Farmland and Forest Conservation: Evaluating Successes and Failures for Smart Growth in Maryland and the United States

David Newburn, Lori Lynch, and Haoluan Wang
Department of Agricultural and Resource Economics
University of Maryland

Two types of development

Urban and suburban development

- Fulton, Pendall, Nguyen, and Harrison (2001)
  - Majority of people reside in urban and suburban areas
  - Who sprawls most?
- Burchfield, Overman, Puga, and Turner (2006)
  - National Land Cover Data (LANDSAT imagery)
  - Urban footprint (1.9 % of US land area)

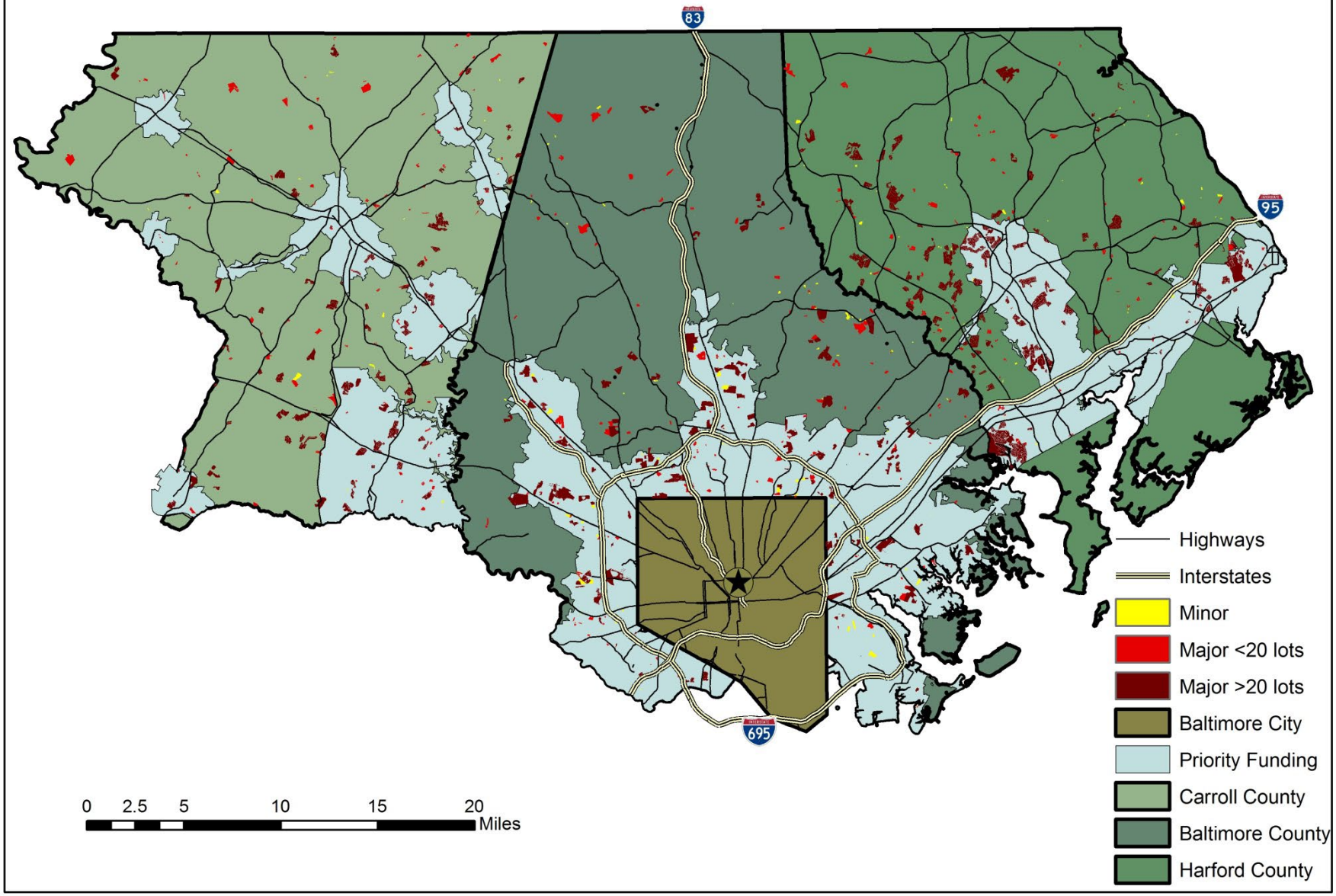
Exurban development

- Heimlich and Anderson (2001)
  - Rural residential properties in exurban area
    - Large-lot development (1 acre or greater)
    - Septic systems and private groundwater wells
  - Majority of farmland loss
- Sutton, Cova, and Elvidge (2006)
  - Nighttime satellite imagery
  - Exurban footprint (14%) and urban footprint (1.7%)

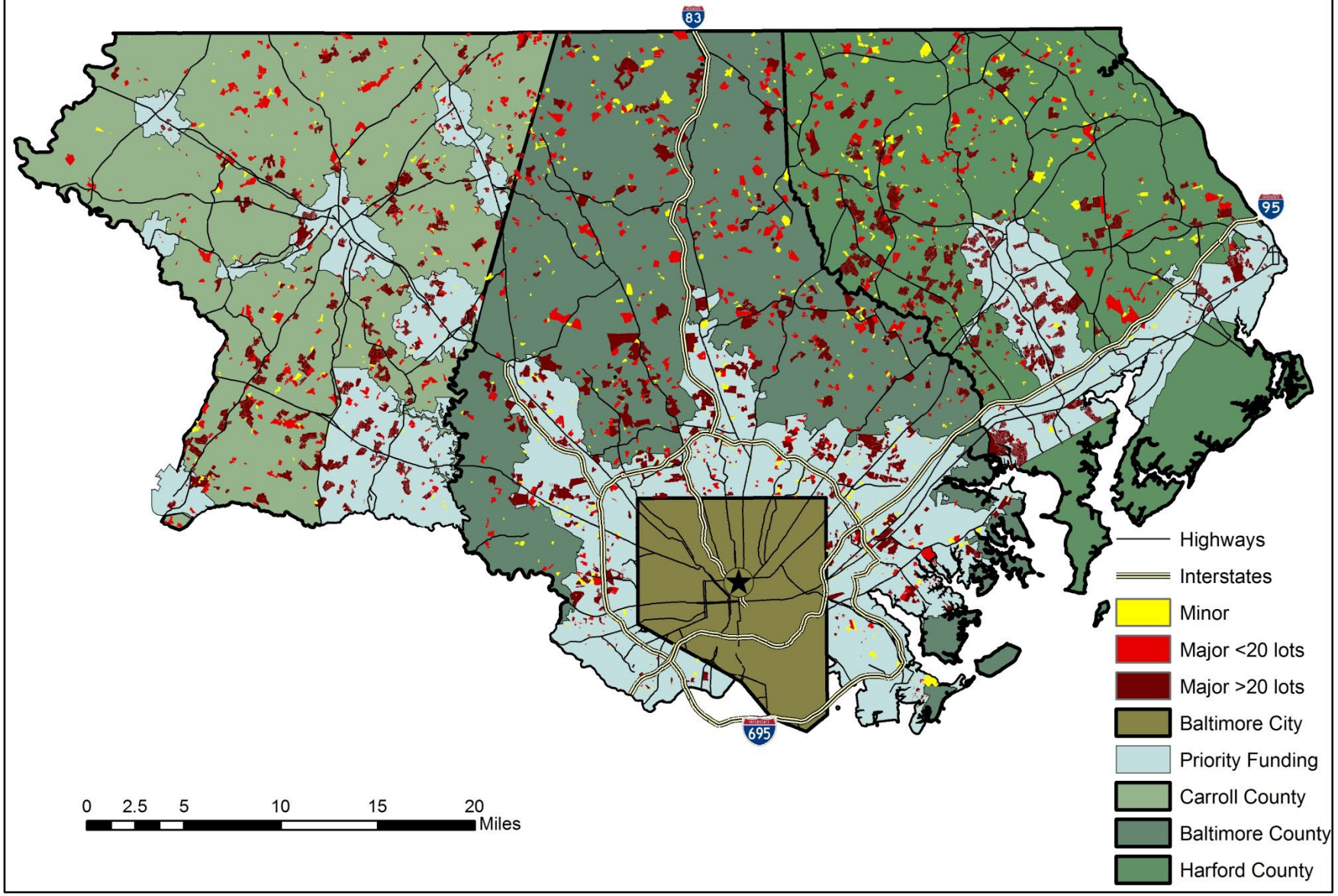
Exurban
(on septic)

Suburban (on sewer)

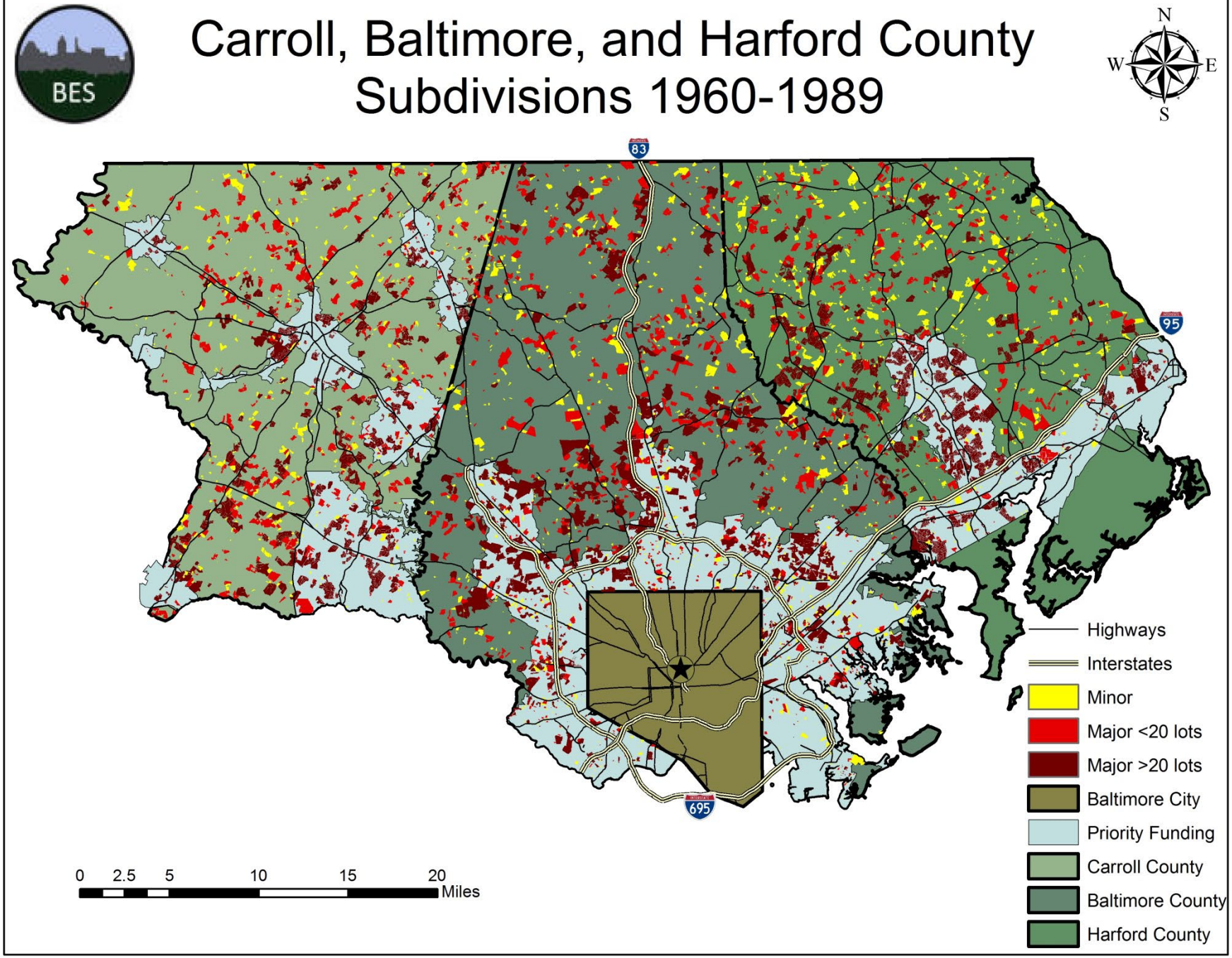
Carroll, Baltimore, and Harford County Subdivisions 1960-1969



Carroll, Baltimore, and Harford County Subdivisions 1960-1979



Carroll, Baltimore, and Harford County Subdivisions 1960-1989



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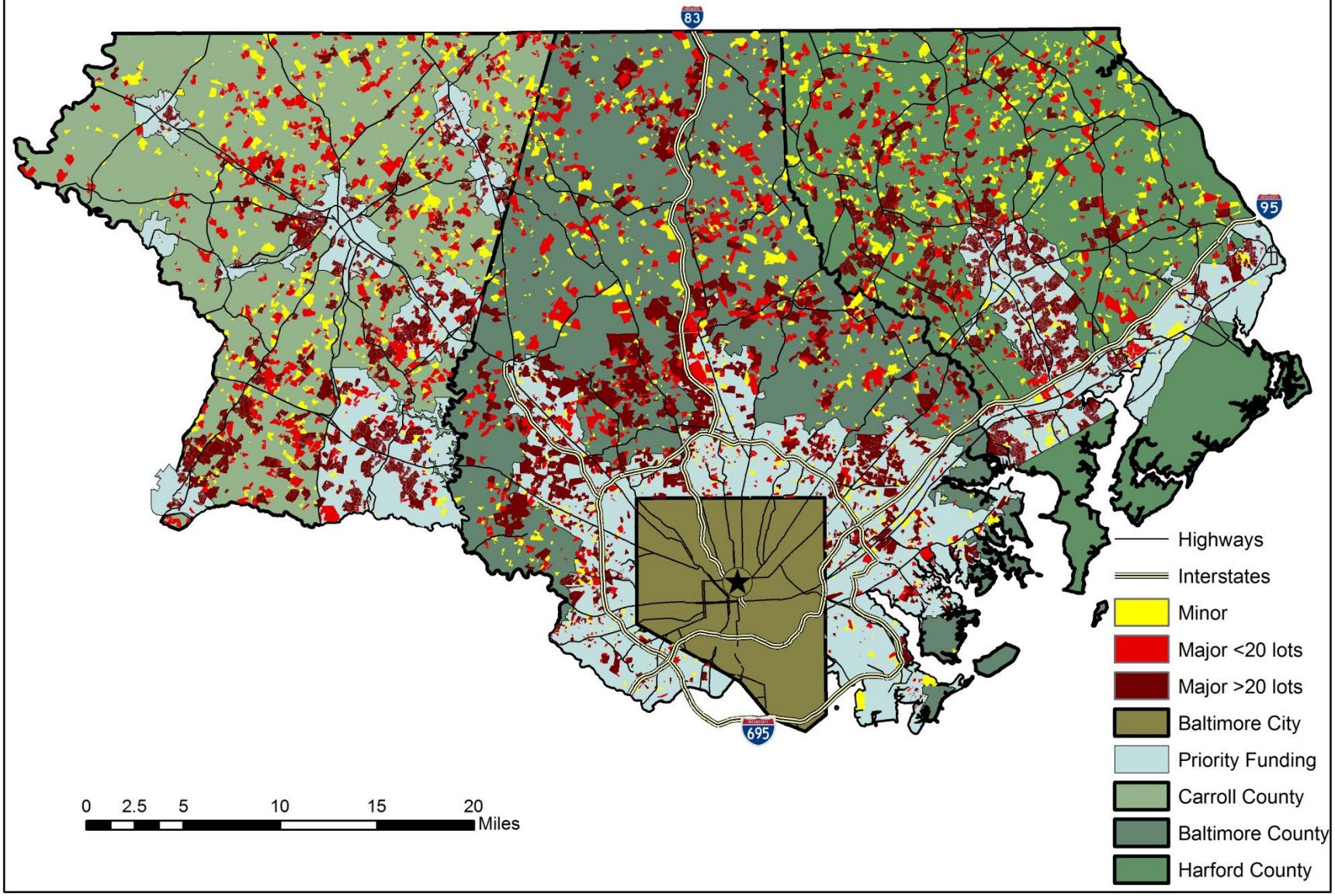
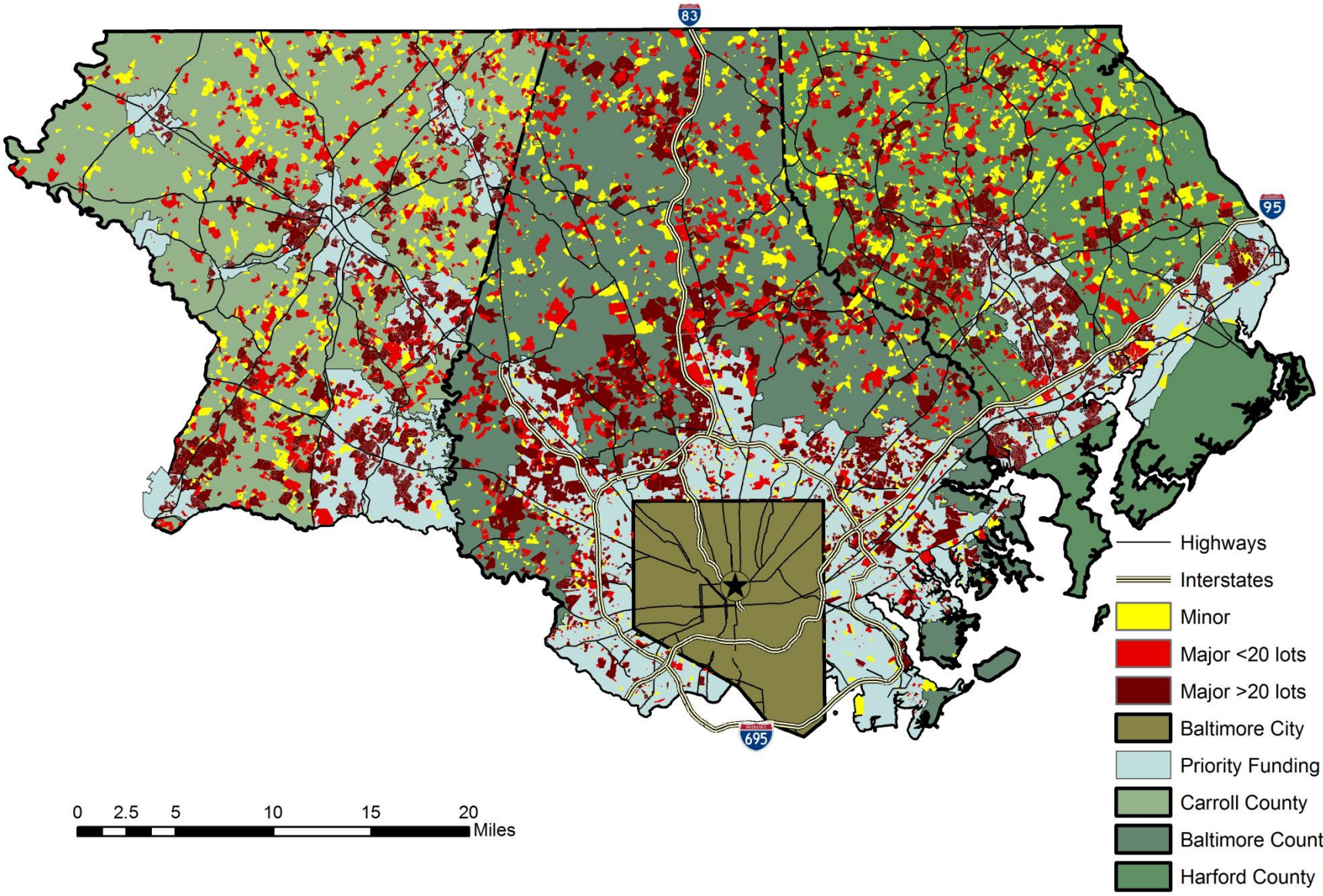
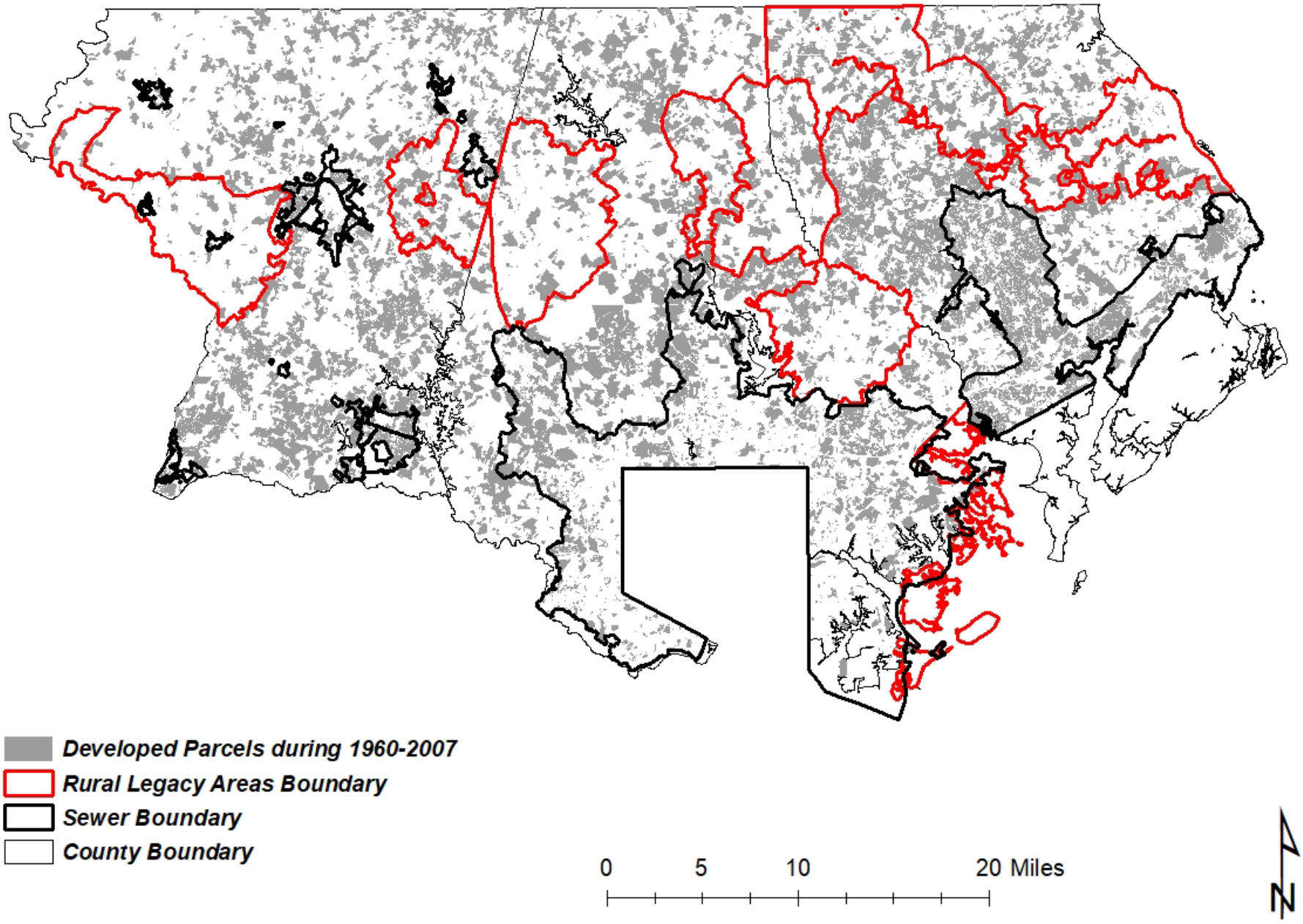


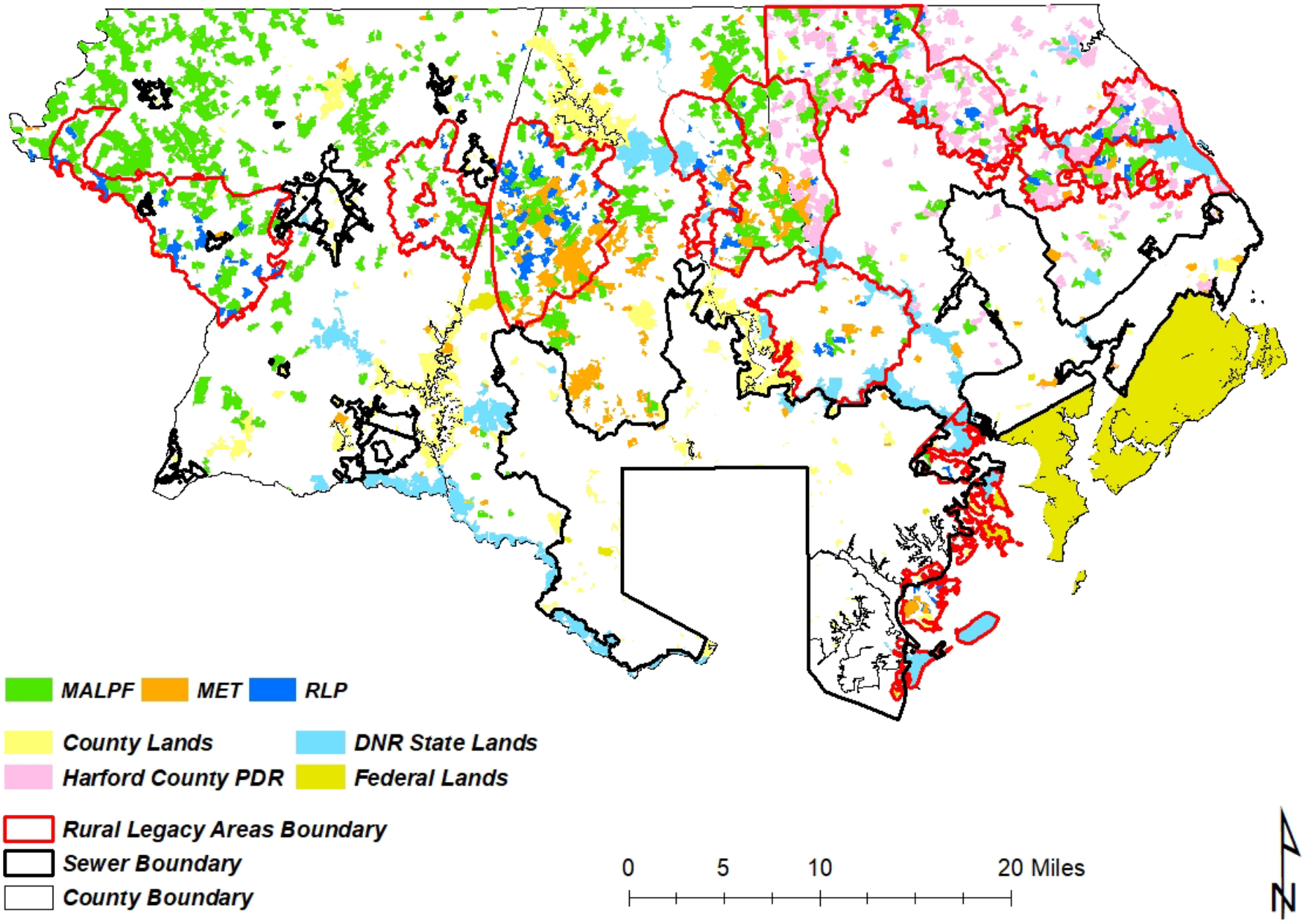
Carroll, Baltimore, and Harford County Subdivisions 1960-2007



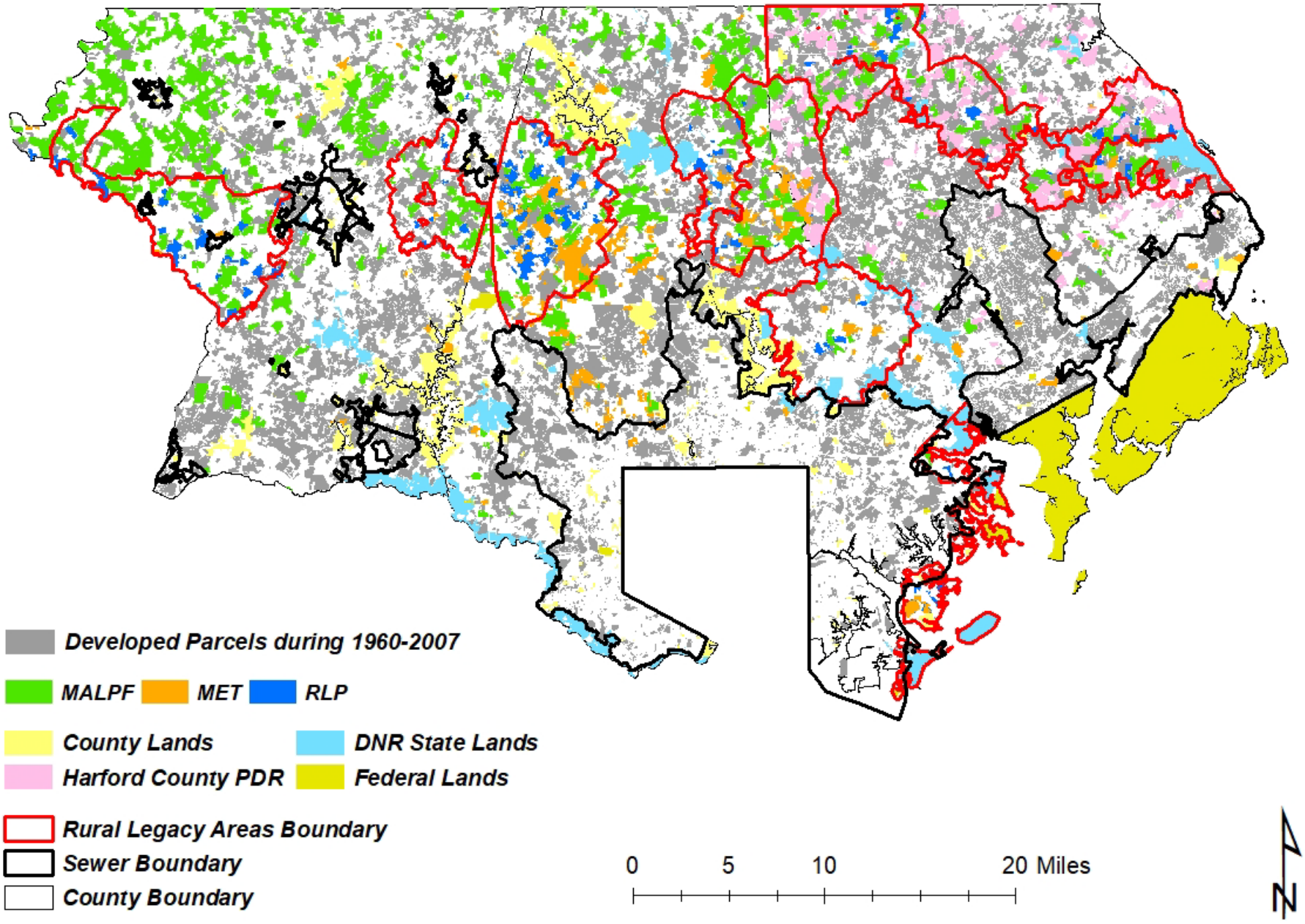
Residential subdivisions in 1960-2007



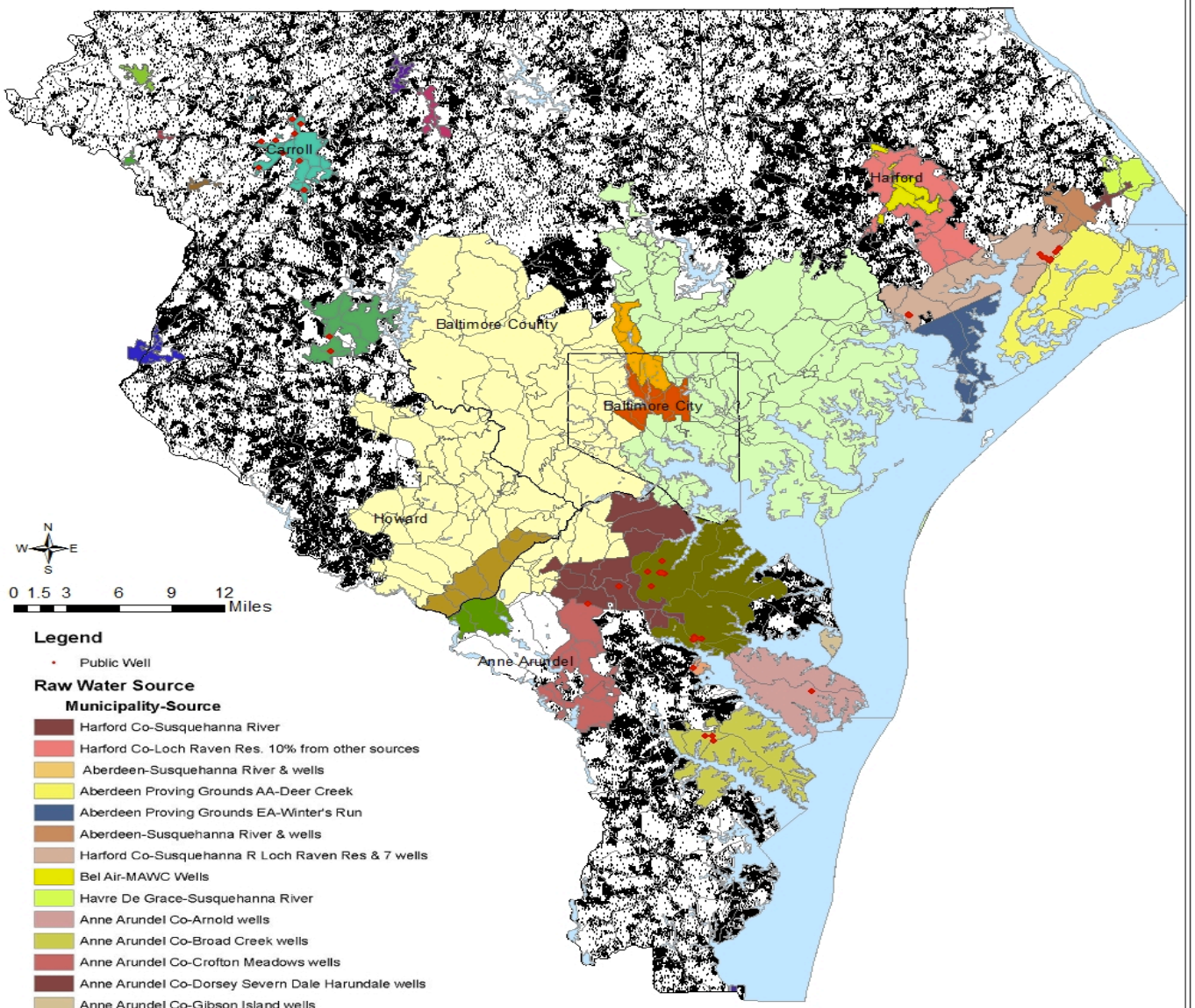
Land conservation programs



Interactions for conservation and development



Septic and groundwater wells (large-lot development)

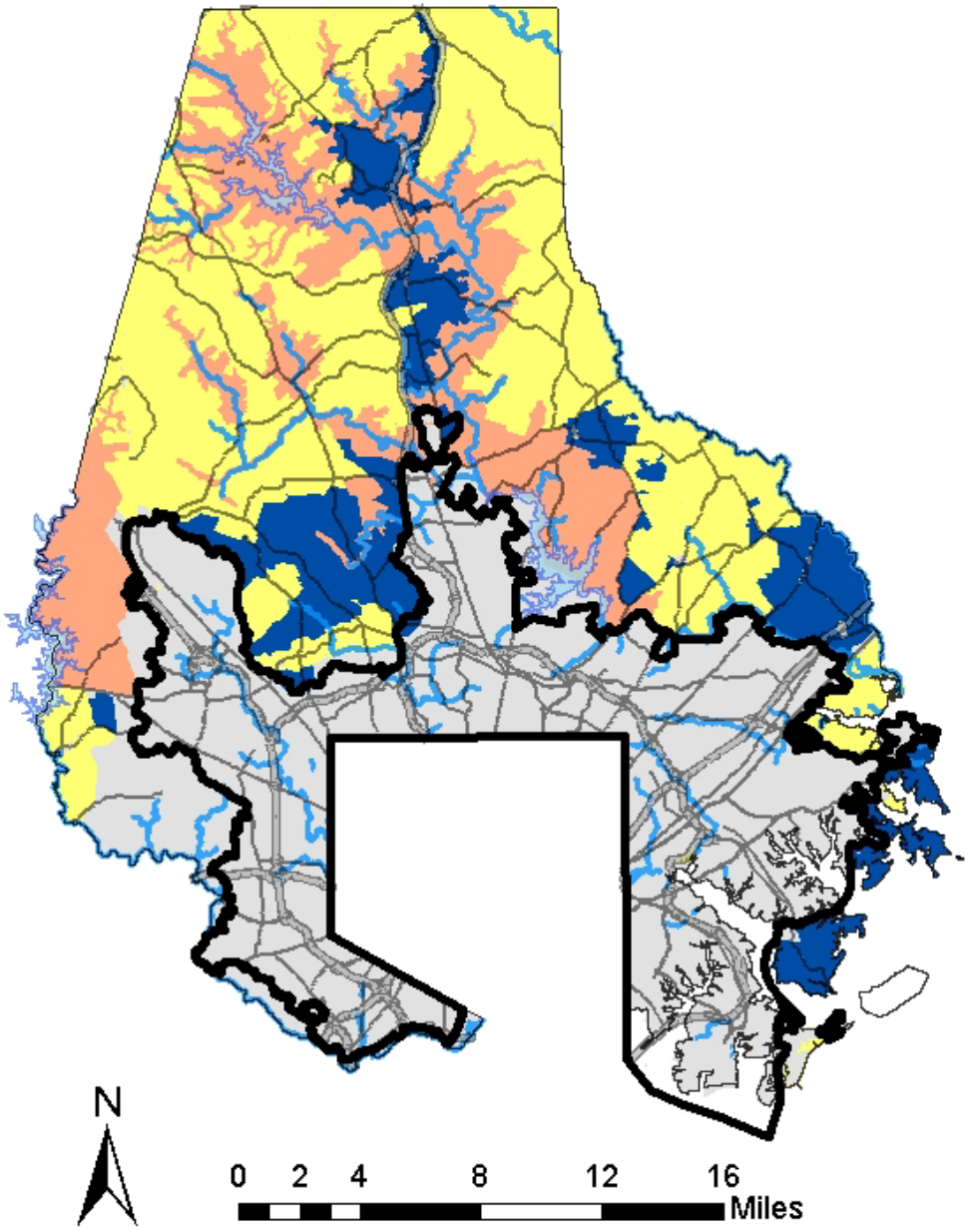


Four policy approaches

- Regulatory policies
  - Zoning
  - Urban growth boundaries (UGBs)
- Incentive-based policies
  - Priority funding areas (PFAs)
  - Use value assessment
- Land preservation programs
  - Purchase of development rights (PDR)
  - Outright purchase (fee simple title)
- Transfer of development rights (TDR)

Main point: Different effectiveness of land use policies and programs for managing suburban (sewer) versus exurban (septic) development

Resource Conservation Zoning in 1976



Legend

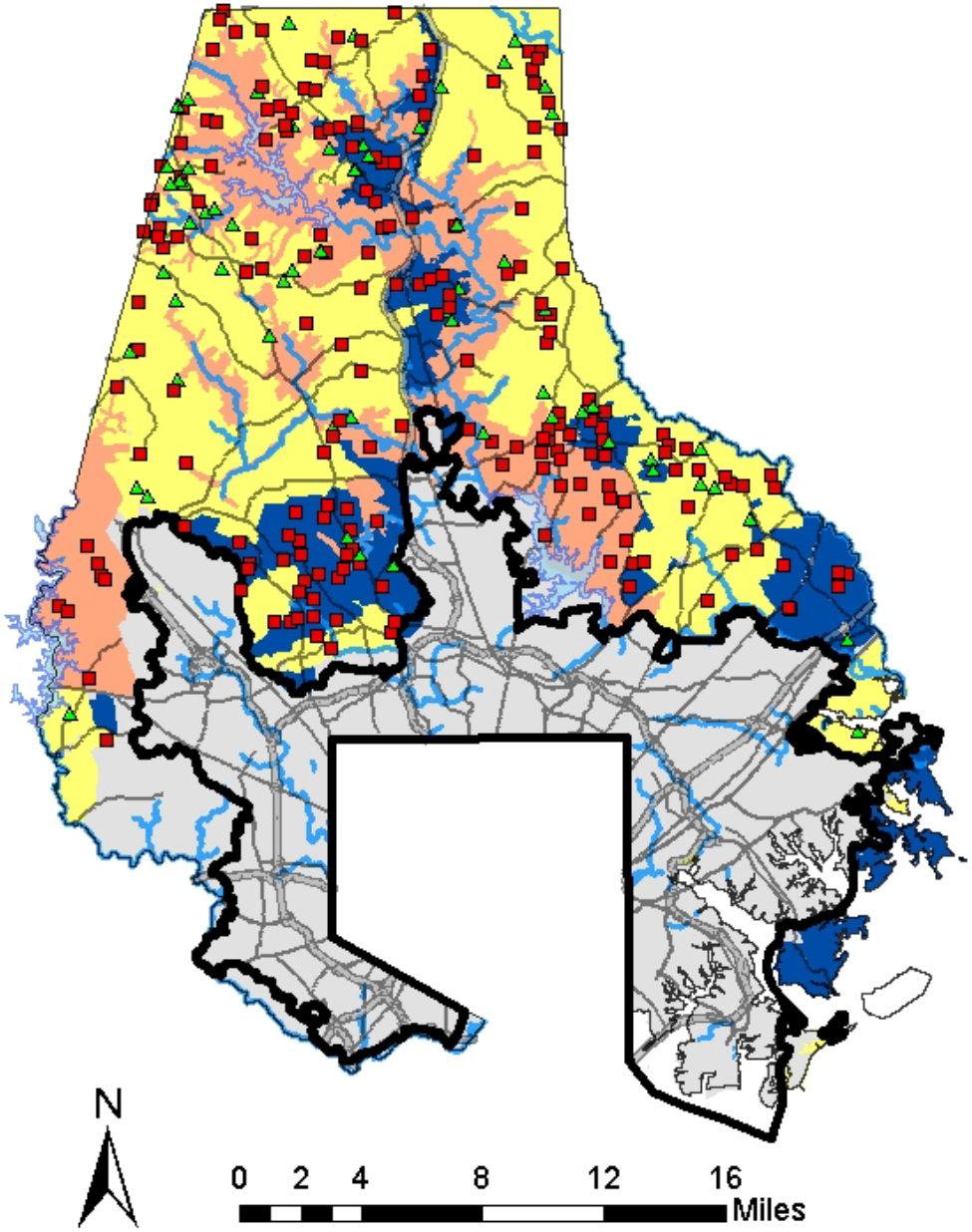
- County Boundary
- Urban Growth Boundary
- Reservoirs
- Major Rivers
- Interstate Highways
- Major Roads

Zoning1976

- Other
- RC 2 0.02 du/ac (1:50)
- RC 4 0.2 du/ac (1:5)
- RC 5 0.5 du/ac (1:2)

Entire rural area had zoning at 1 du/ac (1:1) prior to 1976.

Residential subdivisions in 1967-1976



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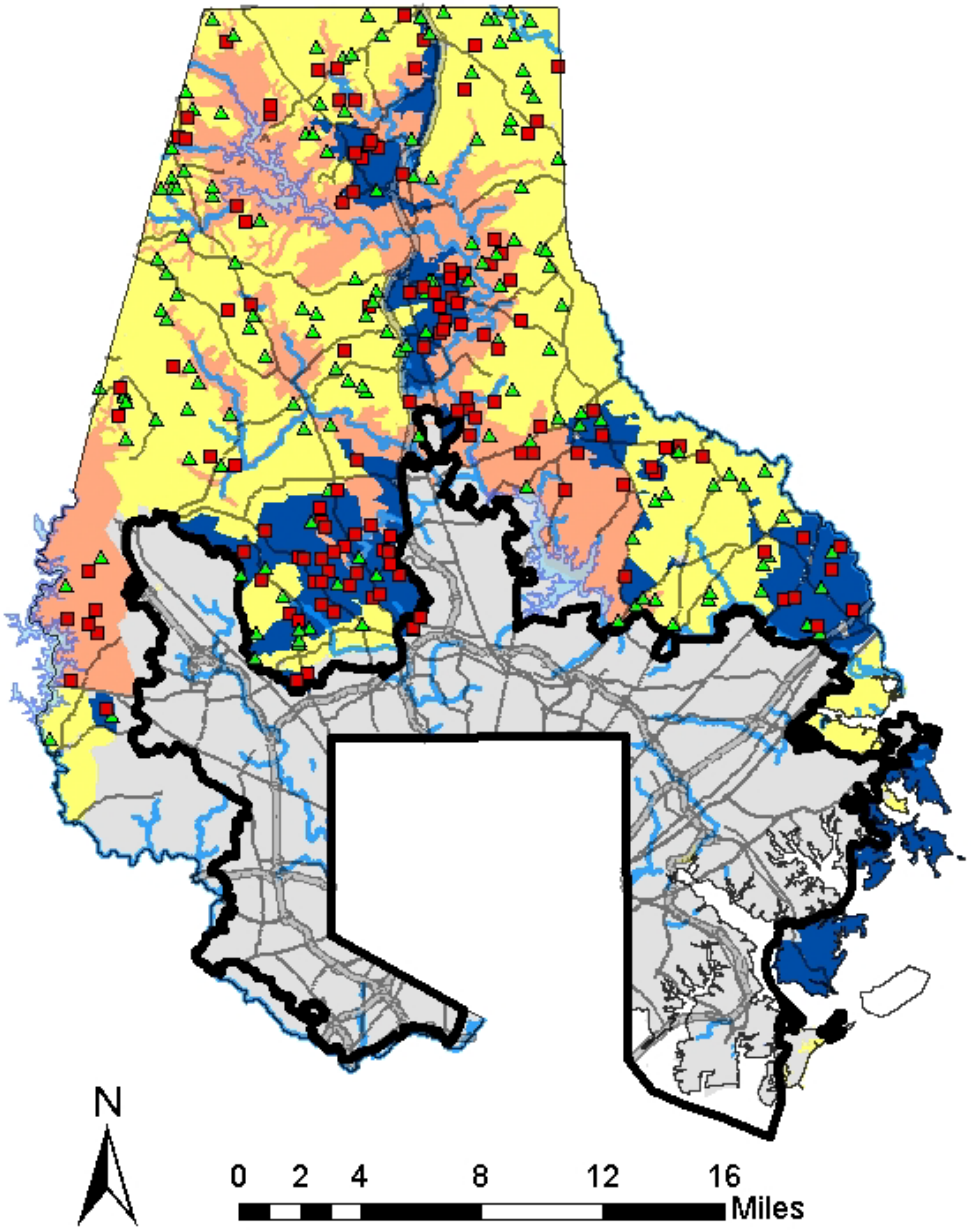
Subdivision Centroids

- Minor (2 or 3 lots)
- Major (=>4 lots)

Residential subdivisions in 1977-1986



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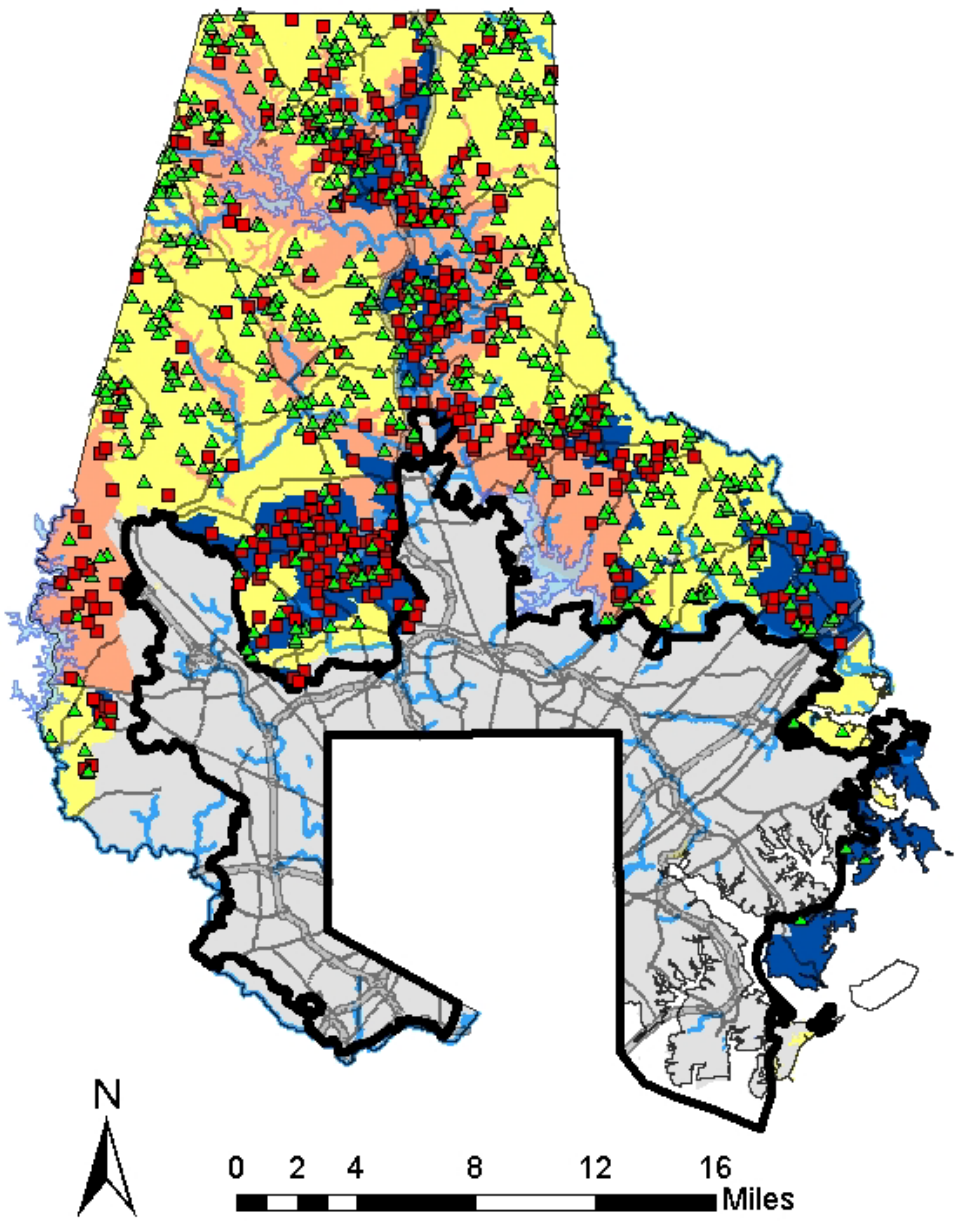
Residential subdivisions in 1977-2007



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Subdivision Centroids

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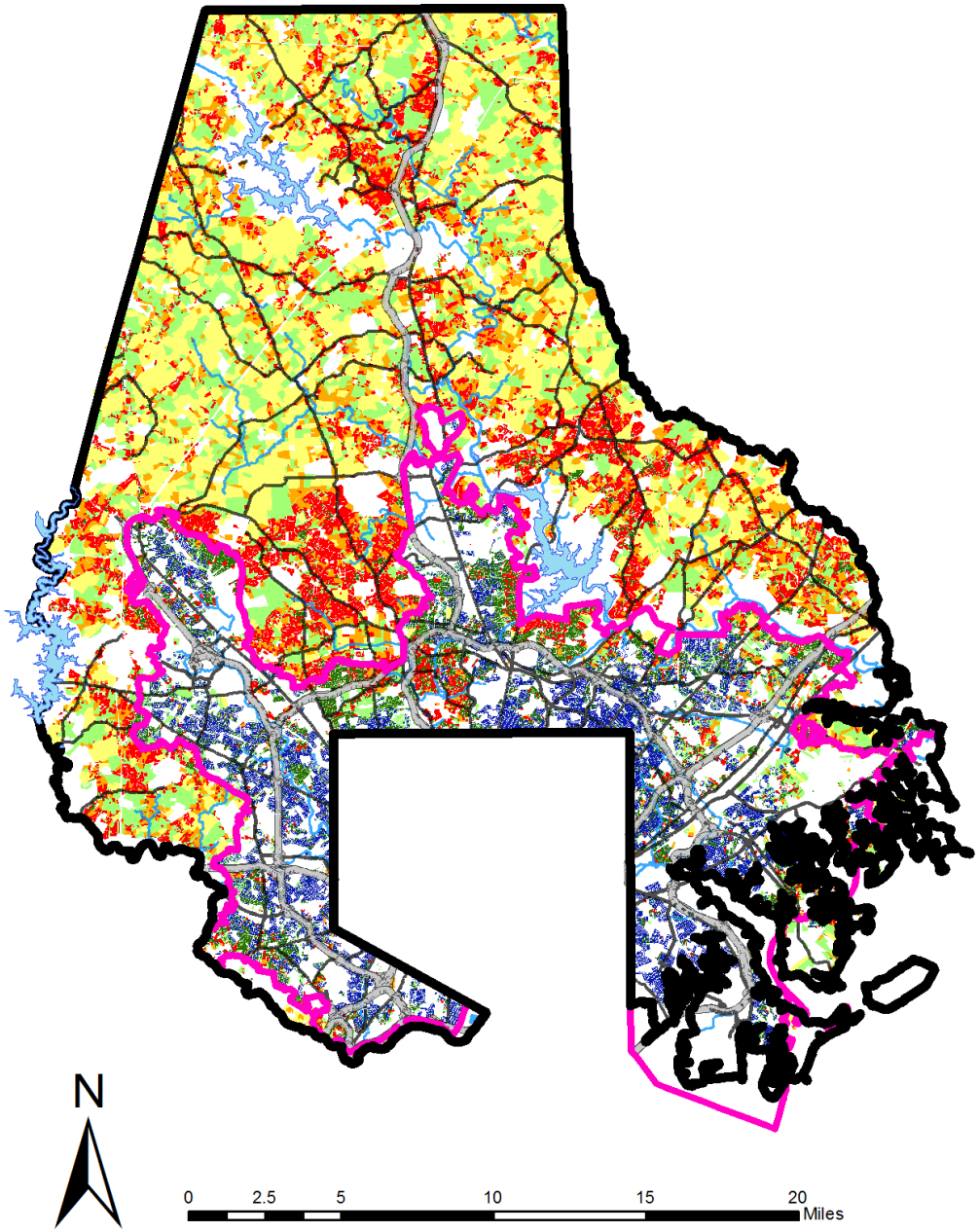
- Major (=>4 lots)

Residential density in Baltimore County, MD



County Boundary

Urban Rural Demarcation Line

Resevoirs

Major Rivers

Interstate Highways

Major Roads

SINGLE-FAMILY RESIDENTIAL DENSITIES

No development

<=0.05 units/acre (>20 acres/unit)

>0.05 - 0.2 units/acre (>5 to 20 acres/unit)

>0.2 - 1.0 units/acre (>1 to 5 acres/unit)

>1.0 - 4.0 units/acre (>0.25 to 1 acres/unit)

>4.0 units/acre (<0.25 acres/unit)

Regulatory policies

Urban growth boundaries

- UGBs limit spatial expansion of municipal sewer service
  - Growth management for urban and suburban density

- UGBs are an urban/suburban (but not exurban) containment strategy
  - Large-lot development on septic leapfrogs into rural region

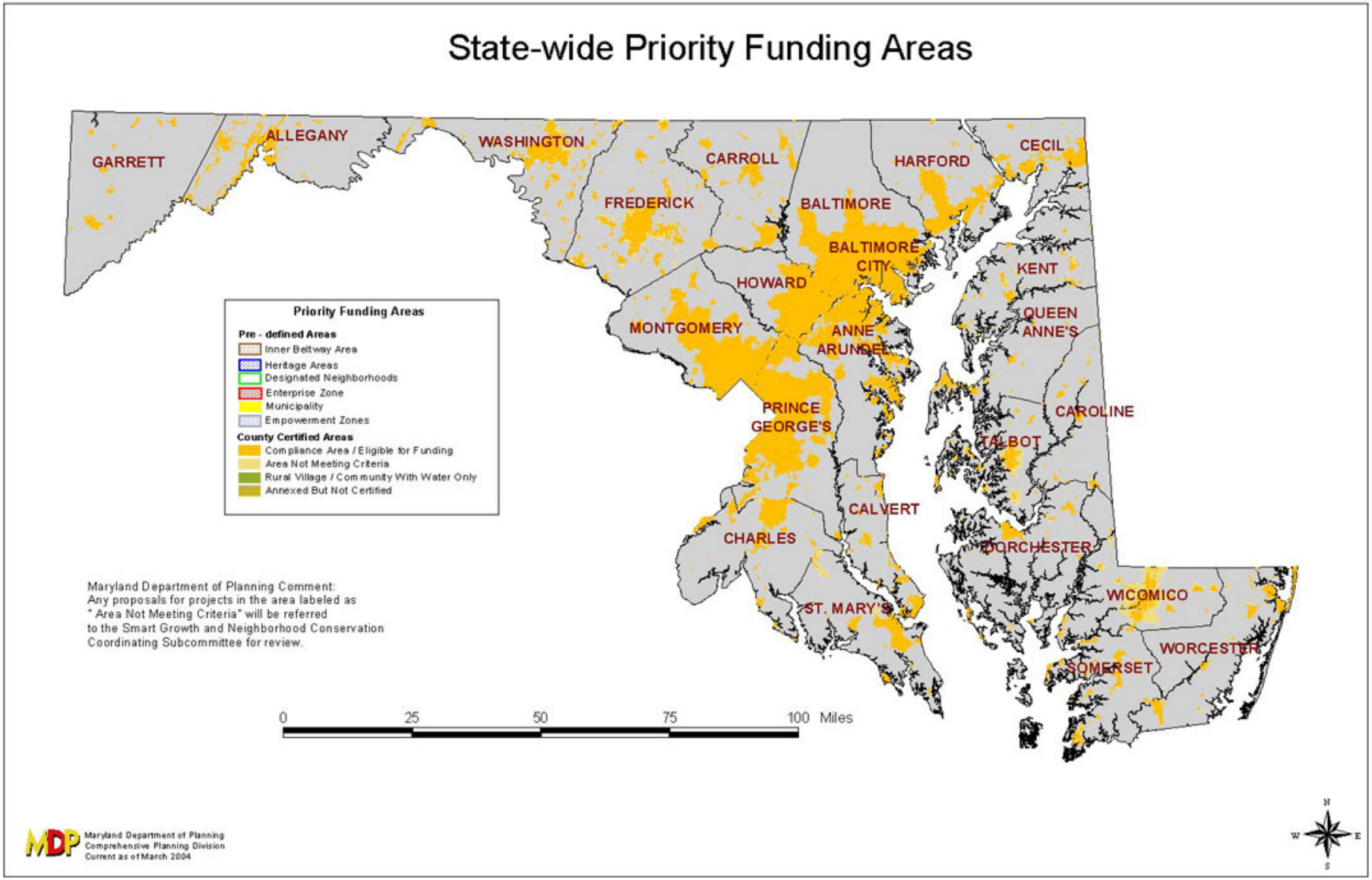
Rural zoning

- Agricultural preservation zoning
  - Effective when max density at 1 housing unit per 20+ acres (Daniels 1997)

- Rural residential zoning
  - Max density at 1 housing unit per 1-5 acres

Maryland Smart Growth Programs

Priority Funding Areas provides state funds for infrastructure (sewer, water & roads) to encourage growth in highly developed areas



Priority Funding Areas

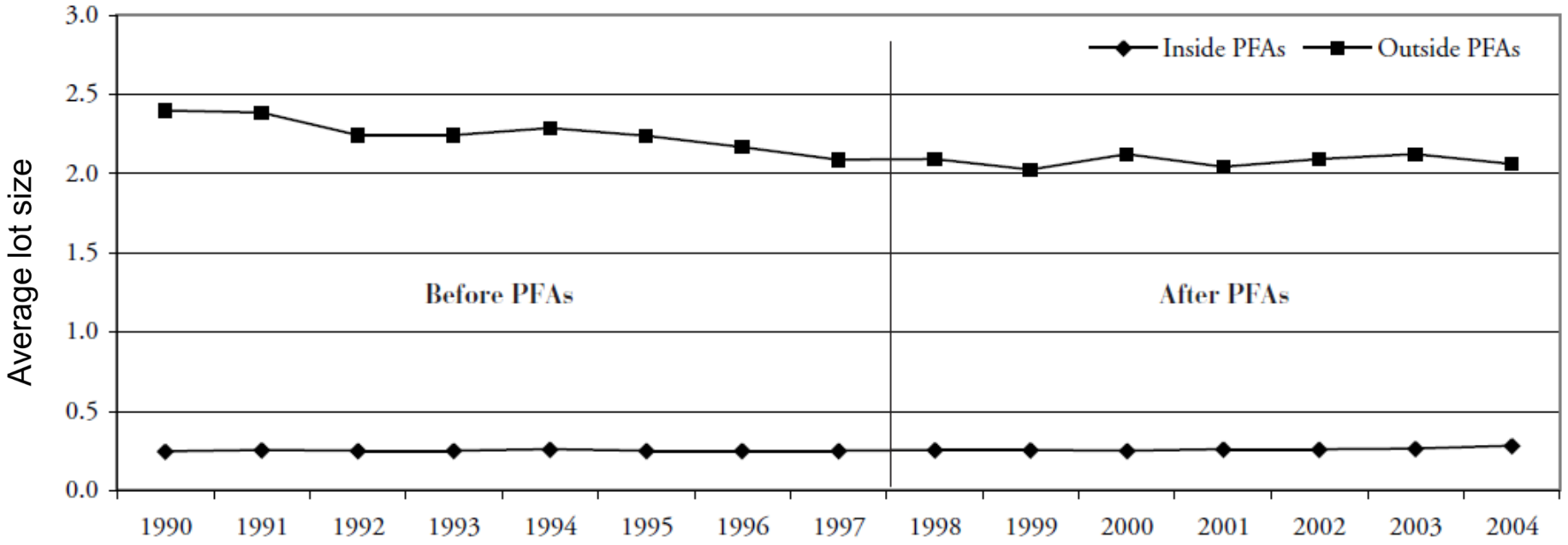


Figure 7. Average acres per parcel for improved single-family residential land[a] inside and outside PFAs in Maryland, 1990–2004.

Note:

a. Defined as parcels of 20 acres or less having improvements worth $1,000 or more.

Source: Lewis, Knaap and Sohn (2009) in JAPA

Priority Funding Areas

PFAs are different from UGBs because…

- PFAs are incentive-based approach
  - Subsidize infrastructure in targeted growth areas

- UGBs are regulatory approach

PFAs are similar to UGBs because…

- Both are designated on existing sewer service
  - Urban/suburban containment
  - Does not directly inhibit exurban large-lot development

- PFA designated boundaries have not changed substantially since adoption in 1997

Use value assessment

Tax differential program

- Use value assessment (UVA) determines the landowner property tax based on the existing use value (agriculture, forestry) rather than the market value

- This tax differential program amounts to tens of billions of dollars annually in foregone taxes in the US and has been a poorly targeted policy instrument.

Eligibility criteria

- Many states have lax eligibility criteria for minimum parcel size or gross farm income → unintended consequence of lowering the costs for rural residential, hobby farms, and ranchettes

Low penalties

- Low penalties for early withdrawal lower the costs for land speculators to hold land for development

- Contract periods are often short, allowing land speculators to hold land only in the short run

Land conservation in 1990-2010

Table 1. Comparison of Government and Land Trust Holdings

	1990 Acres	2010 Acres	Change 1990–2010	% Change 1990–2010
Four federal land agencies:				
Bureau of Land Management	168,223,327	171,186,890	2,963,563	1.76
US Forest Service	165,790,139	167,598,134	1,807,995	1.09
US Park Service	20,179,876	24,380,375	4,200,499	20.82
US Fish and Wildlife Service	4,697,914	4,882,153	184,239	3.92
Federal programs:				
Conservation reserve	32,522,280	31,298,245	−1,224,035	−3.76
Wetland reserve	0	2,311,702	2,311,702	NA
State parks:*	7,895,296	10,526,759	2,631,463	33.33
Land trusts:				
Outright ownership	2,165,041	7,681,198	5,516,157	254.8
Conservation easements	793,137	13,392,500	12,599,363	1588.6

Source: Parker and Thurman (2019)

Purchase of development rights programs

Land trusts

- Tax incentives for donating conservation easements have dramatically increased the amount of protected land

- Programs often report success based primarily on number of acres protected

Challenges

- Tax incentives often target parcels with highest tax deductions, instead of those with highest benefit-cost ratios (Parker and Thurman, 2019)

- Land trusts can be more selective but often want to protect as much of land as possible
  - Taxpayers (not land trusts) are those affected by foregone taxes from donated easements

Transfer of development rights programs

Successful TDR programs are rare

- About 191 TDR programs in US (Pruetz and Standridge 2008)
  - Most have limited or no trading

- Only 350,000 acres preserved nationwide
  - Largest five TDR programs account for three-quarters of acreage

Challenges

- Lack of demand in receiving areas is often most critical (Walls and McConnell 2007)
  - Optimal density has to be constrained under current baseline zoning in receive areas

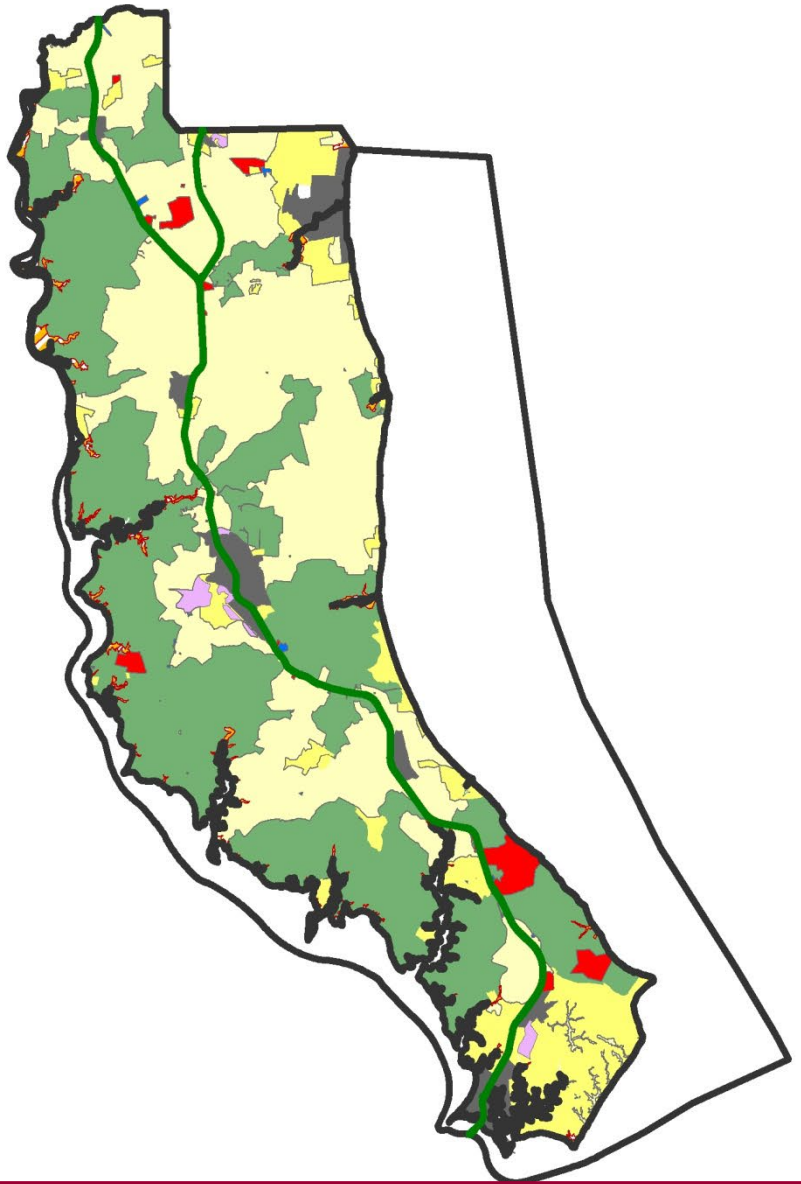
- Receiving areas
  - Exurban areas are often more successful receiving areas than urban areas

TDR program in Calvert County

Flexibility with both urban and rural receiving areas

- Majority of TDR use in rural receiving area

- Rural receiving areas
  - Initial program had baseline zoned density at 1 unit per 5 acres
  - Allowable density with TDRs at 1 unit per 2 acres



Future directions: Reframing urban-rural planning

Urban region

- Planned and existing sewer infrastructure
  - Growth management for urban/suburban areas

Rural preservation region

- Designated priority preservation areas outside planned sewer service areas
  - Contiguous prime farmland, forests and wetlands
- Synergistic land use policies
  - Rural zoning (1 housing unit per 20+ acres)
  - Conservation easements
  - Use value assessments (with stricter eligibility requirements)

Rural residential region

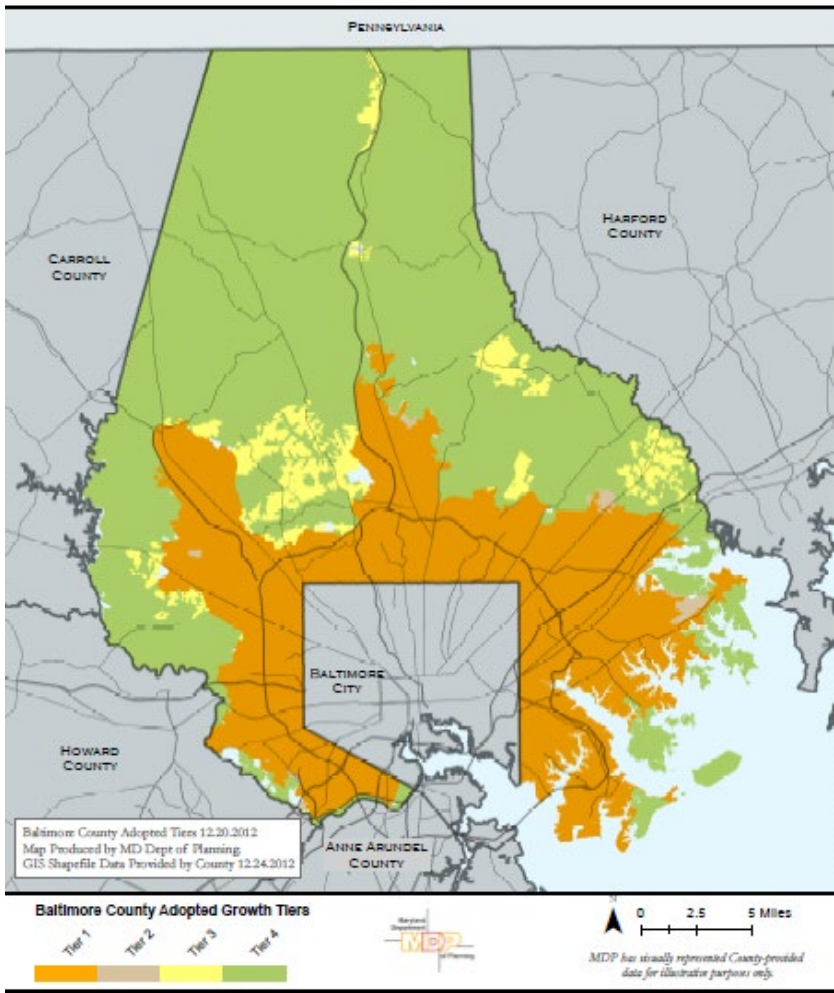
- Exurban "sacrifice" zones
  - Rural residential properties in exurban area

Septic Law in Maryland

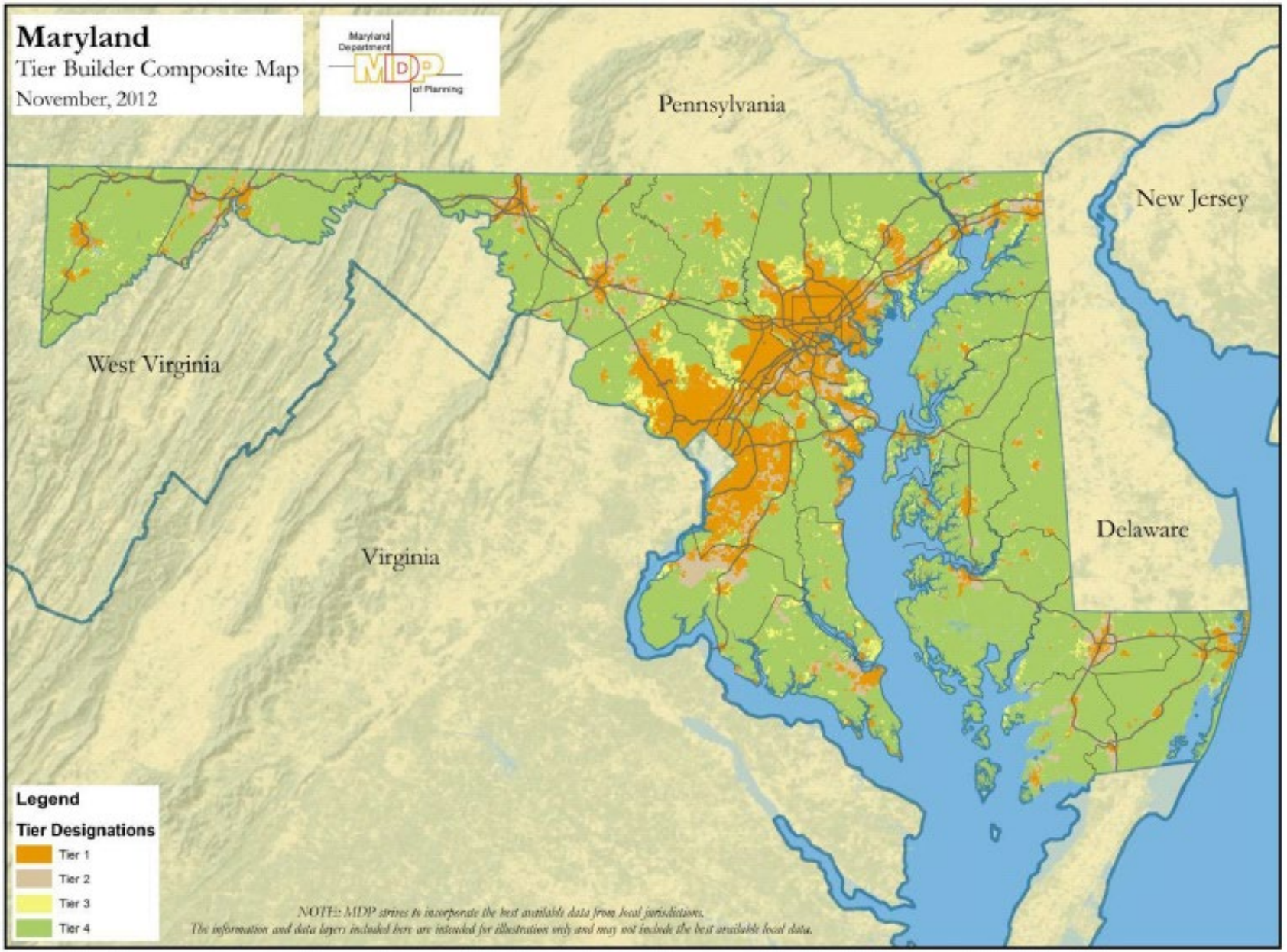
Sustainability Growth and Agricultural Preservation Act ("septic bill") passed by State of Maryland in 2012

Purpose: Restrict major subdivisions on septic systems in resource areas dominated by agricultural and forest lands (Tier 4)

- **Tier 1 and Tier 2** = Inside URDL (existing and planned sewer)
- **Tier 3** = Major subdivisions on septic allowed
- **Tier 4** = No major subdivisions allowed on septic
  - Only minor subdivision with 3 lots are allowed



MD Planning Proposed Tier Maps



Septic Law Tier Map

- **Tier 1 and Tier 2** = Inside URDL (existing and planned sewer)
- **Tier 3** = Major subdivisions on septic allowed
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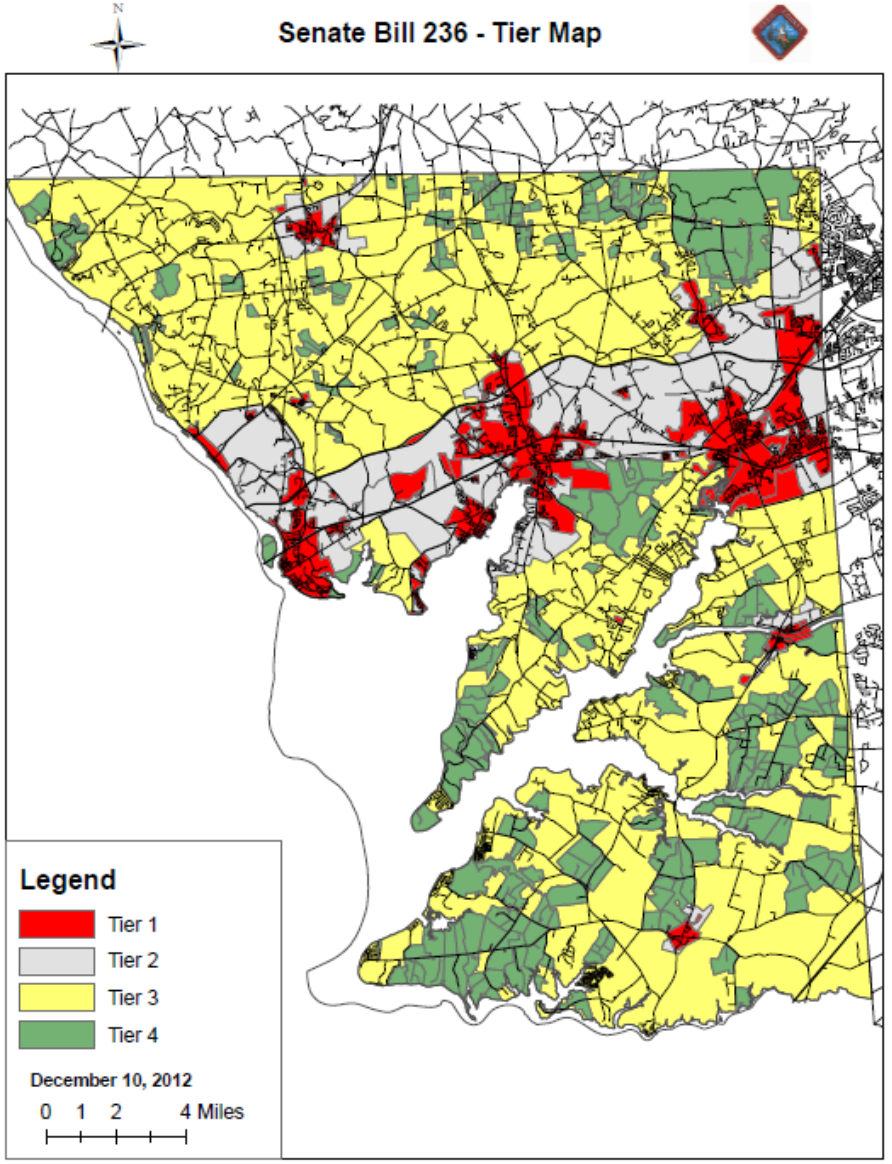
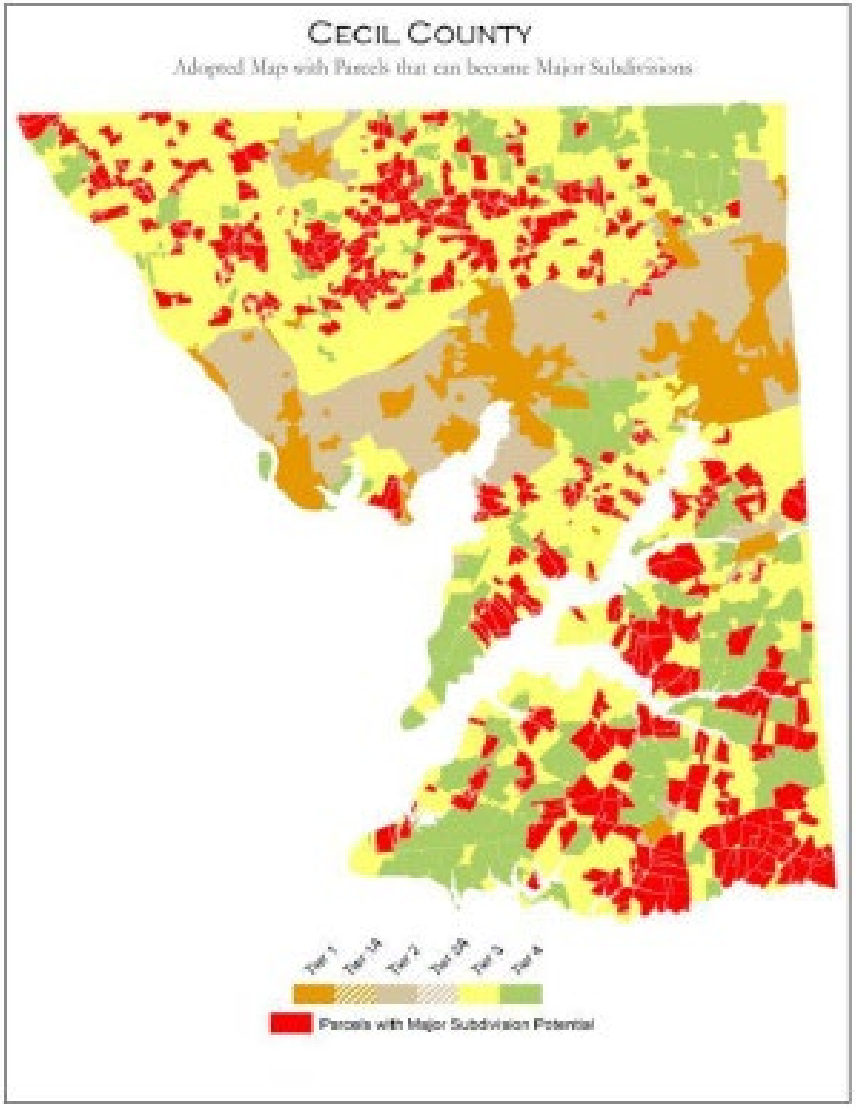
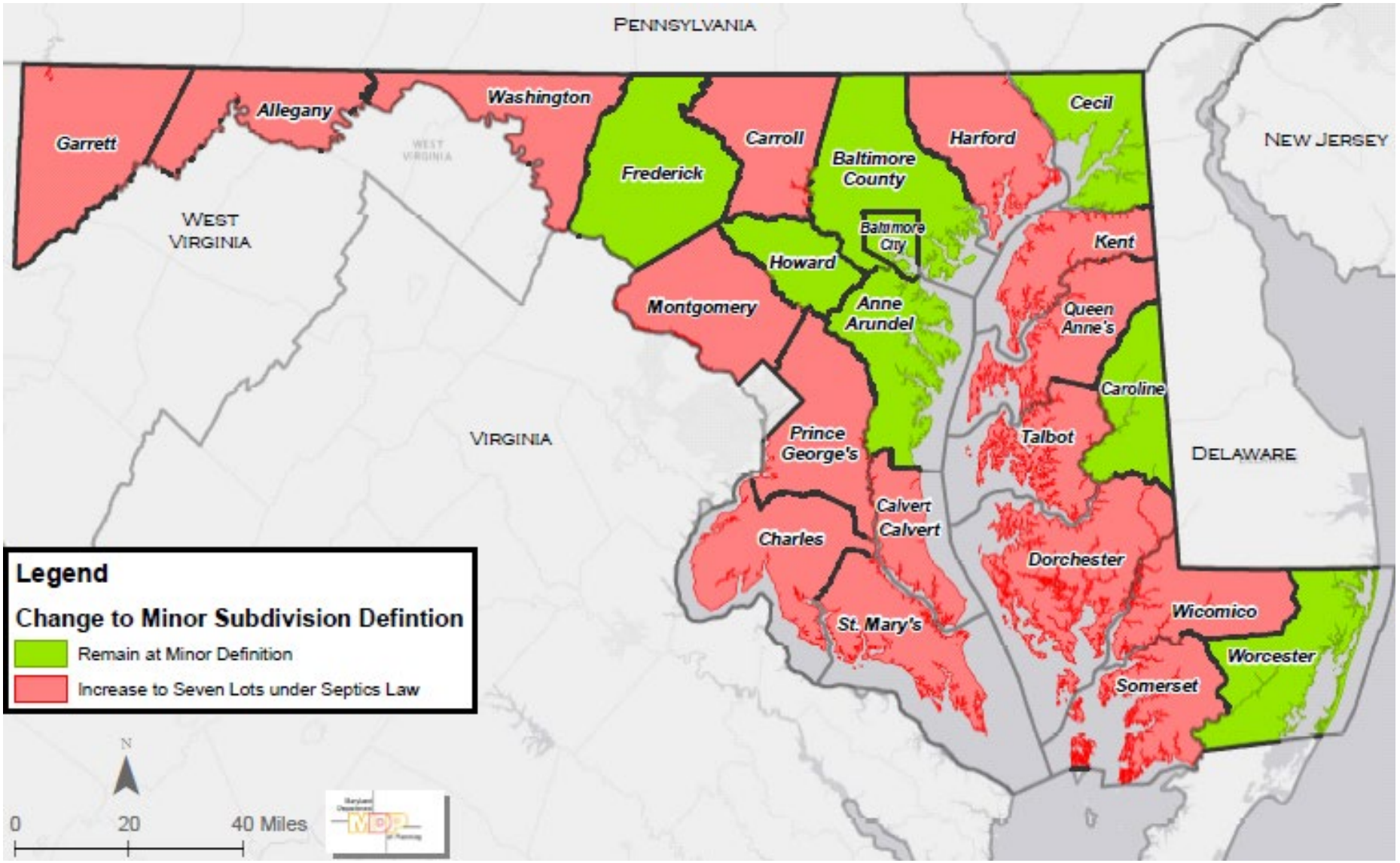


Zoned capacity for major subdivisions in Tier 3 on septic



Change to Minor Subdivision Definition



Zoned capacity (ZC)

Septic law has main impacts in rural residential zoning

$$\textbf{Zoned Capacity} = \frac{\textbf{Parcel area}}{\textbf{Minimum lot zoning}}$$

Example #1: 200-acre parcel in rural residential zoning (5-acre min lot zoning).

$$ZC = \frac{200}{5} = 40 \text{ lots remaining}$$

Septic law impact on ZC = 40 – 7 = 33 lot reduction

Assumes minor subdivision allows 7 lots built in Tier 4.

Zoned capacity (ZC)

Minor exemption reduces septic law impacts in agricultural zoning

$$\textbf{Zoned Capacity} = \frac{\textbf{Parcel area}}{\textbf{Minimum lot zoning}}$$

Example #1: 200-acre parcel in agricultural zoning (20-acre min lot zoning).

$ZC = \frac{200}{20}$ = 10 lots remaining

Septic law impact on ZC = 10 - 7 = 3 lot reduction

Assumes minor subdivision allows 7 lots built in Tier 4.

Redefinition of minor (7 lots allowed)

Zoned capacity

		Farmland parcel acreage			
Zoning	**Min lot zoning**	**50**	**100**	**200**	**300**
RR5	**5**	10	20	40	60
AG20	**20**	2	5	10	15
AG50	**50**	1	2	4	6

Septic law impact (Lot reduction assuming 7 lot minor allowed in Tier 4)

		Farmland parcel acreage			
Zoning	**Min lot zoning**	**50**	**100**	**200**	**300**
RR5	**5**	3	13	33	53
AG20	**20**	0	0	3	8
AG50	**50**	0	0	0	0

Main issues on septic law

Designation on Tier 3 versus Tier 4 areas

MD Dept of Planning proposed Tier 4 as Rural Legacy areas, priority preservation areas, and forest/agricultural dominated areas.

Tier 3 adopted in majority of rural area in some counties (e.g. Cecil County)

Redefinition of minor subdivision (Increased to 7 lots)

Will there be clustered development?

Example: 140 acre parcel with 7 lots allowed in minor subdivision

Without clustering: 7 lots at 20 acre each (increase farmland loss)

With clustering: 6 lots at 1 acre each + 134 acre farm

Regulatory delay and development

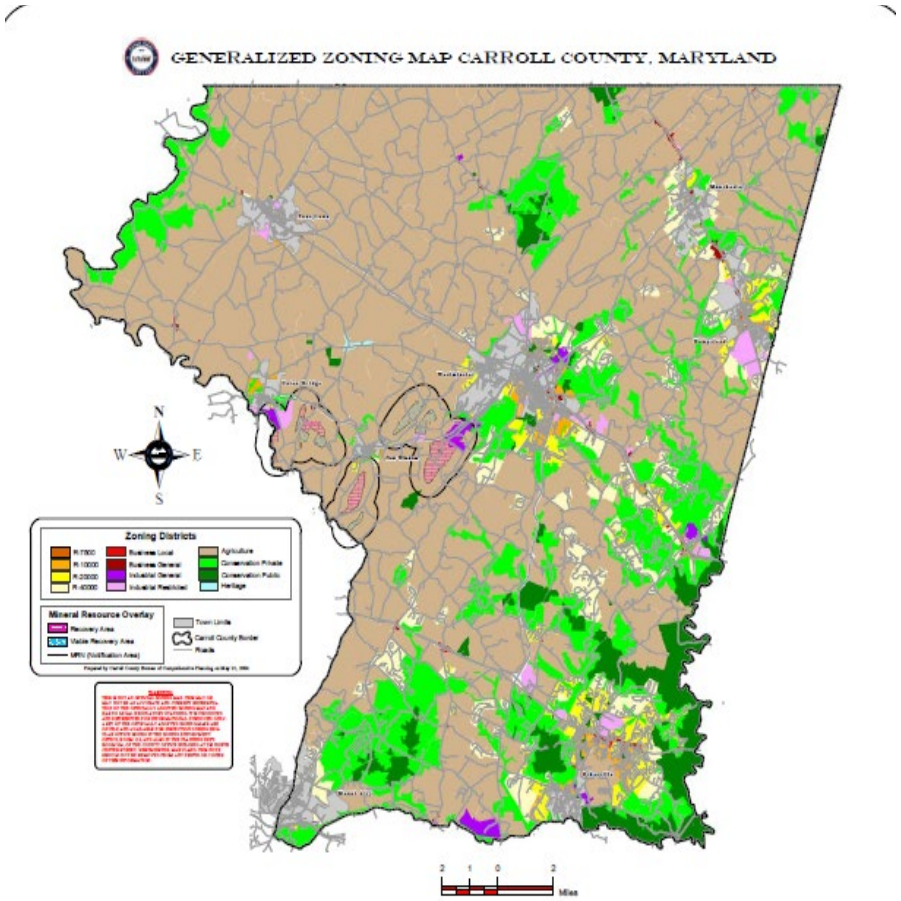
- **Research questions**
  - How does regulatory delay on subdivision approval times affect the probability and density of development?
  - Do spatial differences in approval times induce exurban leapfrog development?

- **Study approach**
  - Parcel subdivisions and approval times in Carroll County
    - Major subdivisions have longer average approval times than minor subdivisions
  - Analysis
    - Subdivision development or remain developable in 1995-2007
    - Explanatory variables: Expected approval time, zoning, accessibility, land quality

Times (Months)	Mean	25th	Med.	75th	N
Major Developments	15.34	7	12	20	118
Minor Developments	5.95	2	4	6.5	244

Regulatory delay and development

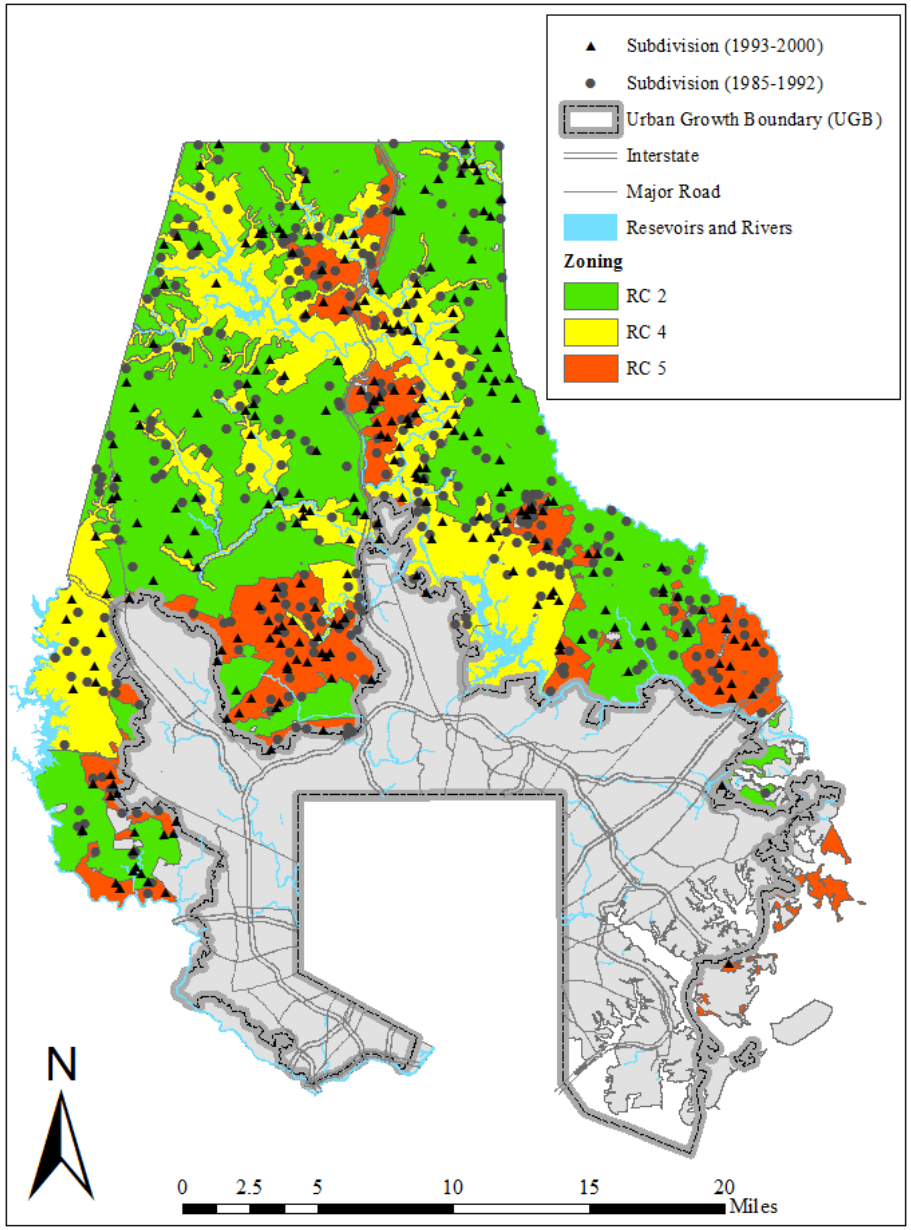
- **Spatial differences in regulatory delays**
  - Longer delays for major subdivisions
    - Reduces size and likelihood of larger development projects
    - Majors are common inside PFAs on sewer
  - Shorter approval times for minor subdivisions
    - Minors are common in agricultural zoning on septic systems
- **Policy implication**
  - Decreasing approval times for large infill projects may reduce exurban leapfrog development



Forest Conservation Act (FCA) and development

- **Research question**
  - How did the 1993 Forest Conservation Act (FCA) in Maryland affect residential development and forest cover change decisions?
- **Study area and data**
  - Rural area in Baltimore County (Outside UGB)
  - Parcel-level residential development from tax assessment records
  - Forest cover data in 1984-2004 from North American Forest Dynamics Project
- **Policy analysis**
  - Forest cover change
  - Subdivisions before FCA (1985-1992) and after FCA (1993-2000)

Residential subdivisions in 1985-2000



Forest Conservation Act (FCA) in Maryland

- FCA is a statewide law in Maryland and implemented by county and local governments starting in 1993

- Purpose: Set afforestation and conservation requirements to reduce forest loss and encourage tree planting on subdivisions

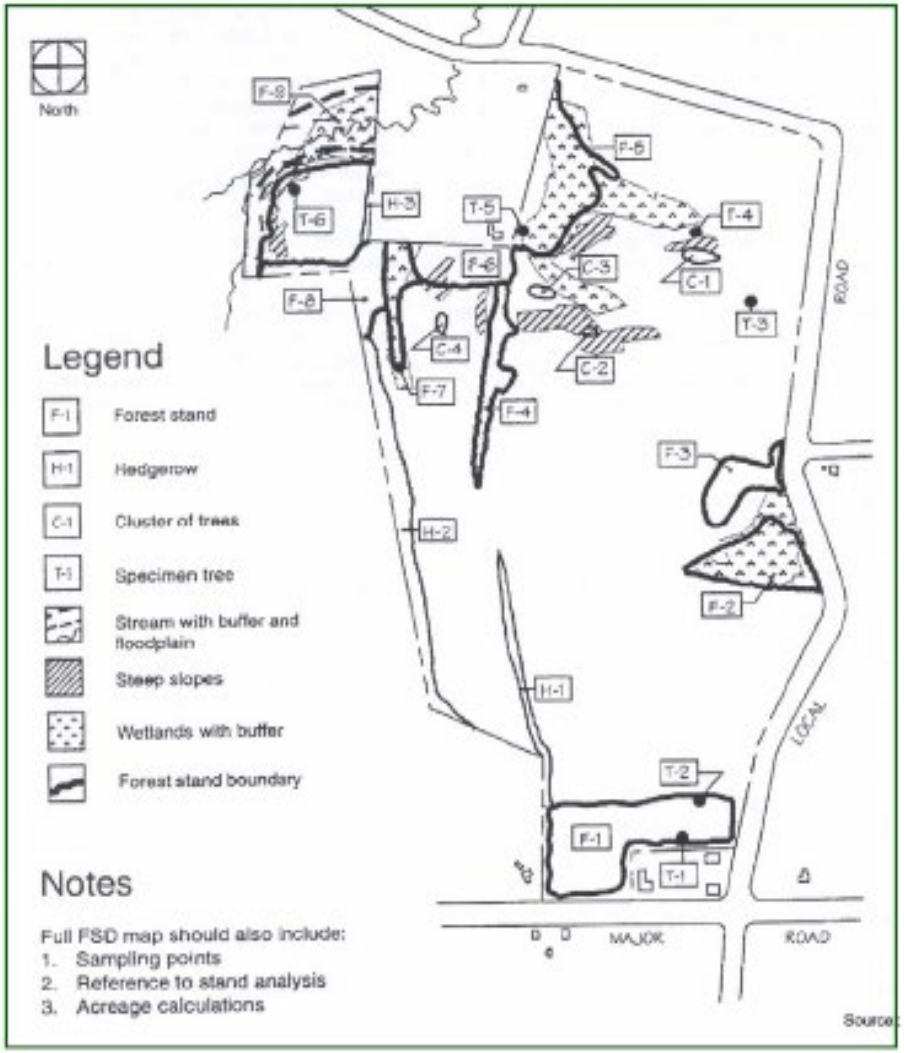
- Priority areas for forest protection and restoration
  - Riparian buffers, 100-year floodplains, wetlands, steep slopes, erodible soils

Afforestation and conservation thresholds

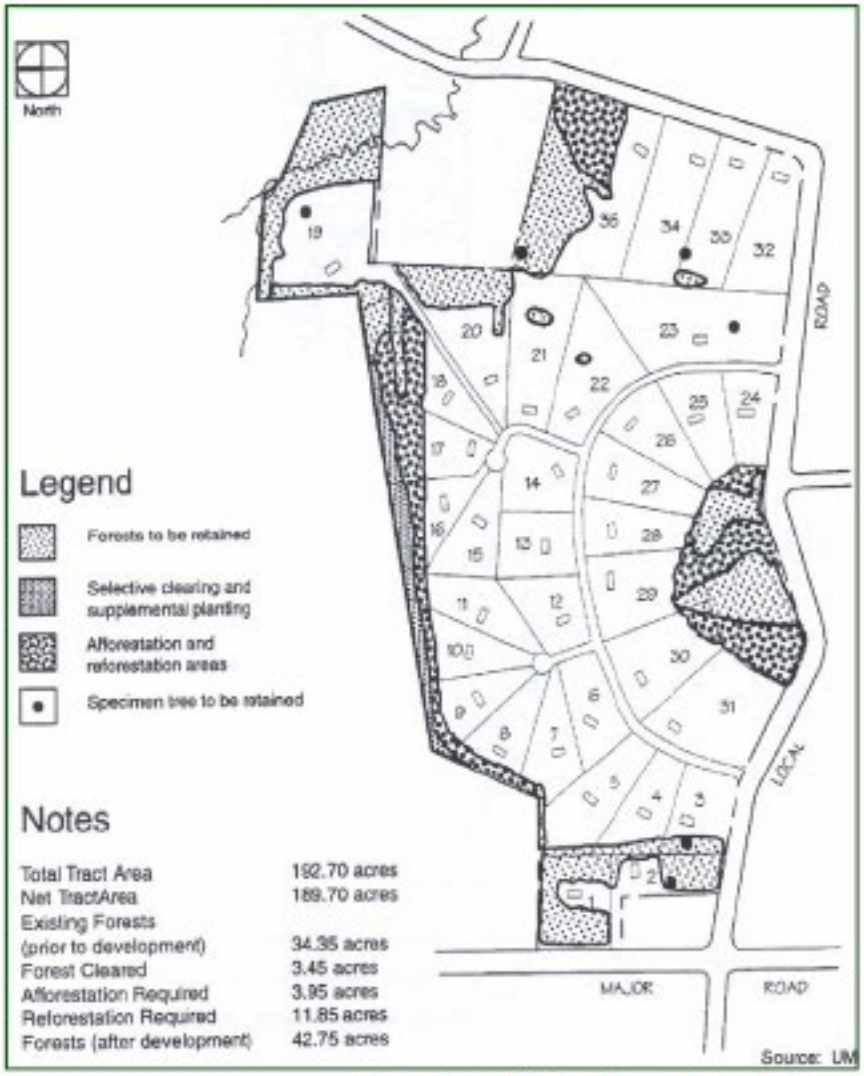
- **Afforestation**
  - Afforestation threshold at 20% forest cover for all parcels
  - Example: Parcels with <20% existing forest cover must plant trees up to the afforestation threshold even if no trees cleared during development

- **Conservation**
  - Conservation threshold at 50% forest cover for agricultural and resource areas (RC2 & RC4 zoning) and 25% forest cover for medium residential areas (RC5 zoning)
  - Example: Parcel in agricultural or resource areas that clears forest below the conservation threshold must replace forest at double the amount

Forest Conservation Act



Forest stand delineation



Forest conservation plan

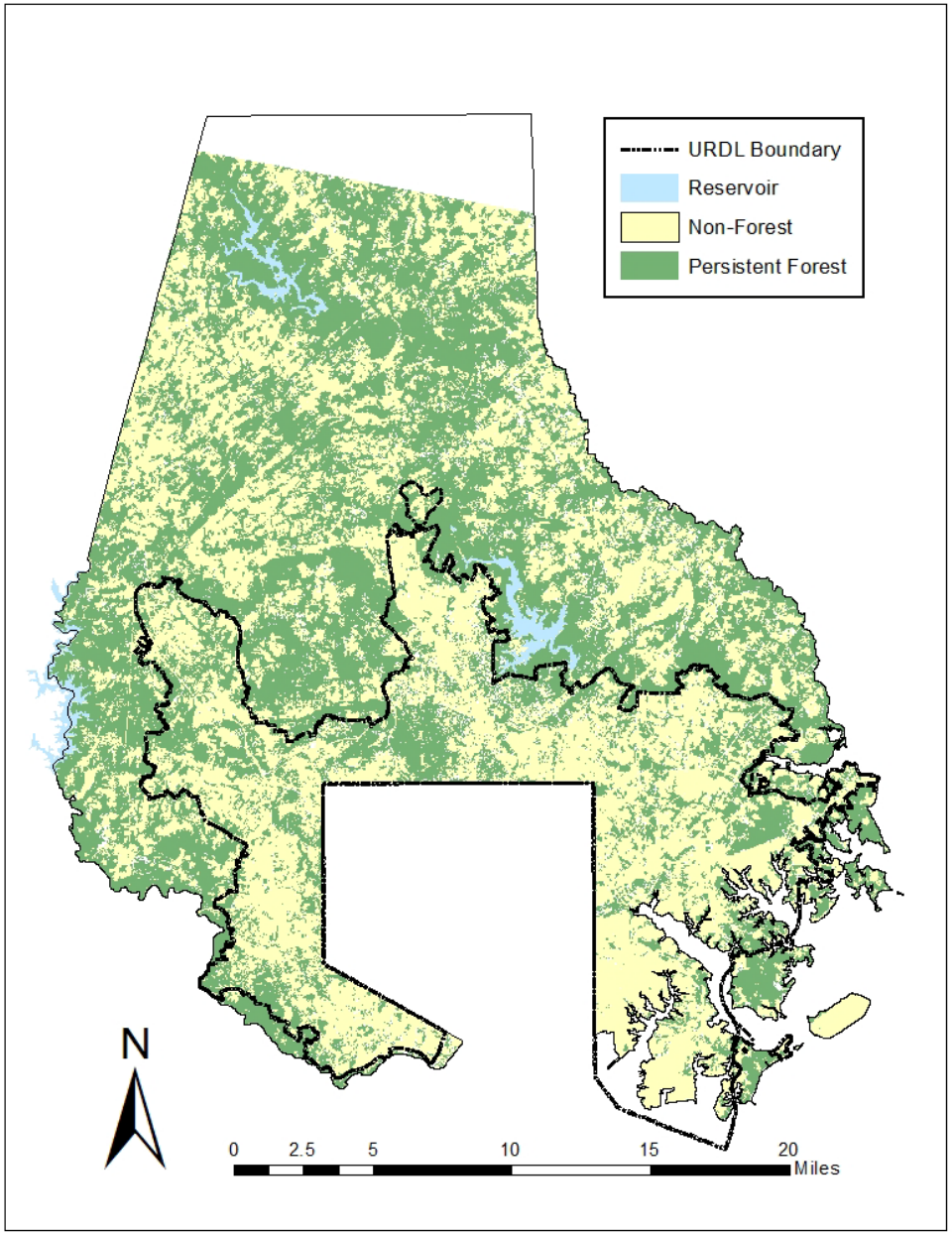
Forest Cover Data

- Forest cover data in 1984-2004 for Baltimore-DC corridor
  - NASA funded North American Forest Dynamics Project (Goward et al. 2012)
  - Forest classification based on Landsat imagery at 30 meter grid cells
  - Snapshot on forest cover for 12 time periods: 1984, 1986, 1987, 1988, 1990, 1991, 1994, 1996, 1998, 2000, 2002, 2004
  - Accounts for deforestation, reforestation and afforestation
- Existing forest cover
  - % existing forest cover calculated as forest area divided by total parcel area

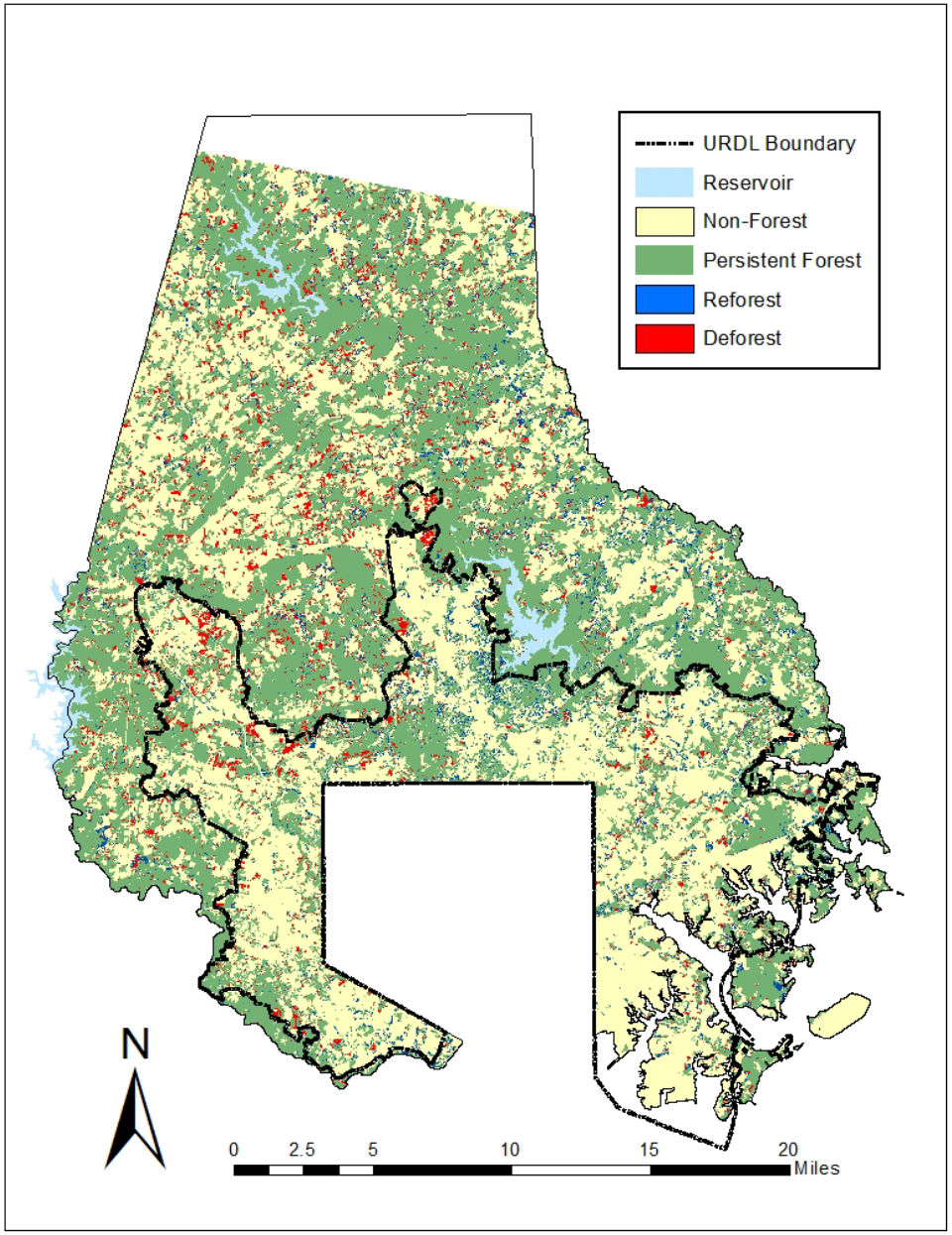
Forest Cover Change

- Forest cover change (dependent variable in second stage)
  - Difference in % forest cover after development and prior to development
  - Example: Subdivision event in 1989 would calculate difference for % forest cover in 1996 and % forest cover in 1988 prior to development

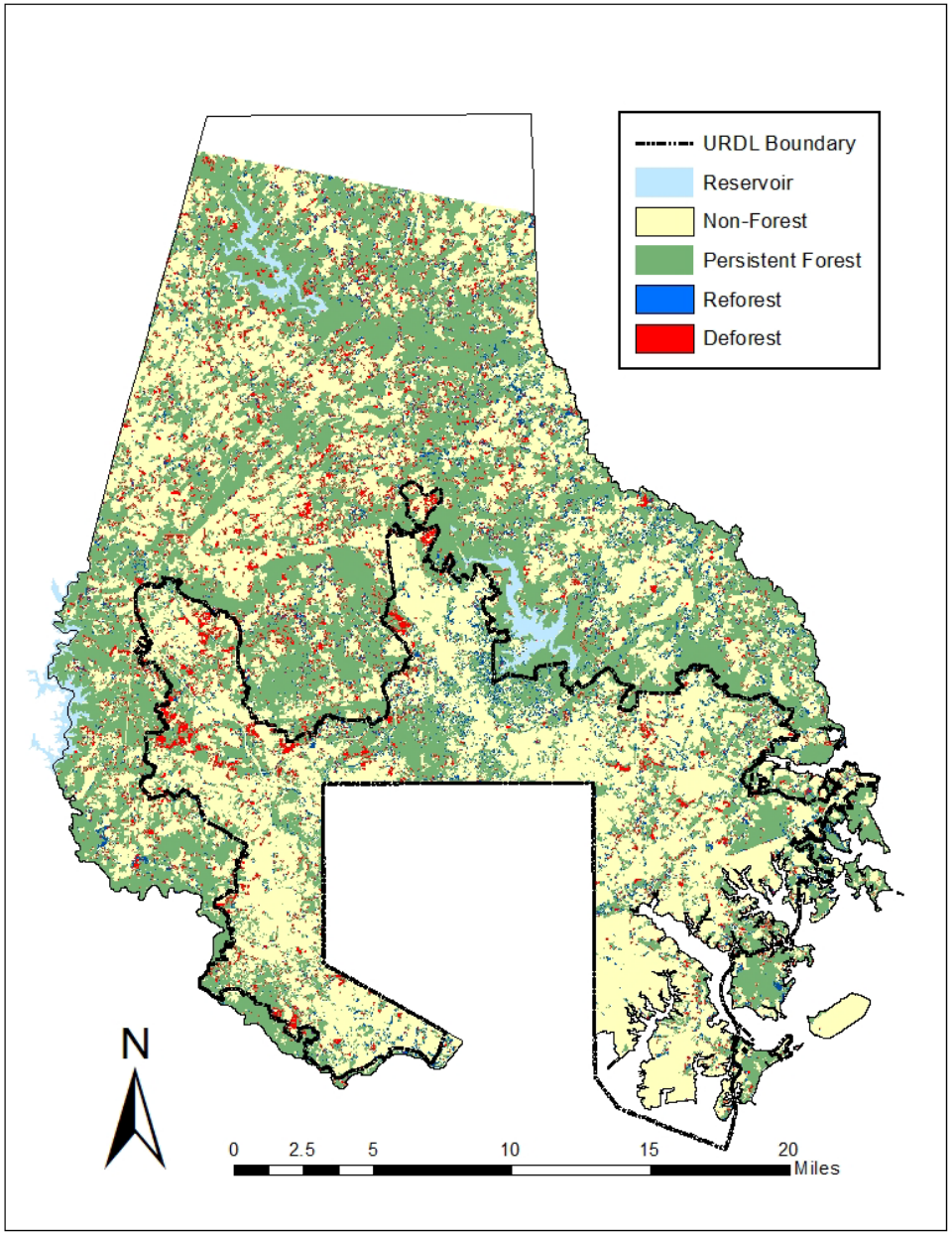
Forest Cover in 1984



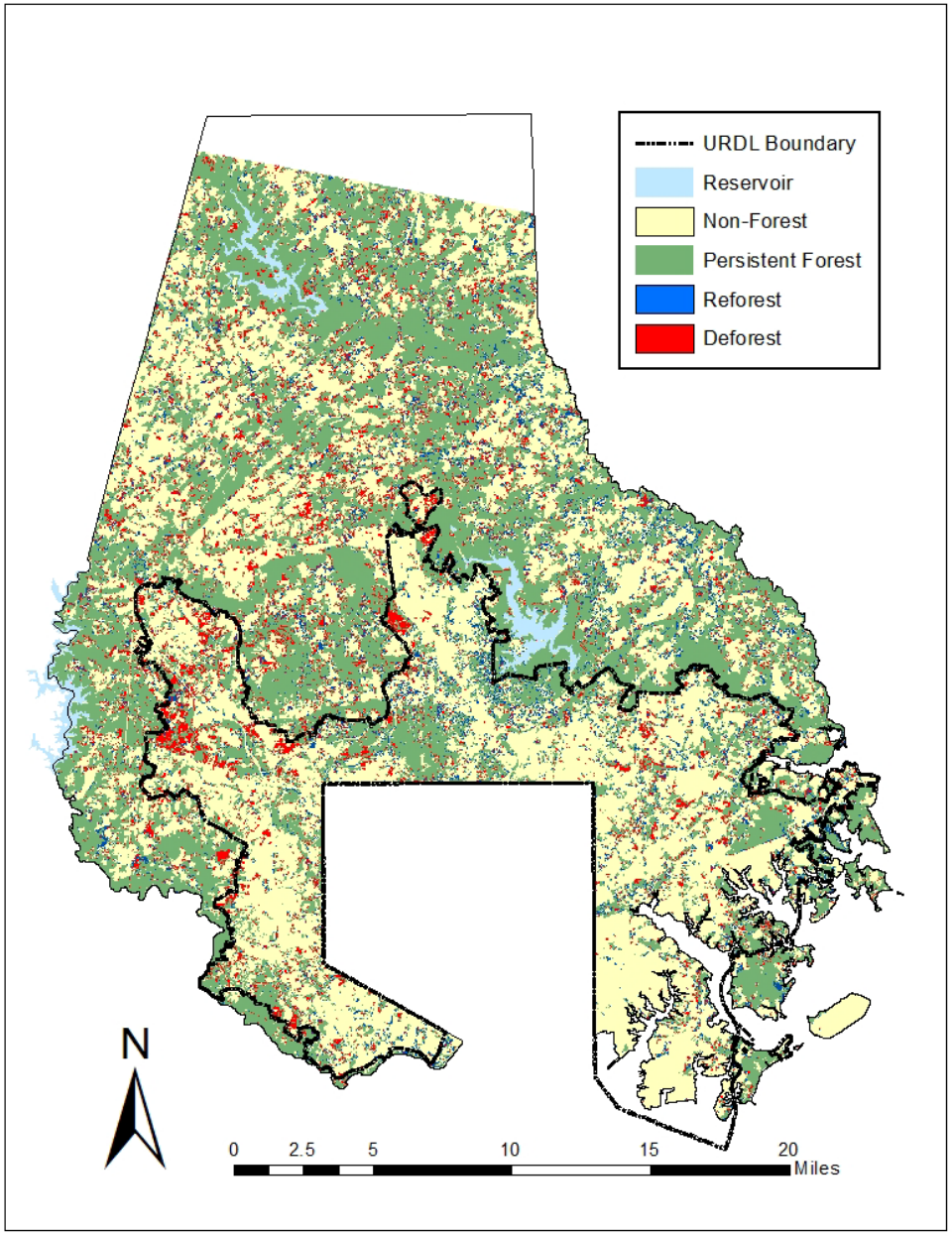
Forest Cover in 1990



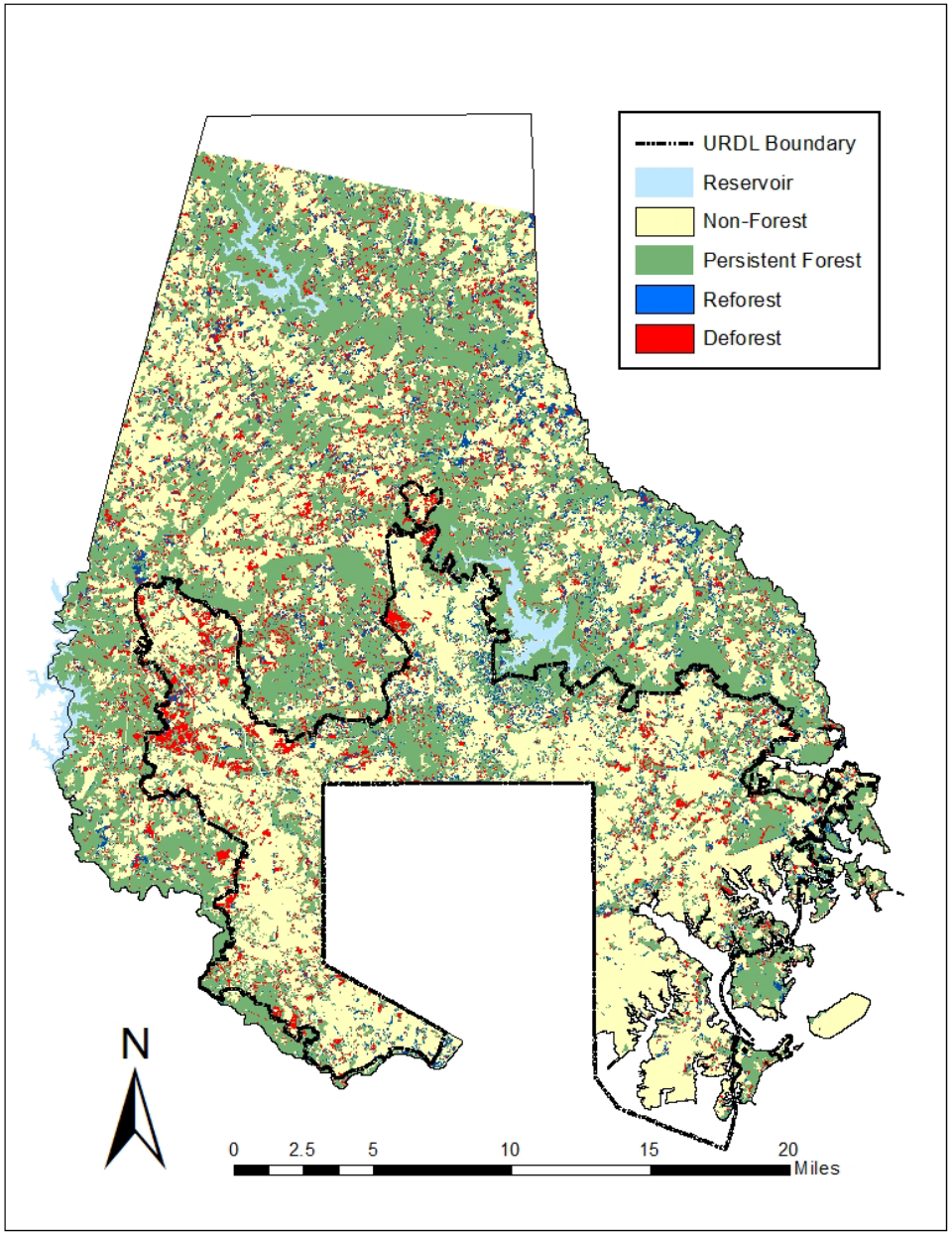
Forest Cover in 1995



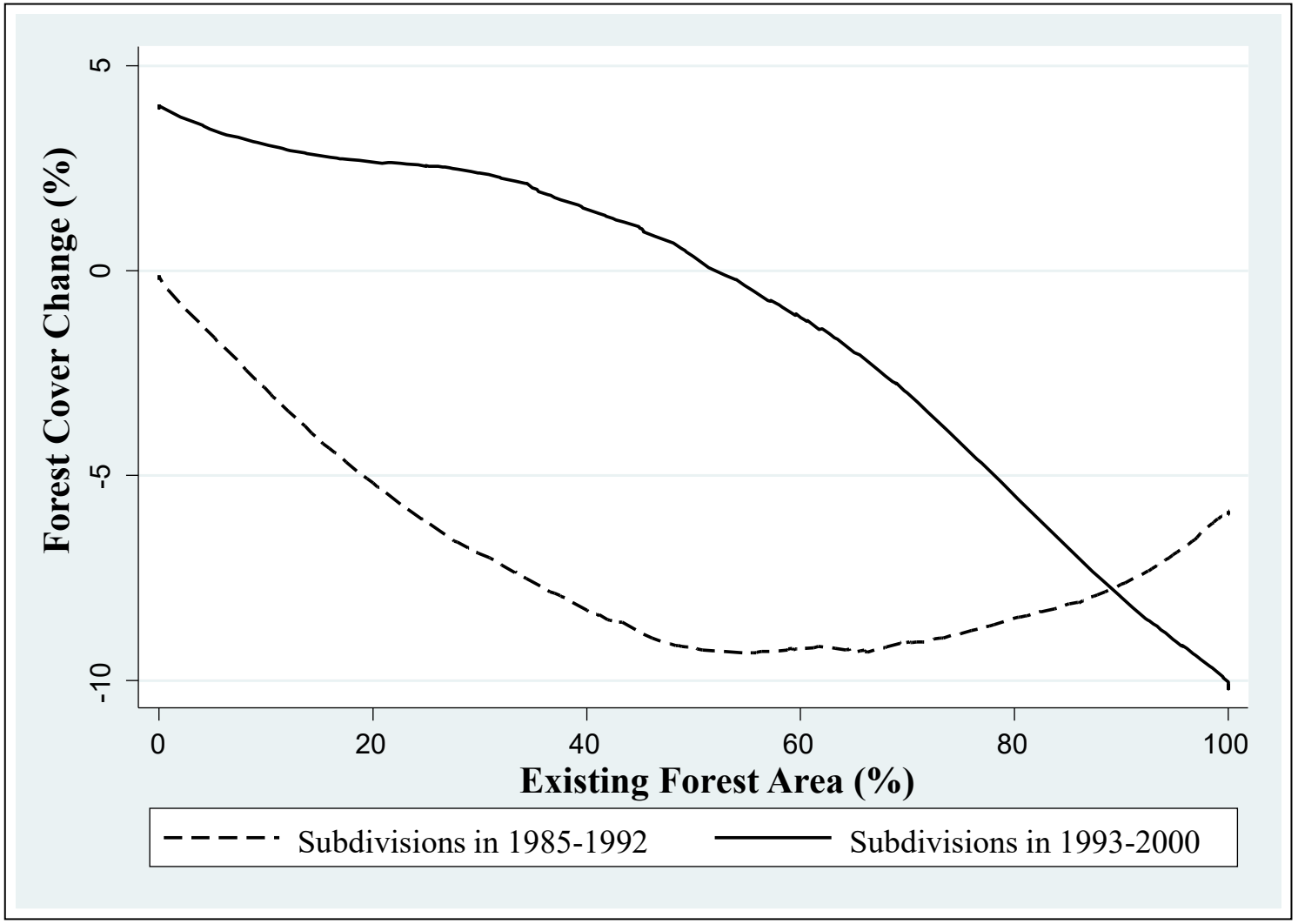
Forest Cover in 2000



Forest Cover in 2004



Forest cover change on subdivisions before (1985-1992) and after (1993-2000) FCA policy



Conclusions

- **Before FCA policy**
  - Loss in forest cover across the range of existing forest cover
  - Prior studies often implicitly assume residential development creates a complete loss in forest cover
- **After FCA policy**
  - Overall 22% increase in forest cover on residential subdivisions relative to the amount without the FCA policy
  - Parcels with 0-60% existing forest cover have increase in forest cover
  - Most intact habitat have continued forest fragmentation (parcels with 80-100% not affected by FCA policy)
- **Opportunities for synergy between FCA and land preservation programs**
  - Target funds from easement programs (or in lieu fees) to protect high priority forested areas with intact habitat

Thank you!

David Newburn
Dept of Agricultural and Resource Economics
University of Maryland
Email: dnewburn@umd.edu