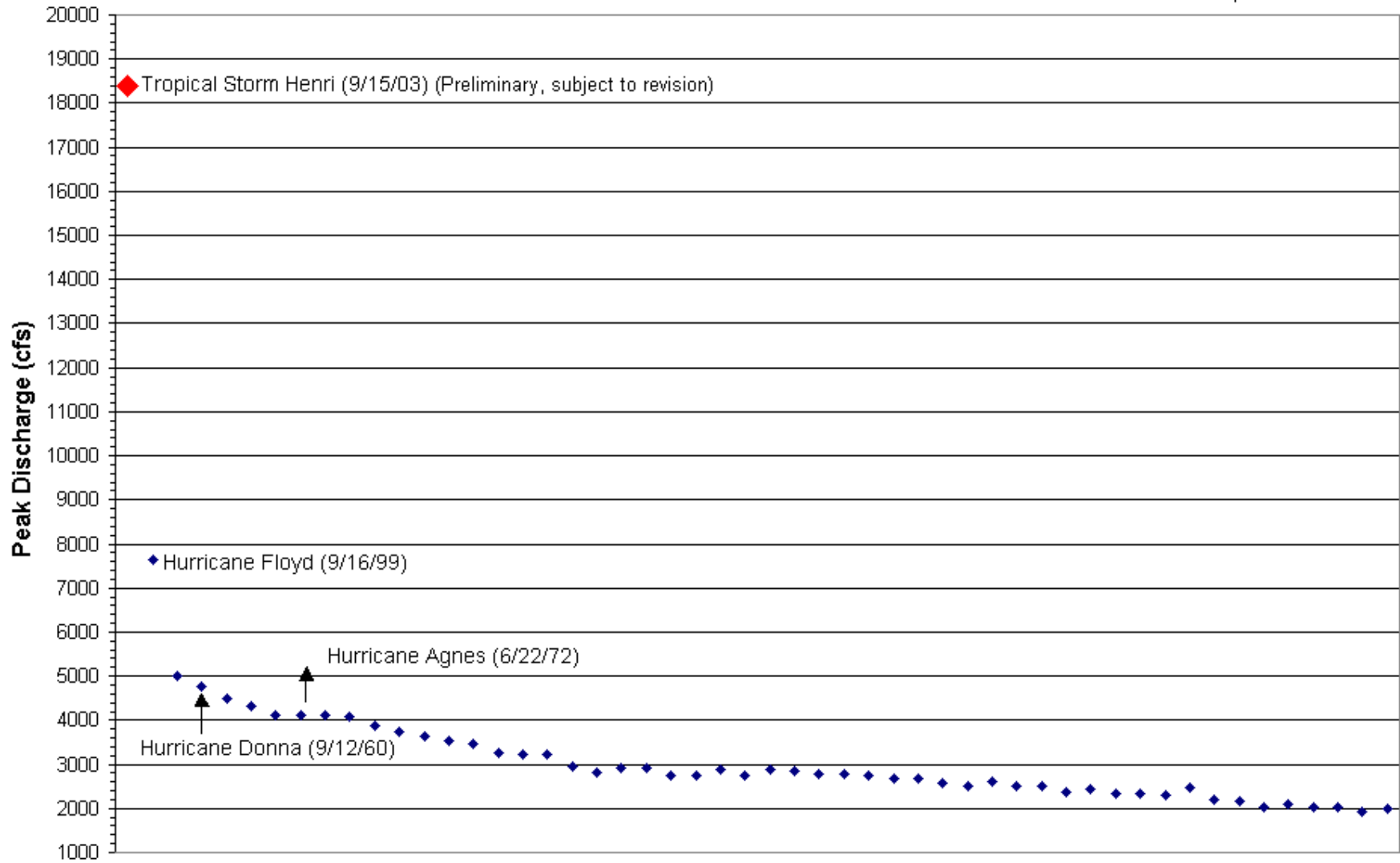
Source: David Legates
University of Delaware

Red Clay Creek at Wooddale
Cumulative Rate of Rise, 15-Minute Intervals
September 15, 2003



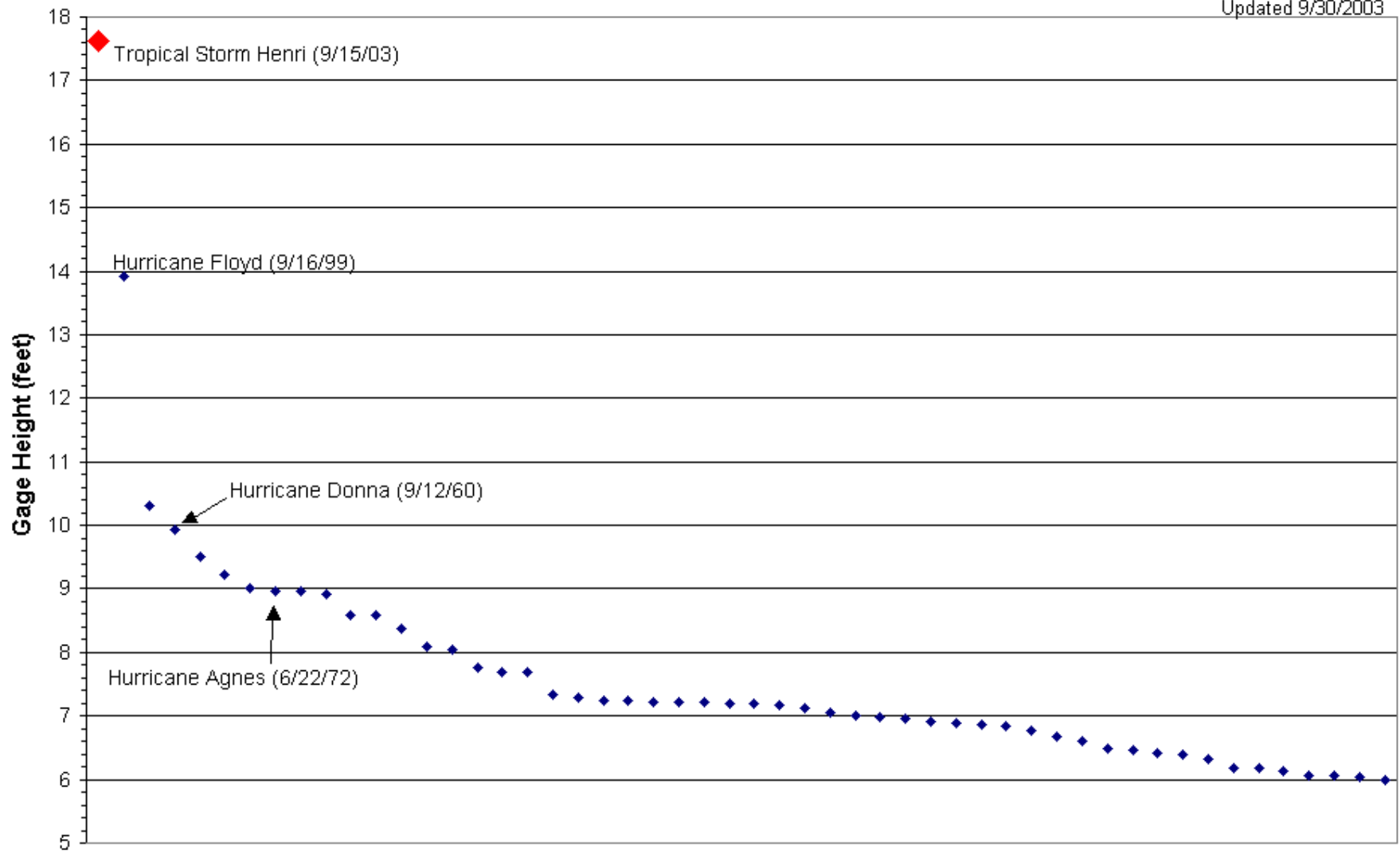
DELAWARE GEOLOGICAL SURVEY
Peak Discharges of Record Red Clay Creek at Wooddale
Station 01480000
Period of Record 1943 - 2003

Updated 9/30/2003



DELAWARE GEOLOGICAL SURVEY
Peak Gage Heights of Record Red Clay Creek at Wooddale
Station 01480000
Period of Record 1943 - 2003

Updated 9/30/2003

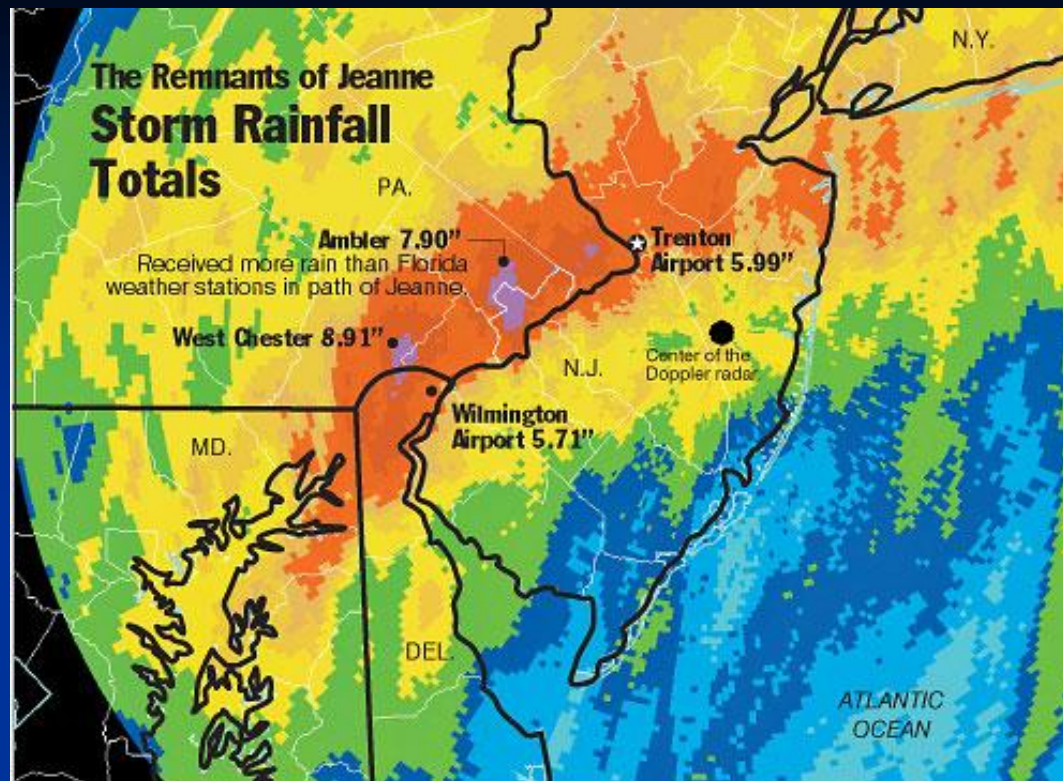






Tropical Storm Jeanne

September 28, 2004



Area	Rainfall	Area	Rainfall
Bucks County		Philadelphia	
Doylestown	5.06	Fairmount Dam	5.98
Neshaminy Falls	6.49	N. Phila. Airport	5.68
Montgomery County		Phila. Airport	3.60
Ambler	7.90	New Jersey	
King of Prussia	6.15	Trenton	5.00
Wynnewood	6.28	Trenton Airport	5.99
Chester County		Atlantic City Airport	1.47
Downingtown	6.66	Absecon	0.90
West Chester	8.91	Margate	0.56
Delaware County		Delaware	
Chadds Ford	7.84	Newark	7.44
Havertown	7.00	Wilmington Airport	5.71



SOURCE: National Weather Service The Philadelphia Inquirer



Precipitation Totals September 28, 2004

Compiled from DGS, DEOS and NWS

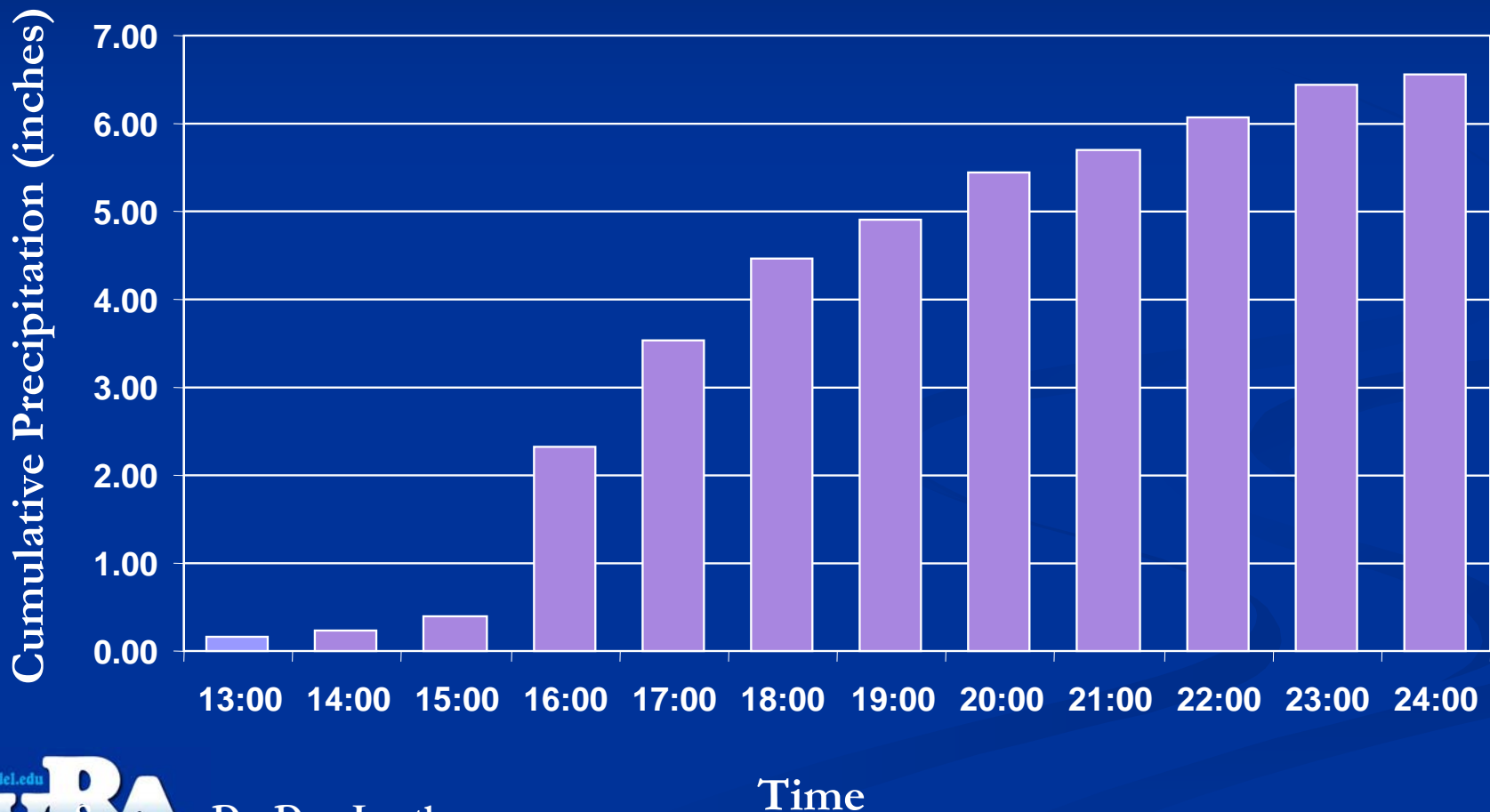
COUNTY	LOCATION	TOTAL PRECIPITATION (Inches) Observed (O) or Automated (A)
New Castle	Newark	7.44 (O)
	Ogletown	8.20 (O)
	Porter Reservoir	4.69 (A)
	Wilmington Hospital	3.89 (A)
	New Castle Airport	5.71 (A)
	Cherry Island	3.52 (A)
	Christiana Hospital	5.23 (A)
	Bear	7.31 (O)
	Christiana Hockessin	5.40 (O) 5.40 (O)
Chester	Downingtown	6.66 (A)
	West Chester	8.91 (O)
	Glenmore	3.65 (O)
	Honey Brook	2.24 (A)
	Modena	4.57 (A)
	Strickersville	6.56 (A)
	Chatham	7.19 (A)
Cecil	Fair Hill	6.39 (A)



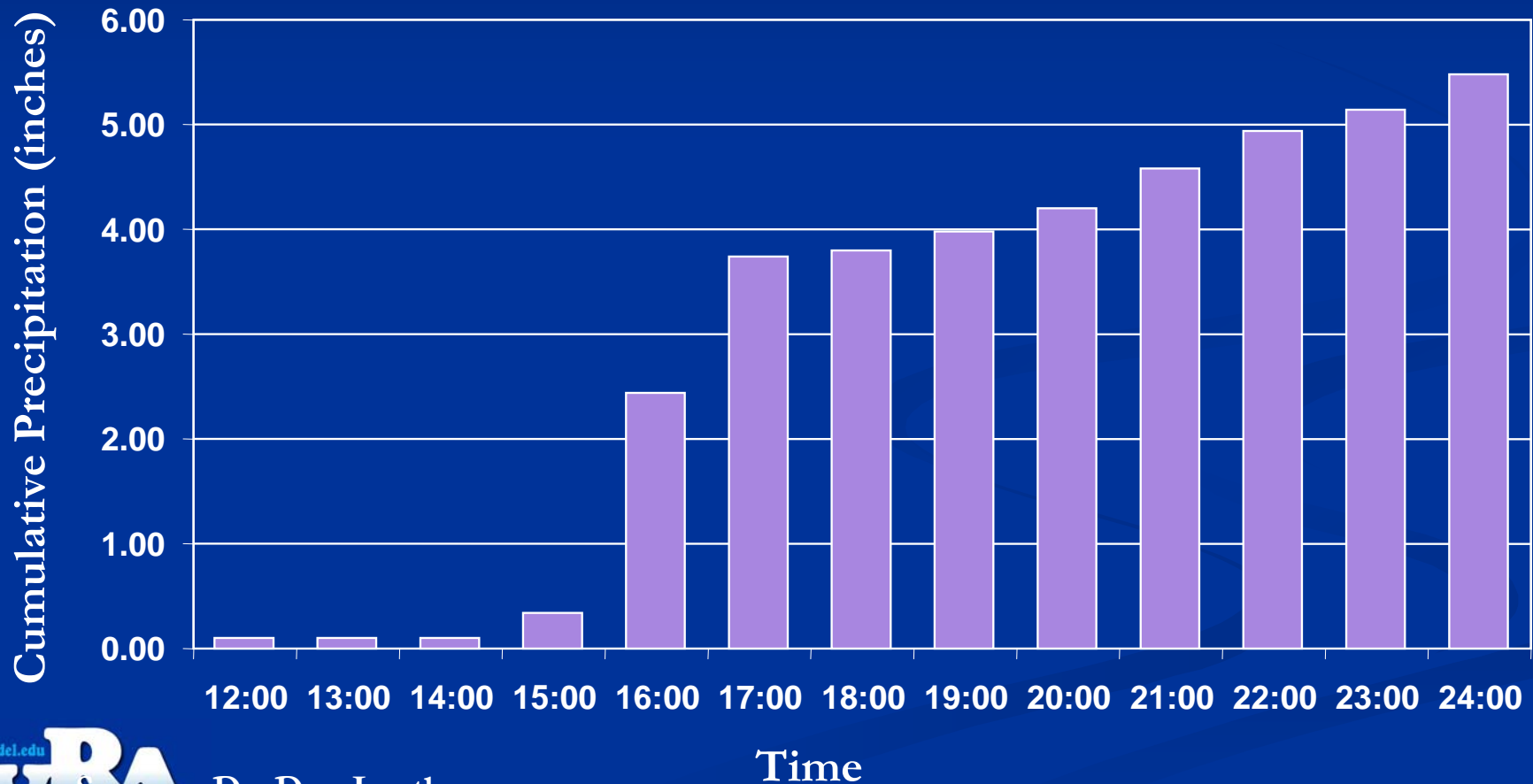
Precipitation & Peak Discharge Recurrence Intervals

Water Course	Thunderstorm 7/15/1999	Floyd 9/16/1999	Henri 9/15/2003	Jeanne 9/28-29/2004
	100 year precipitation (5 – 9.5” in 7 hrs.)	100 year precipitation (8 – 10” in 10 hrs.)	500 year precipitation (10” in 5 hrs.)	100 year precipitation (4-7.5” in 4 hrs.)
Shellpot	50	10	<5	<5
Brandywine	>2 & < 5	50	20	25
Red Clay	>5	>50	>500	>100
White Clay	>25	>100	>50	>100
Christina	>50	>100	2	>50

Precipitation at Strickersville, PA September 28, 2004



Precipitation at Christiana Hospital September 28, 2004



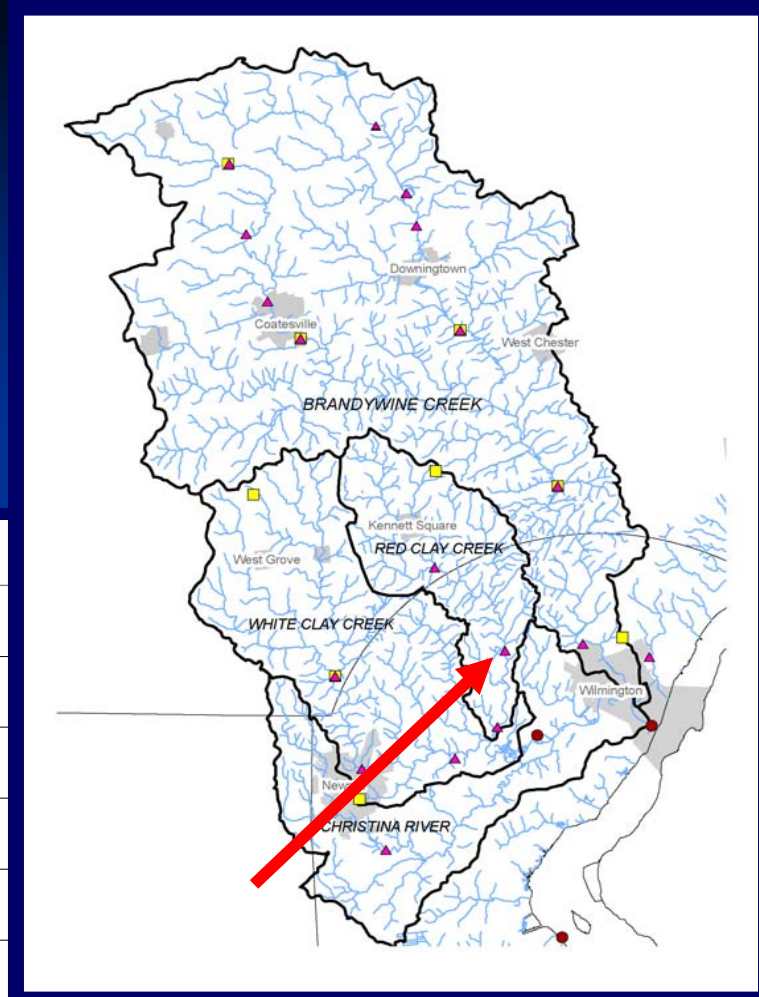
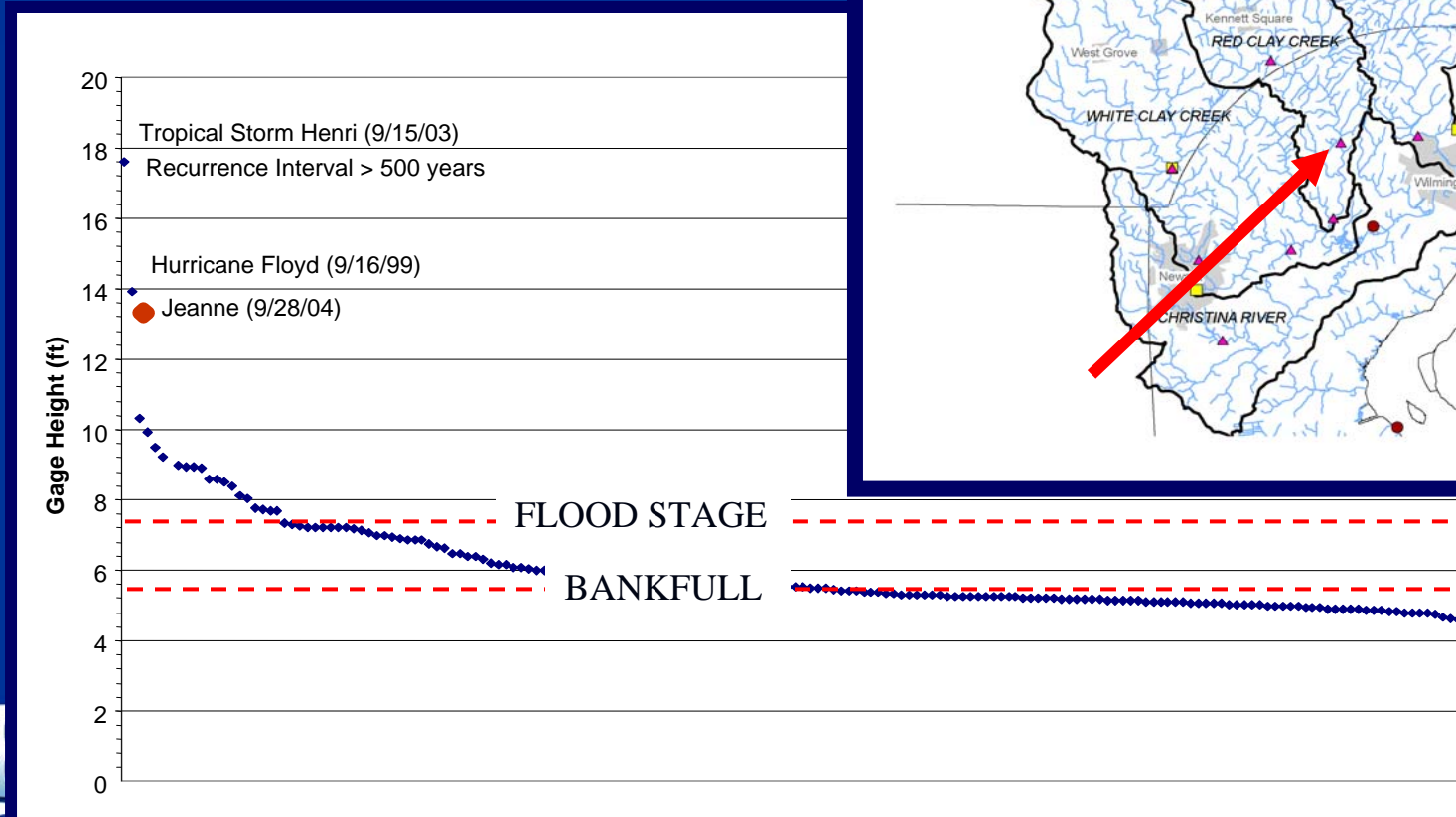
Red Clay Creek at Wooddale

Cumulative Rate of Rise, 15-Minute Intervals



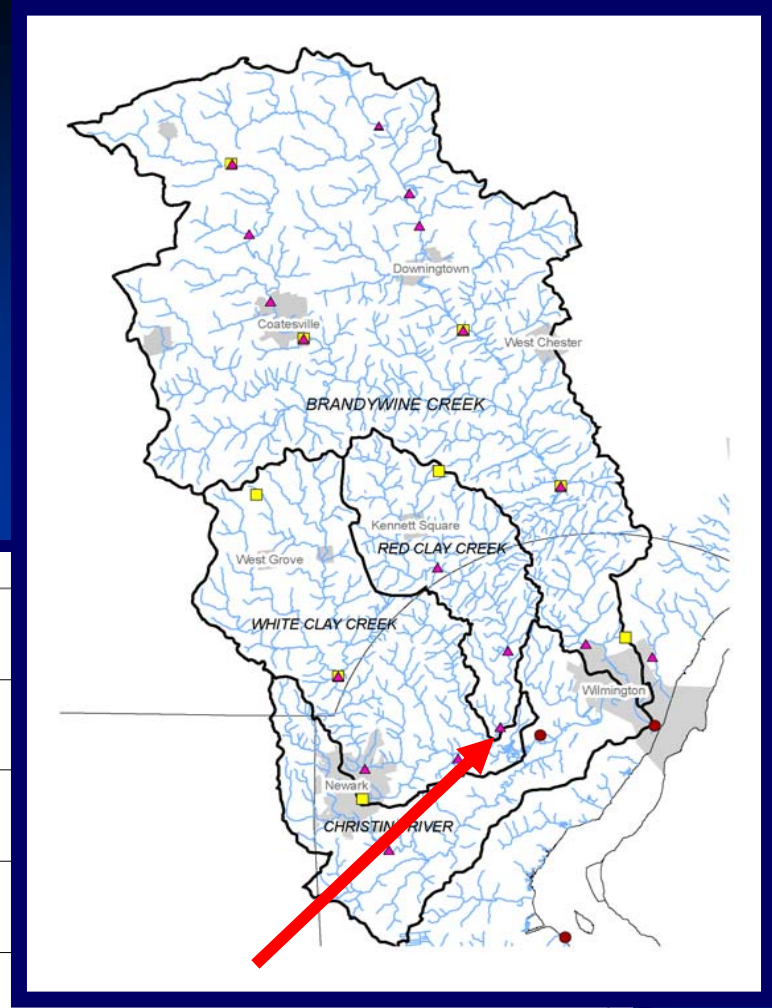
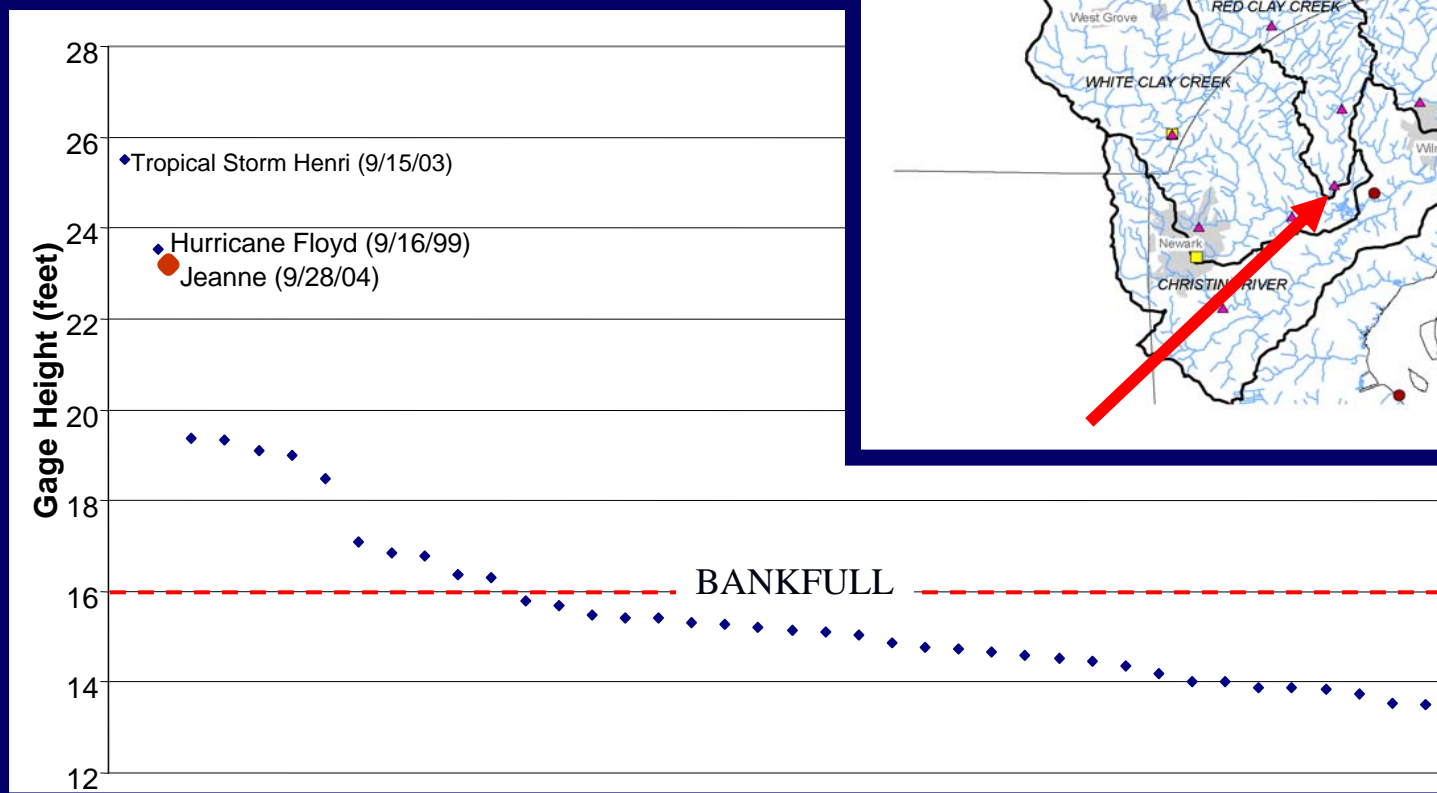
Peak Gage Height of Record Red Clay Creek at Wooddale

Station 01480000
Period of Record 1943 - 2004



Peak Gage Height of Record Red Clay Creek at Stanton

Station 01480015
Period of Record 1989 - 2004



Red Clay Creek Route 4 Stanton

Tropical Storm Jeanne September 28, 2004



High Water Mark – Red Clay Creek

Tropical Storm Henri

September 15, 2003





High Water Mark Red Clay Creek

Tropical Storm
Jeanne
September 28,
2004

High Water Mark Shone Lumber

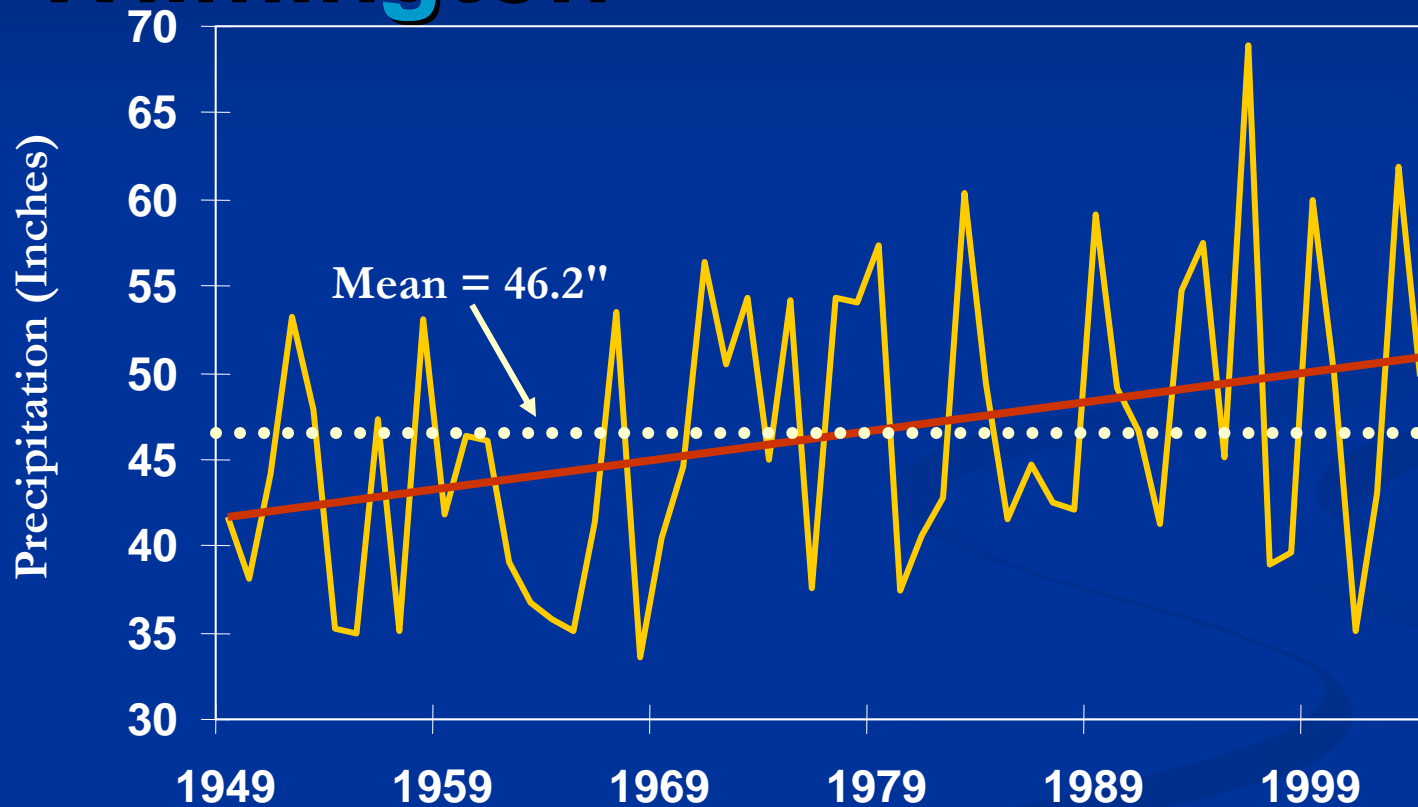
Tropical Storm Jeanne



Recently Built Hotel Tropical Storm Jeanne September 28, 2004



Annual Precipitation Porter Reservoir, Wilmington

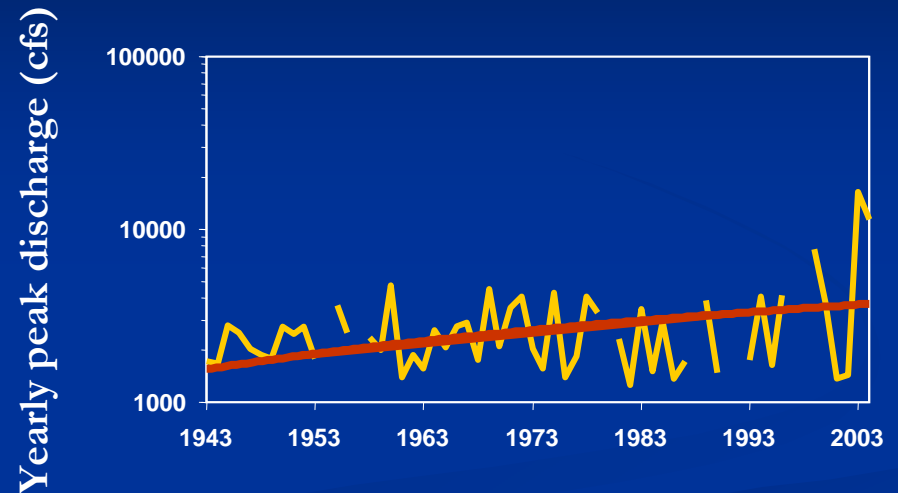
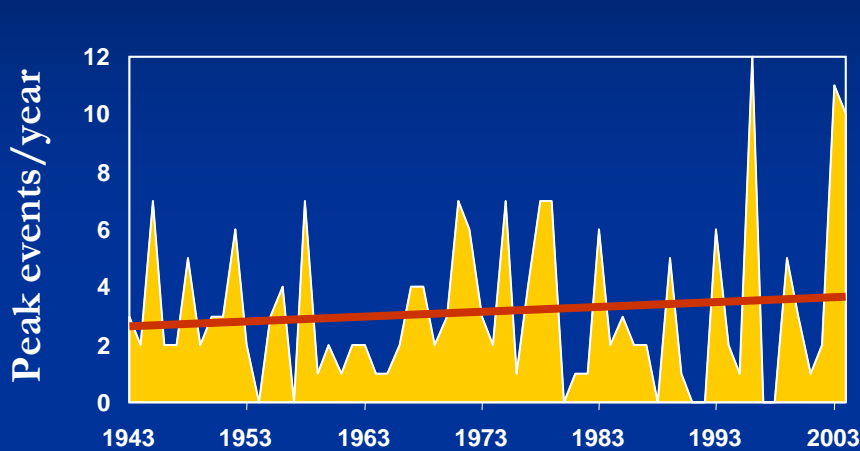


1950-1963: 42.79"

1990-2003: 49.28"



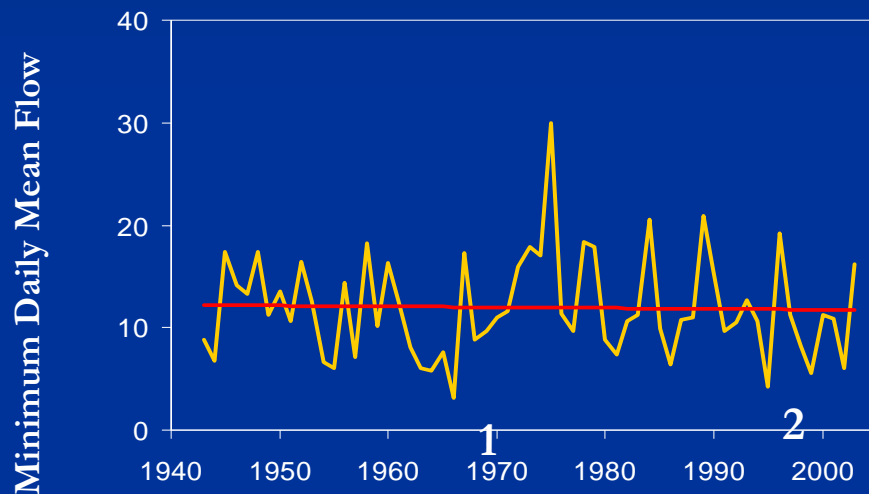
Red Clay Creek at Wooddale



- Baseline for peak events is 1200 cfs; @ 2-year event
- No obvious trend in peaks per year above 1200 cfs
- Slight increasing trend in annual peaks over time

Red Clay Creek at Wooddale Annual 7-Day Minimum Flow (mgd)

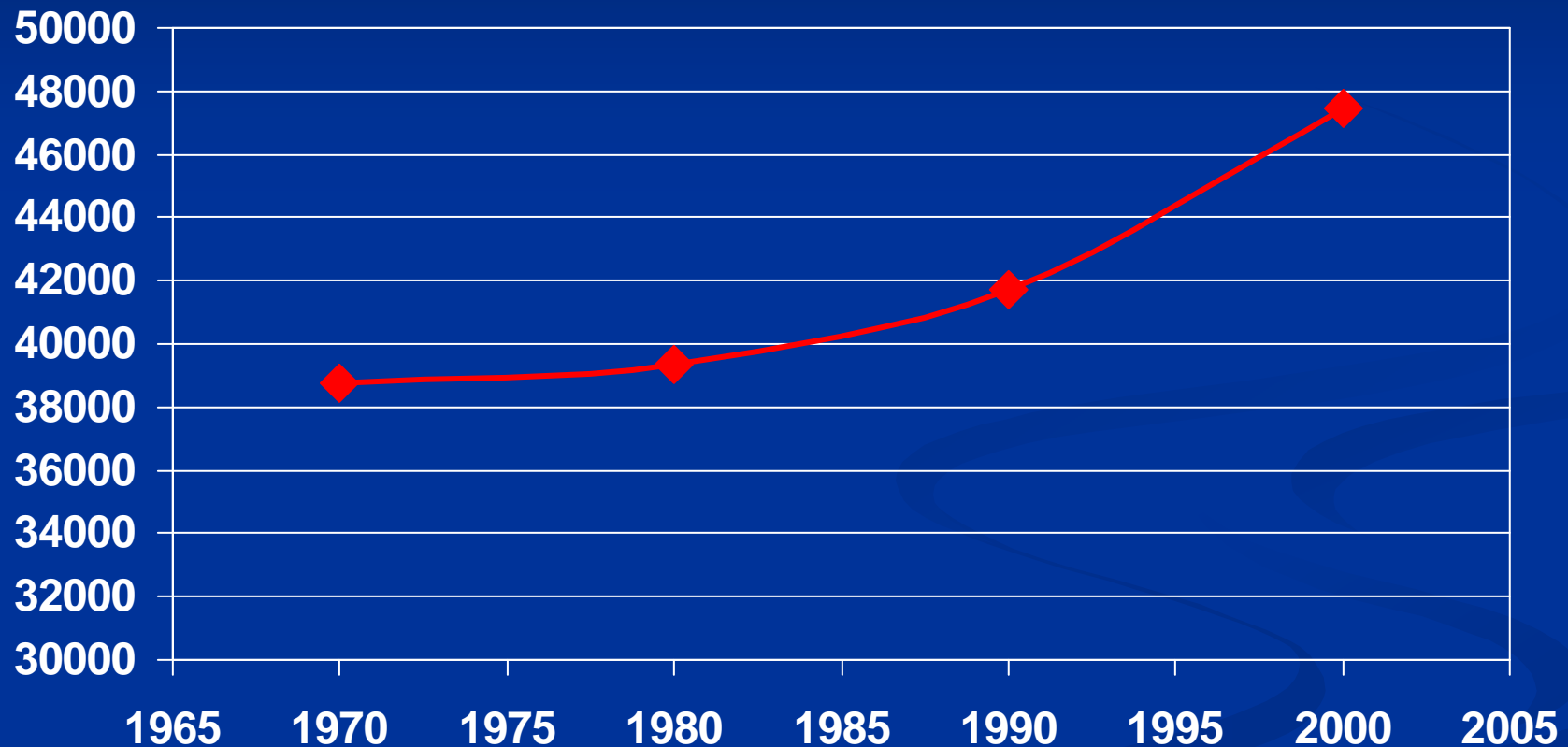
- 61 years of record
 - 1 3.1 mgd (1966)
 - 2 4.2 mgd (1995)



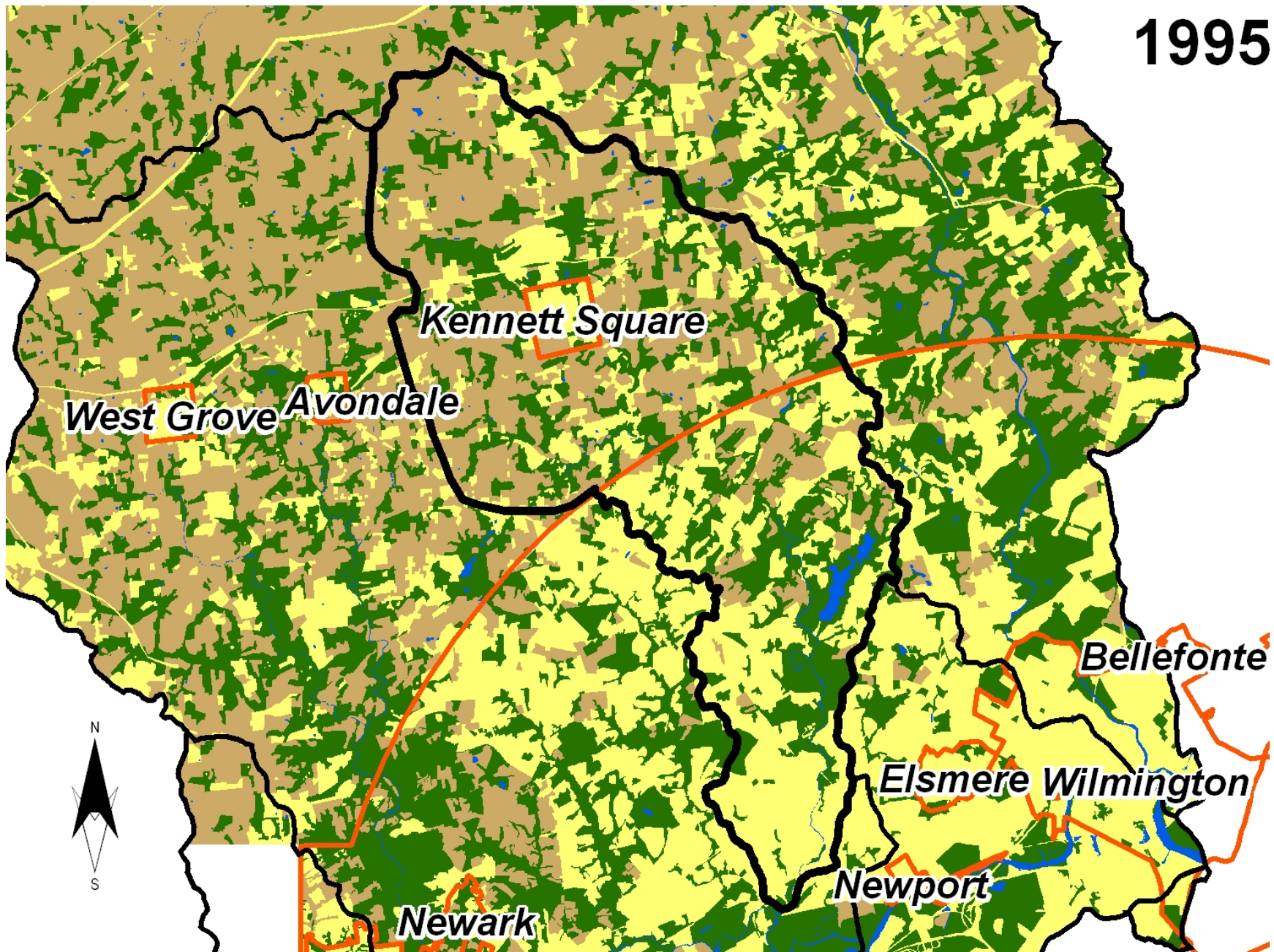
Red Clay Creek	Subwatershed	Population			
		1970	1980	1990	2000
	BURRIS RUN	1,666	1,863	2,032	2,524
	EAST BRANCH	4,375	4,763	5,333	6,402
	MAIN STEM ABOVE WOODDALE	5,286	6,060	6,596	7,384
	MAIN STEM BELOW WOODDALE	20,575	18,462	17,699	17,820
	WEST BRANCH	6,859	8,228	10,050	13,354
	Total	38,761	39,375	41,709	47,484



Population Red Clay Creek Watershed



1995



West Grove Avondale

Kennett Square

Bellefonte

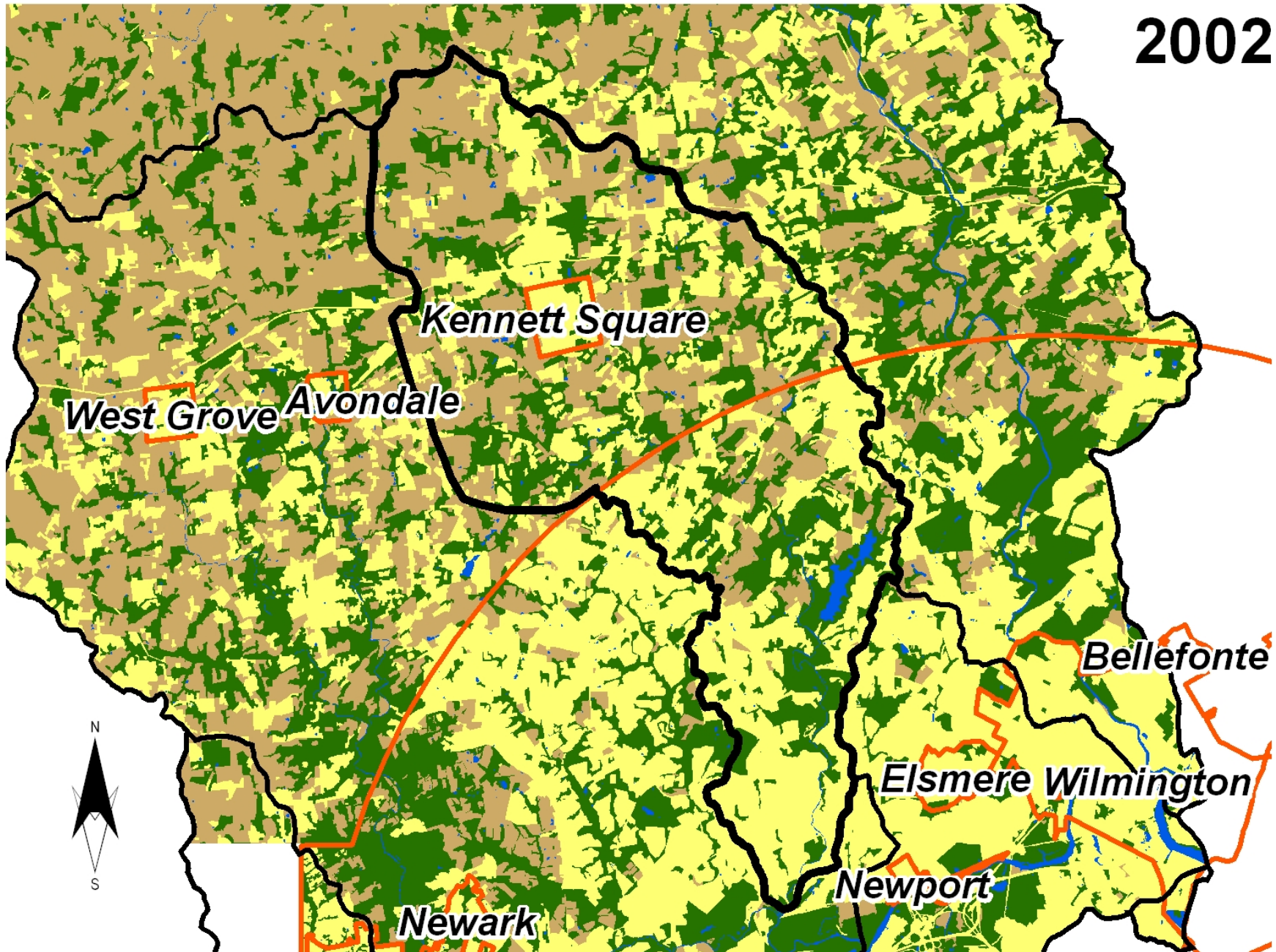
Elsmere Wilmington

Newport

Newark



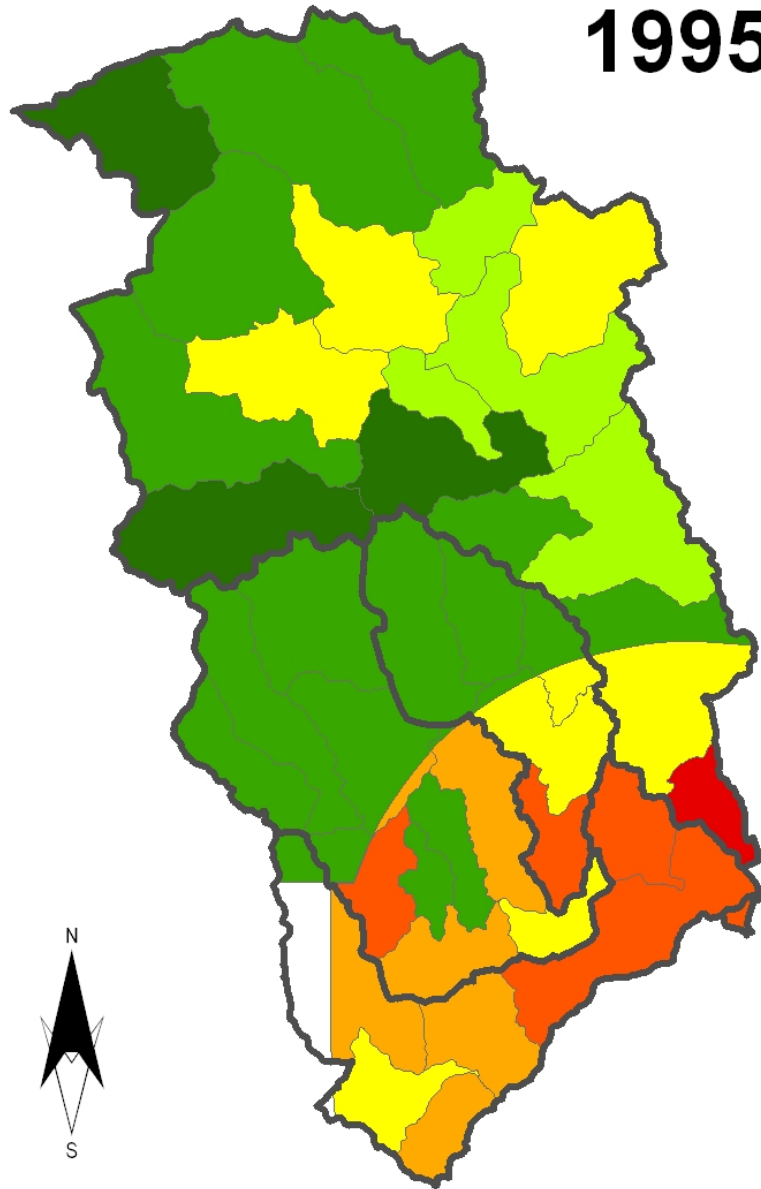
2002



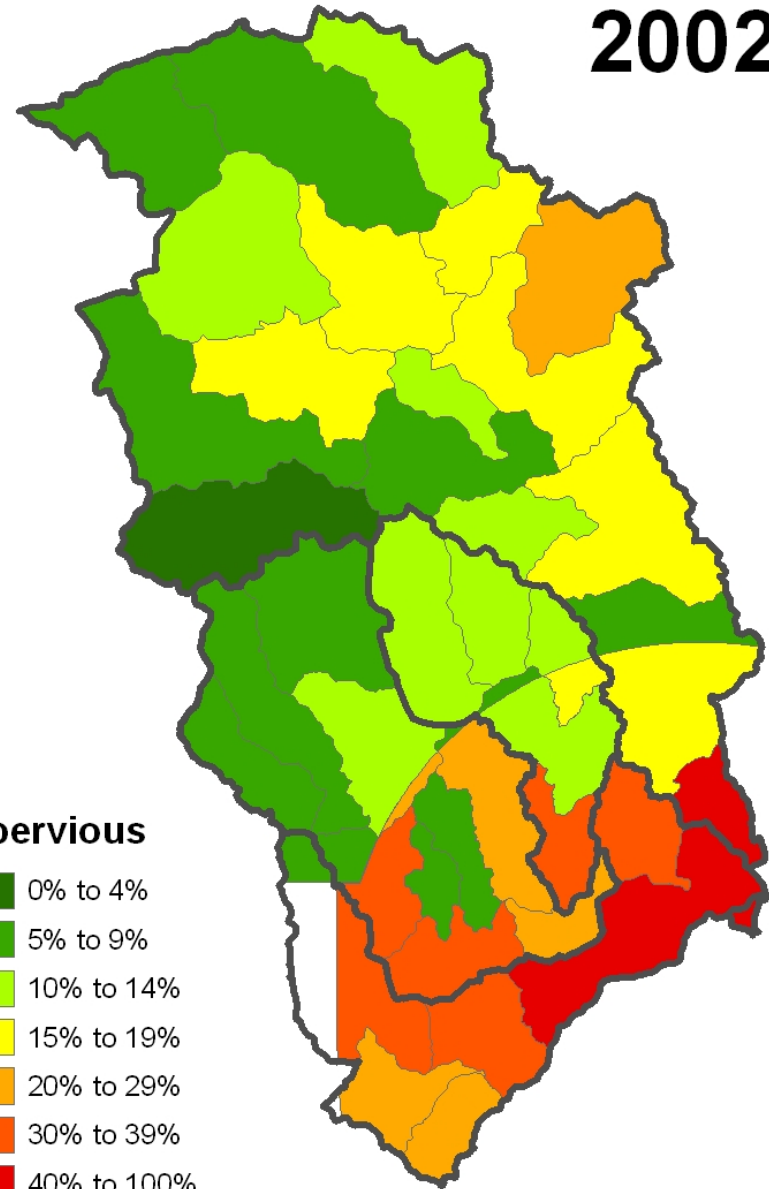
Red Clay Creek Impervious Cover

1990	15%
1995	16%
2000	17%

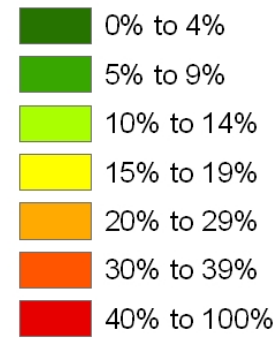
1995

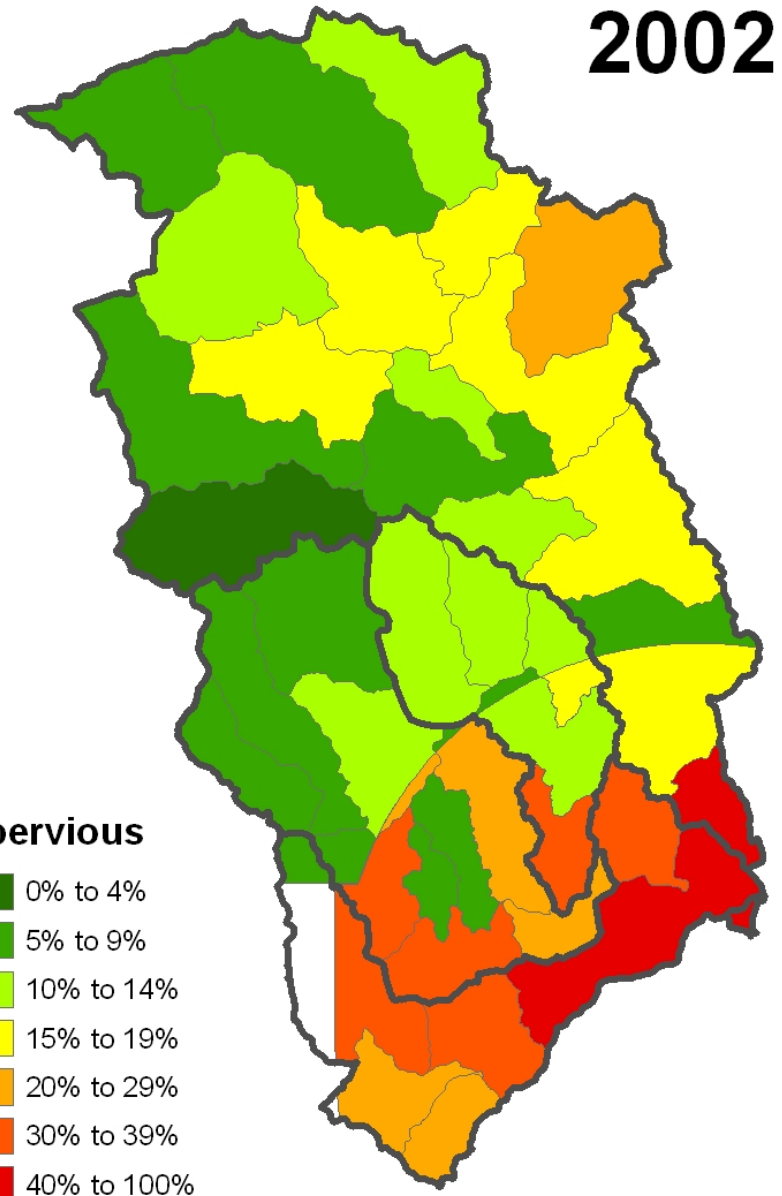
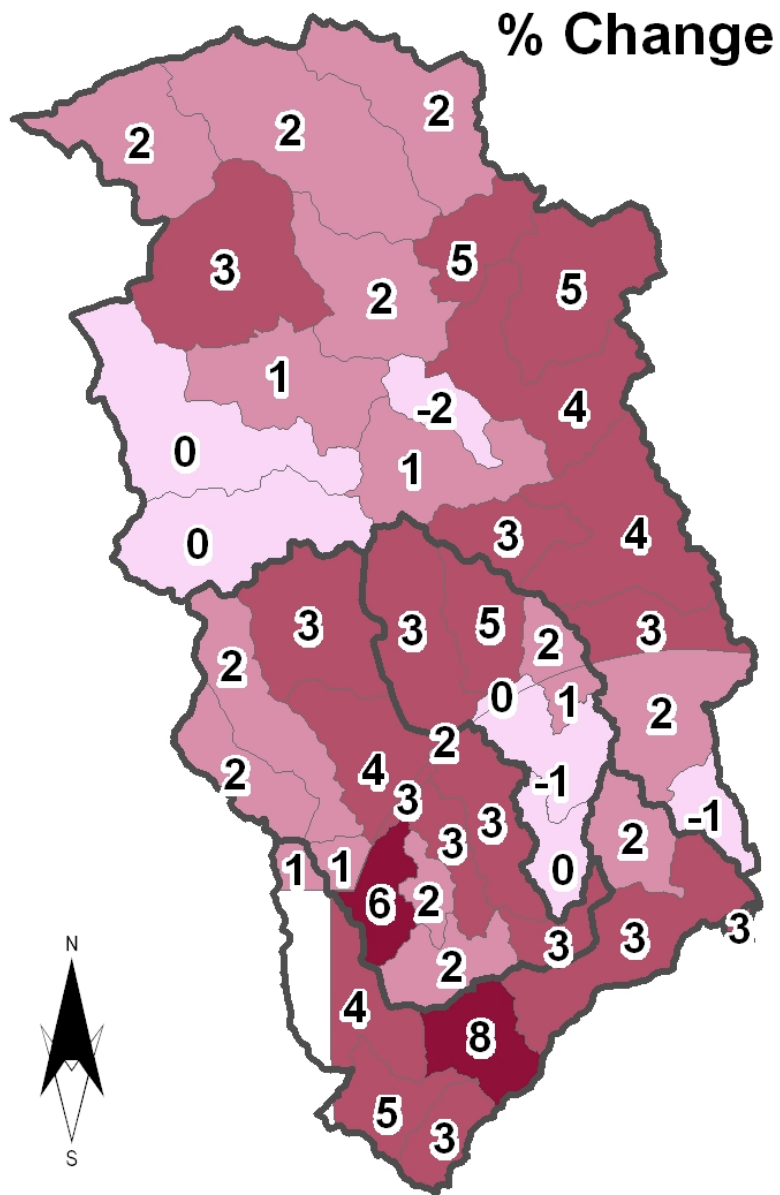


2002



Impervious





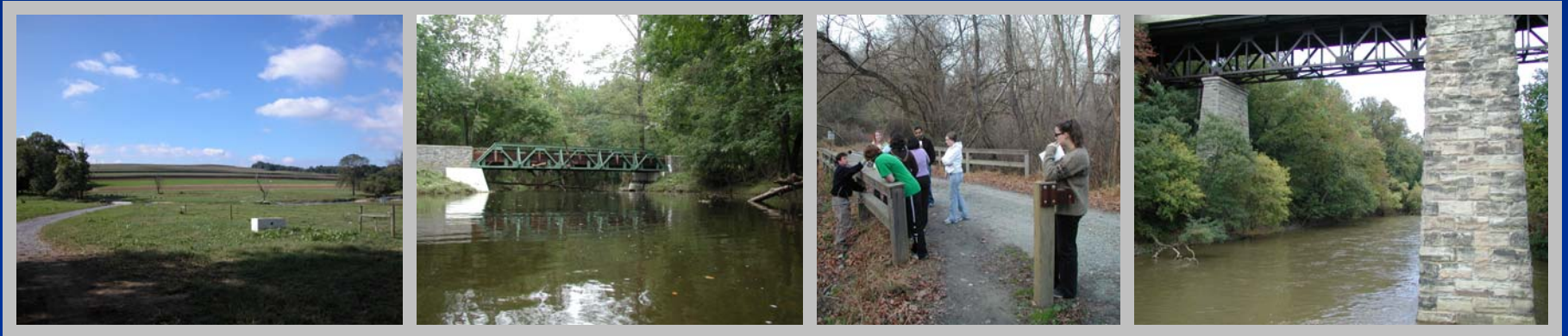
Impervious

- 0% to 4%
- 5% to 9%
- 10% to 14%
- 15% to 19%
- 20% to 29%
- 30% to 39%
- 40% to 100%

Watershed / State Comparison

IMPERVIOUS COVER	Pennsylvania		Delaware	
	1995	2000	1992	2002
Brandywine	9%	11%	23%	25%
Christina	5%	6%	30%	35%
Red Clay	8%	11%	21%	21%
White Clay	6%	9%	22%	25%
BASIN	9%	11%	26%	29%

Questions?



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