

Modeling Residential Development in the Baltimore Metro Region

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Residential development in Baltimore County

Subdivision data in 1960-2008

Land use trends and zoning policies

Residential land-use change models in 1996-2007

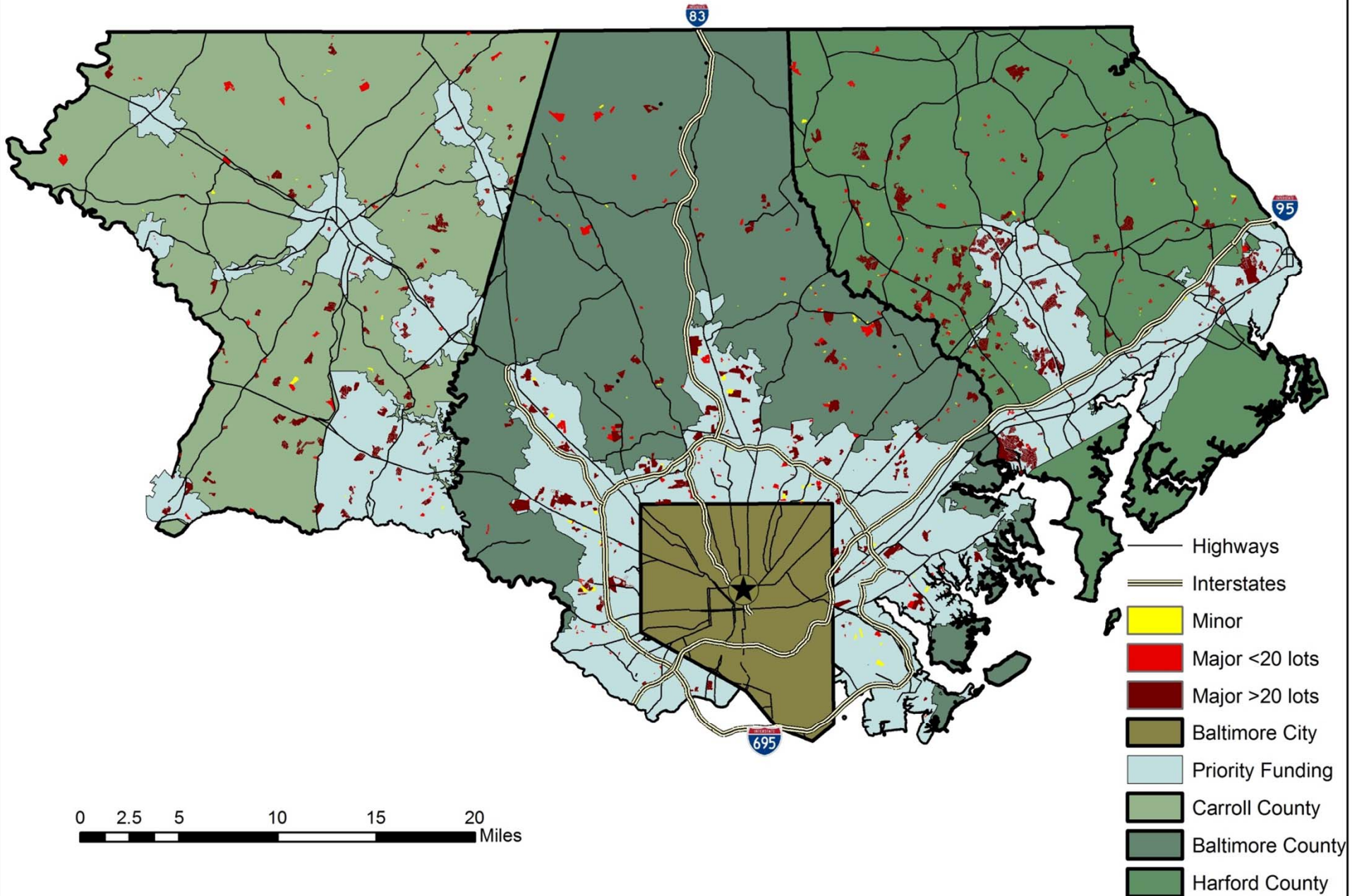
Excess zoned capacity and septic law in Maryland

- Business as usual (before septic law)
- After septic growth tiers adopted

Ongoing research in Baltimore Metro Region

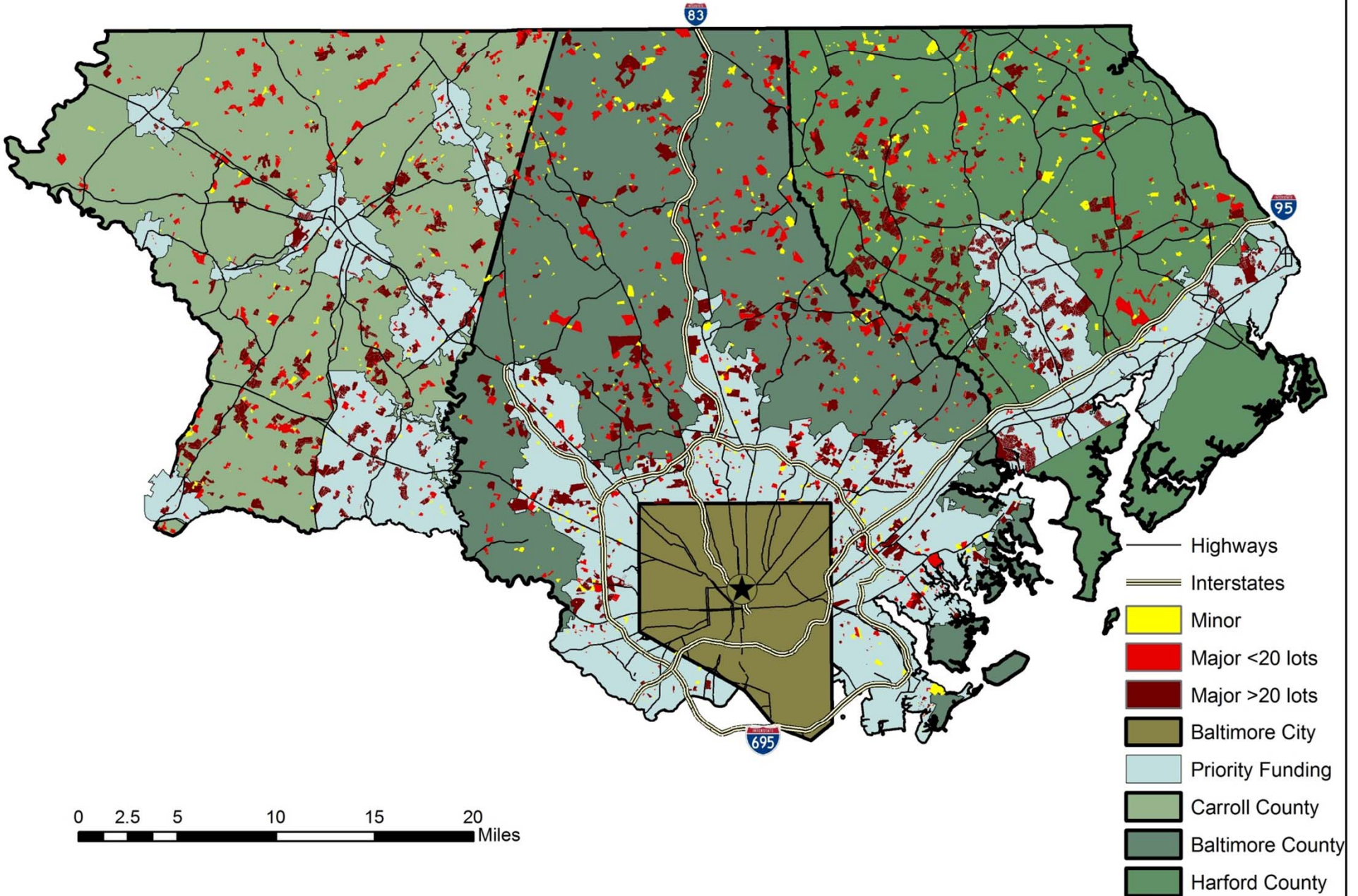


Carroll, Baltimore, and Harford County Subdivisions 1960-1969



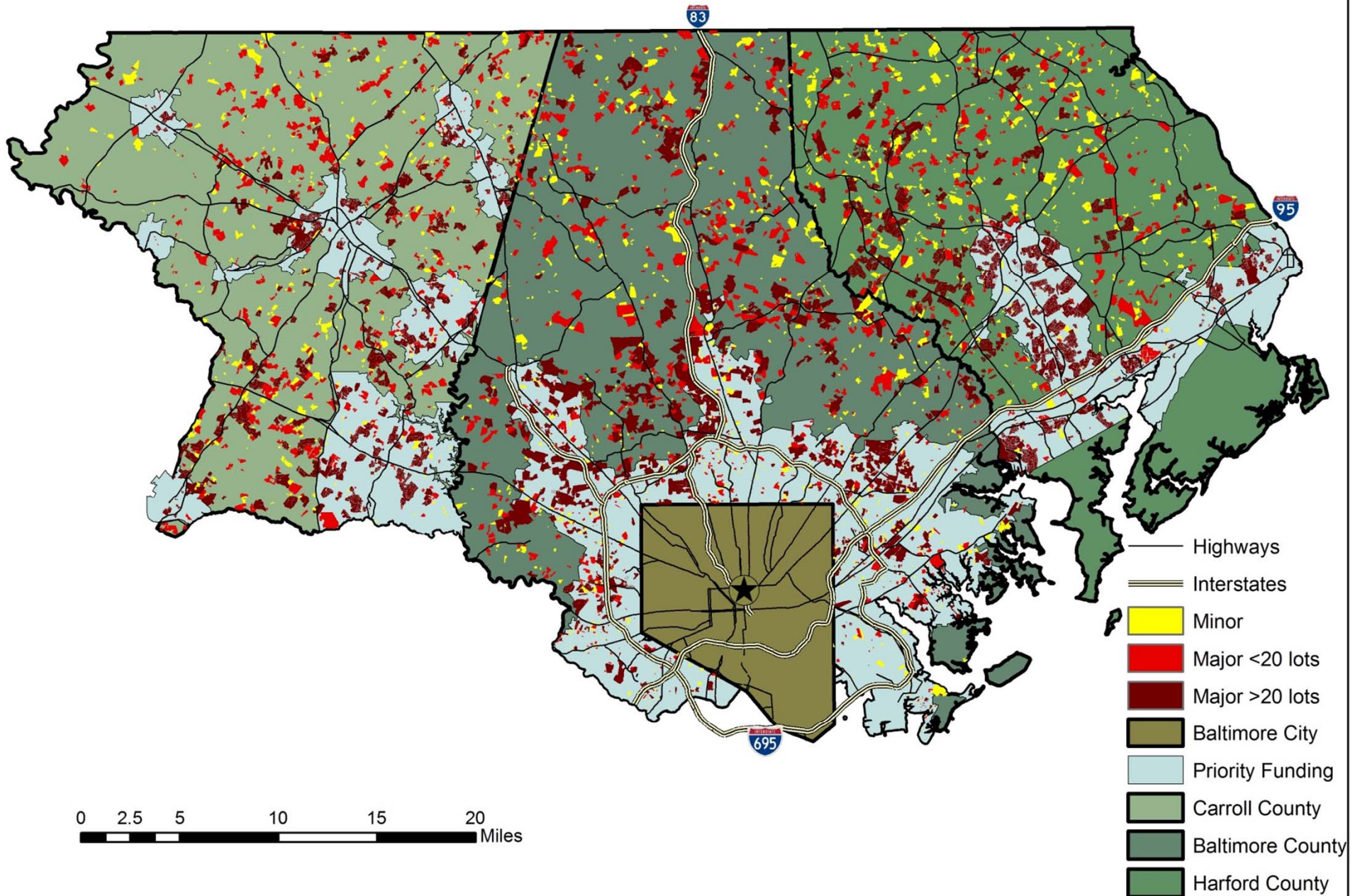


Carroll, Baltimore, and Harford County Subdivisions 1960-1979



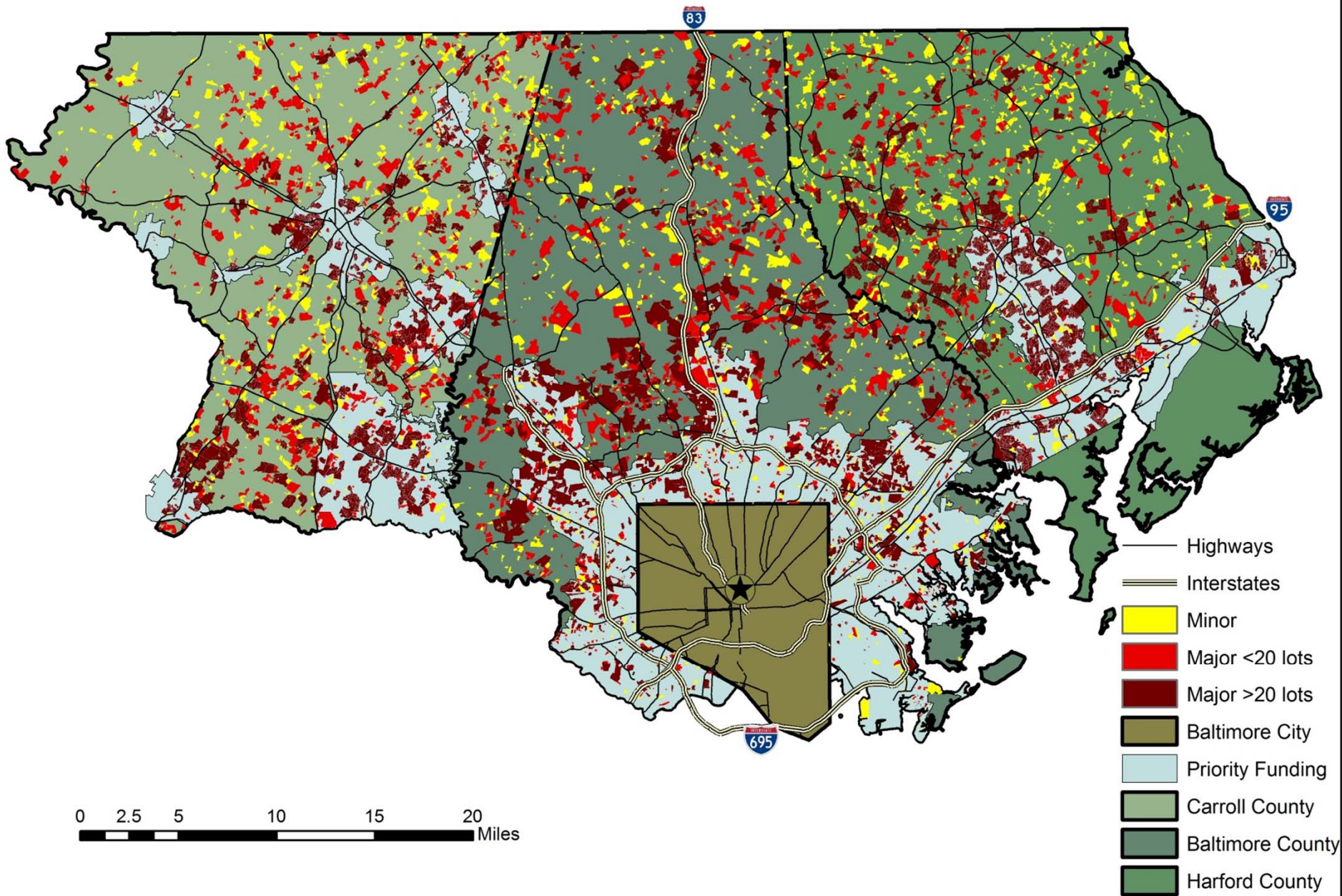


Carroll, Baltimore, and Harford County Subdivisions 1960-1989



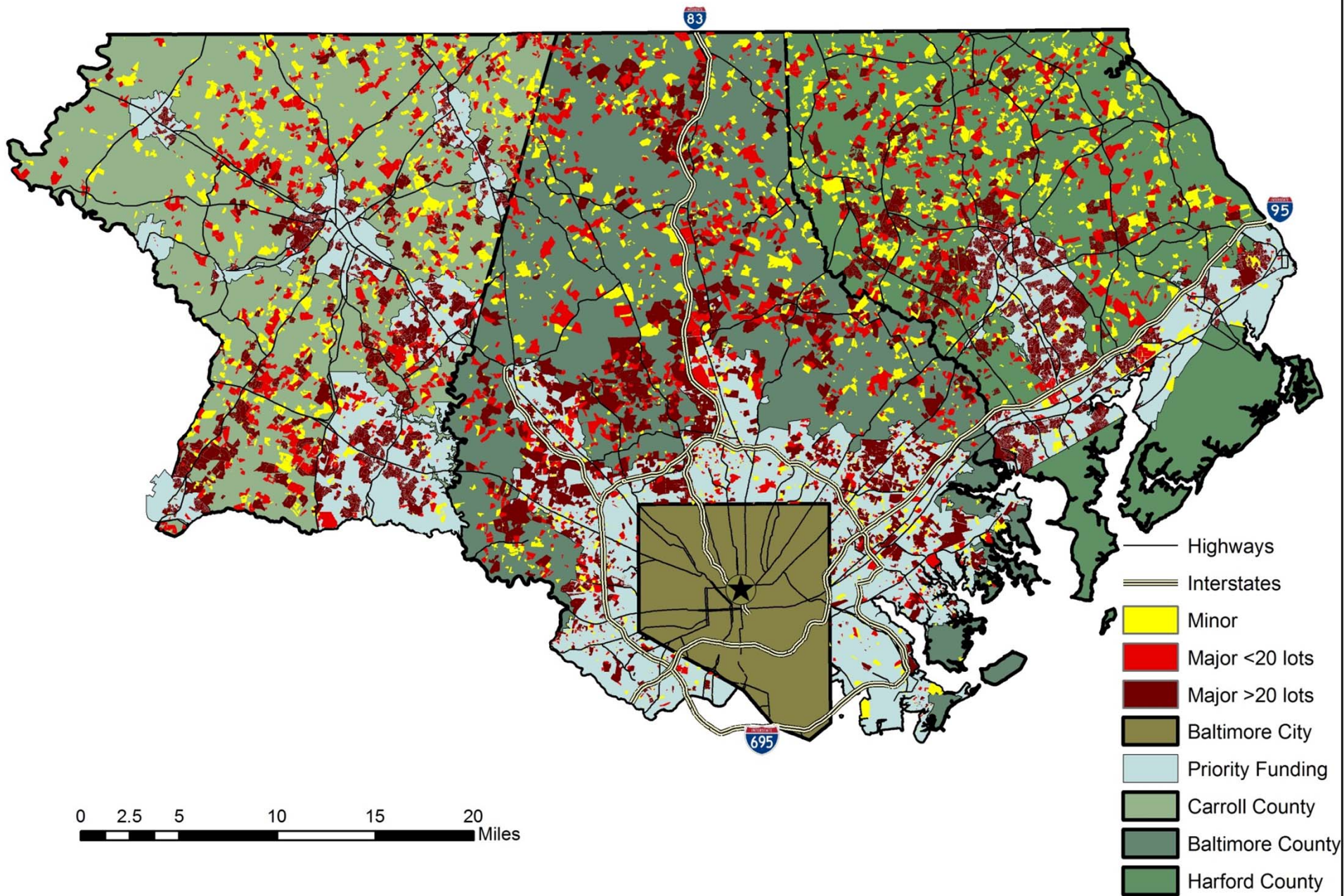
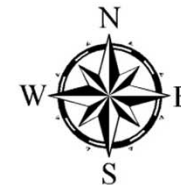


Carroll, Baltimore, and Harford County Subdivisions 1960-1999

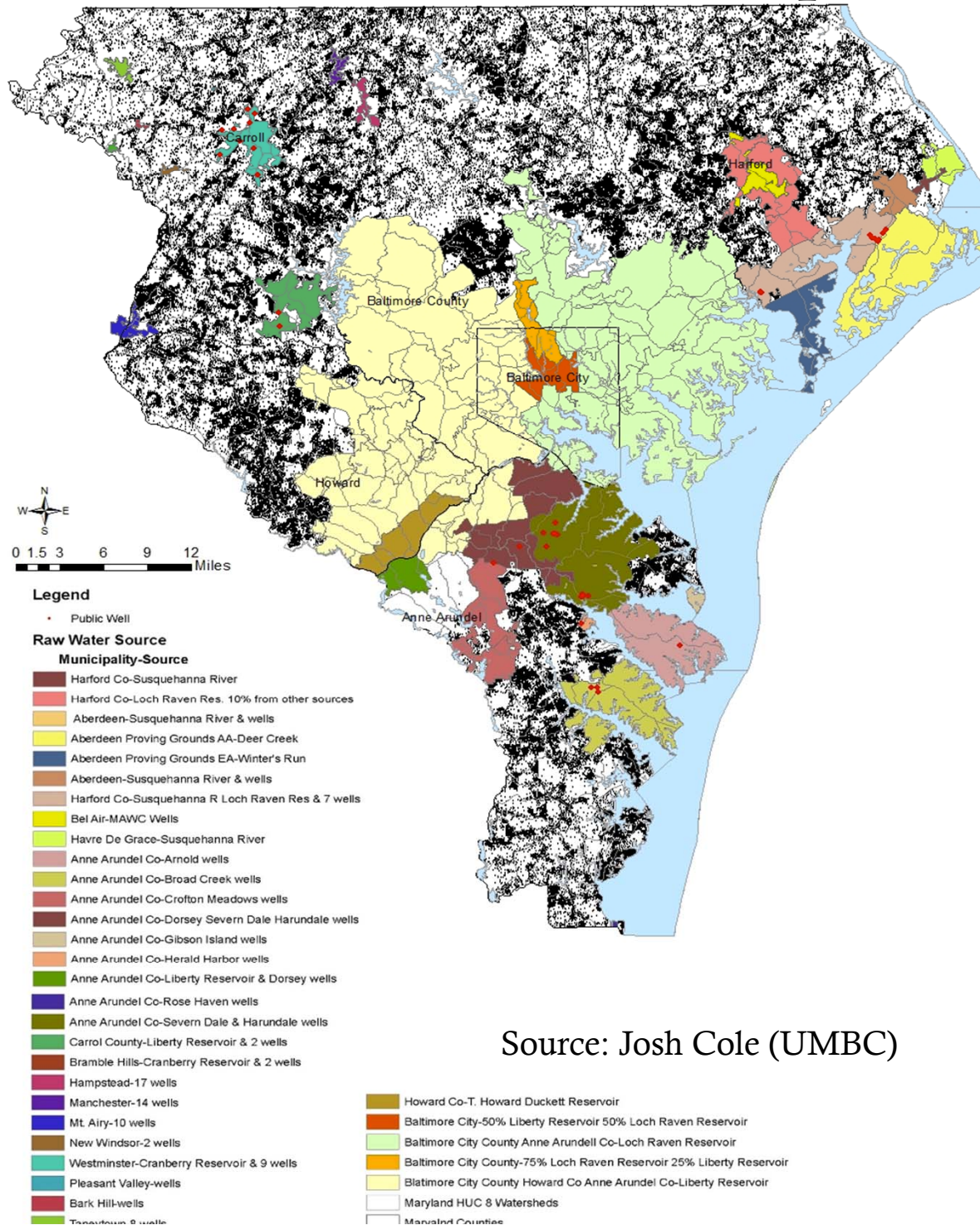




Carroll, Baltimore, and Harford County Subdivisions 1960-2007

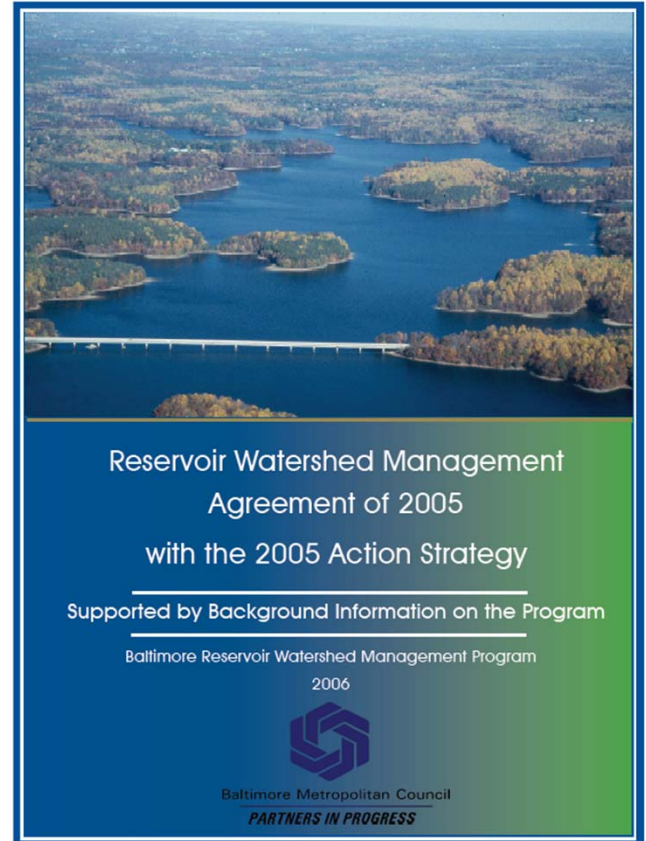
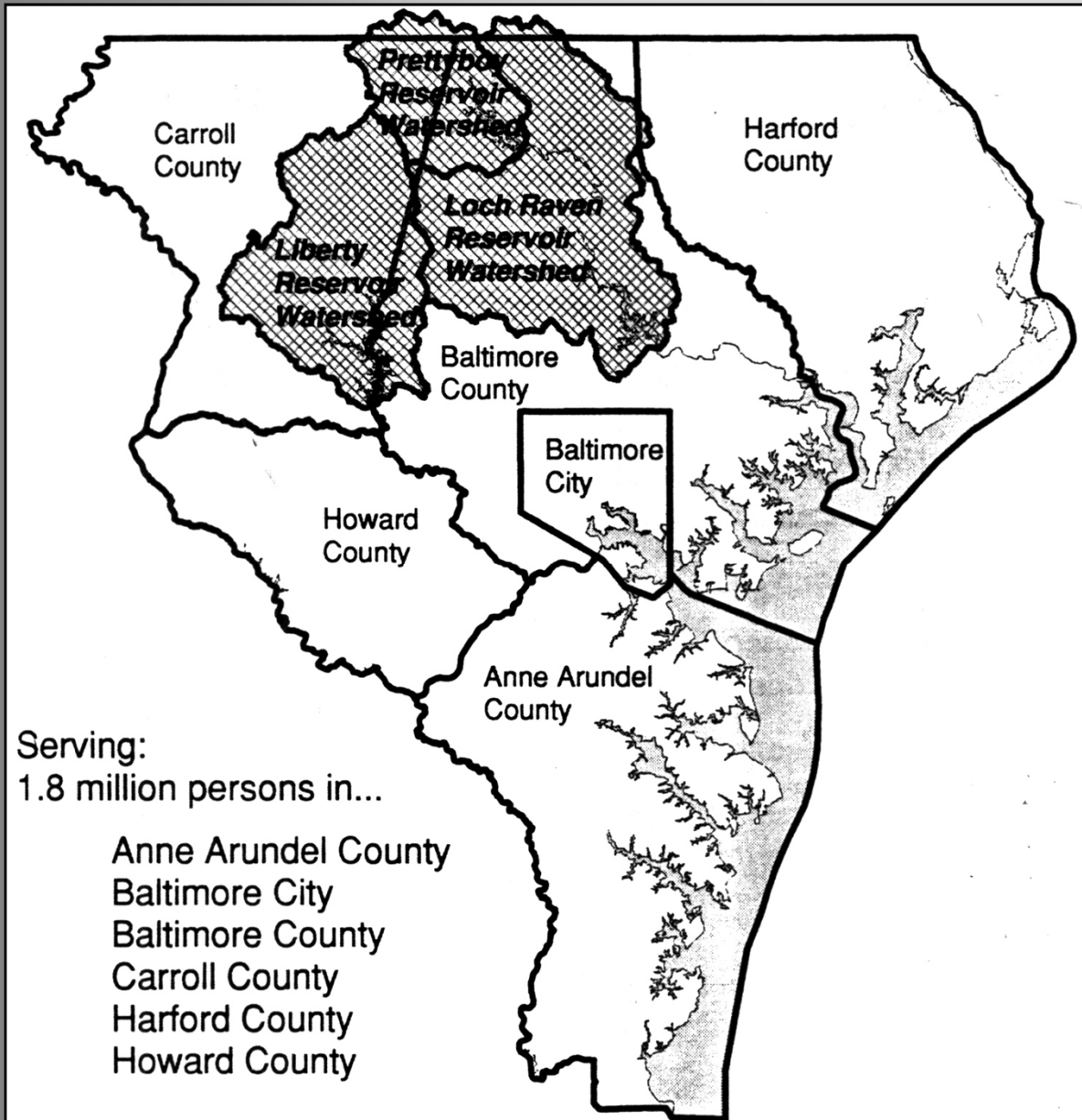


Groundwater wells and septic



Source: Josh Cole (UMBC)

Protecting Drinking Water Sources



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Baltimore County

- 63% of the region's 294 sq. mi. of reservoir watersheds
- 48% of the County

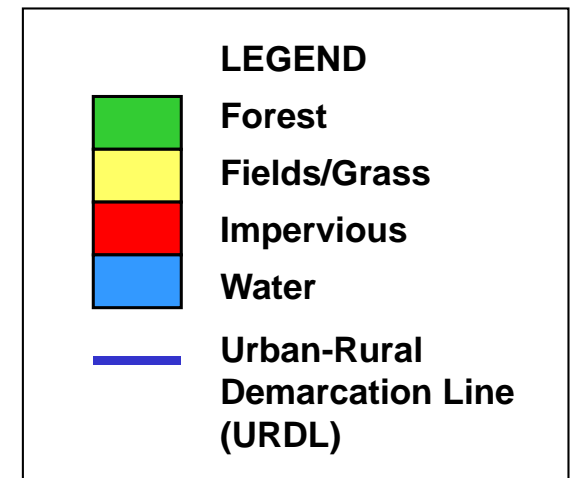
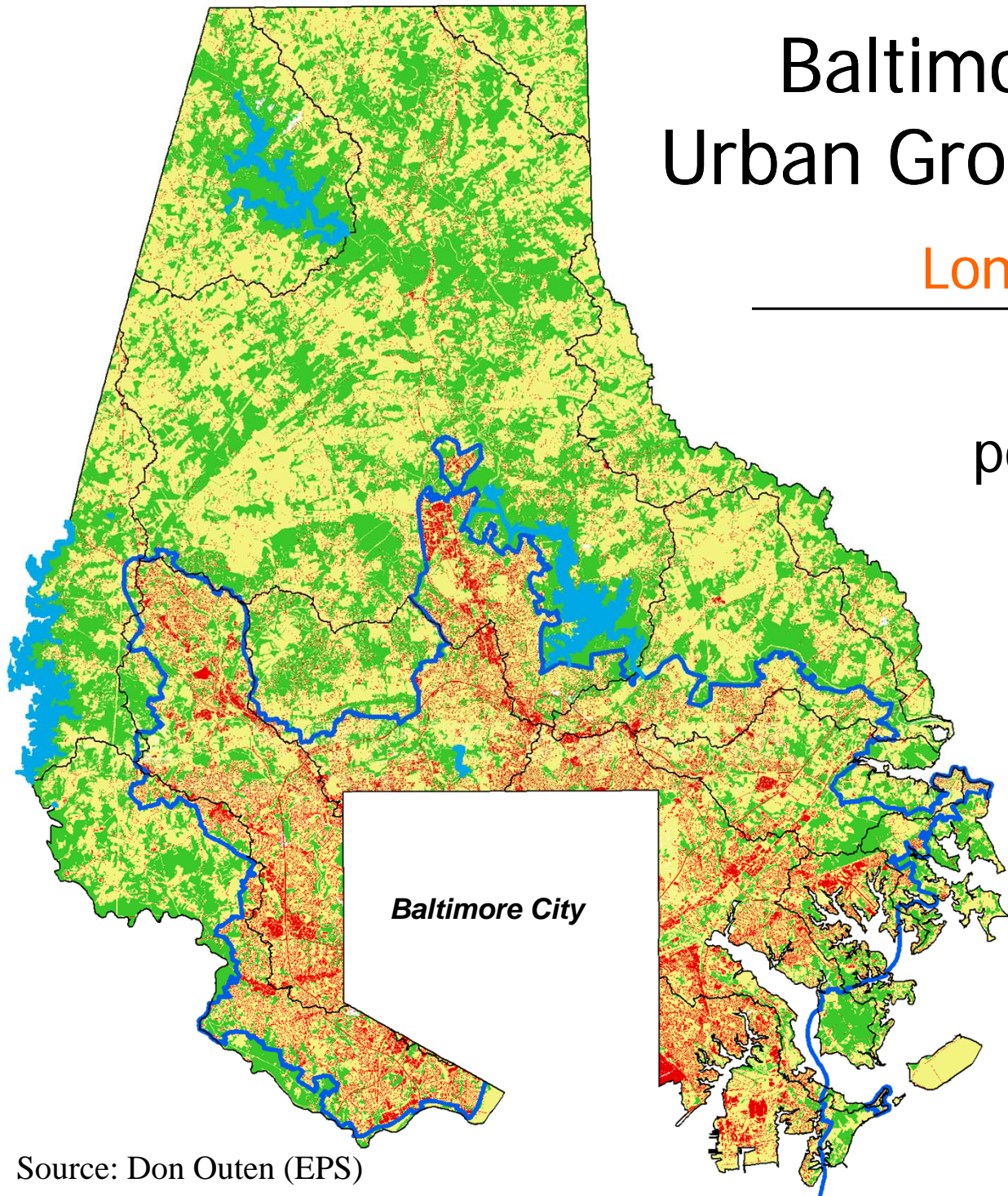
Source: Don Outen (EPS)

**Baltimore County:
Land use trends and zoning**

Baltimore County Urban Growth Boundary

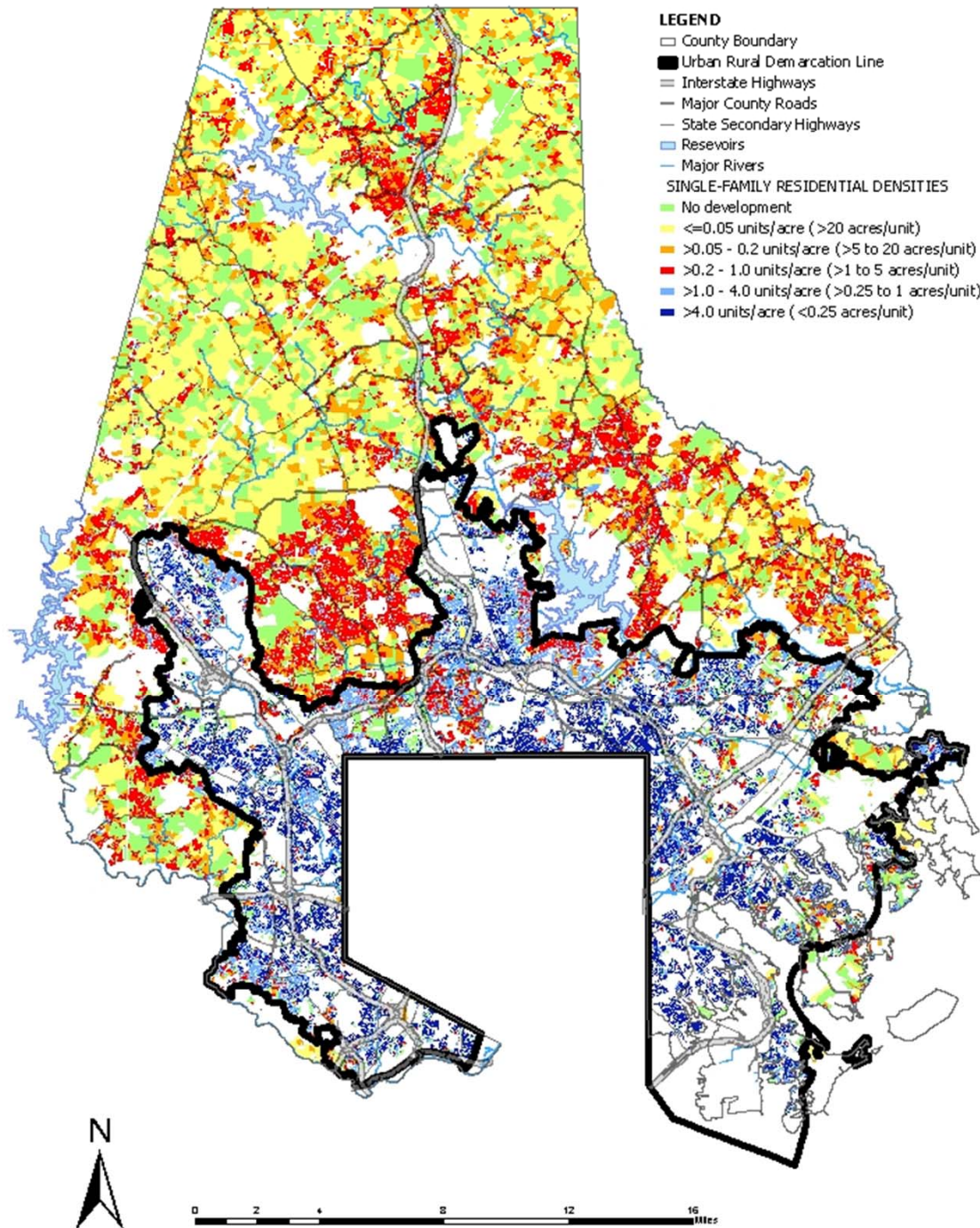
Long-Term Results

90% of year 2000
population lived inside
the urban growth
boundary (UGB) on
1/3 of the land

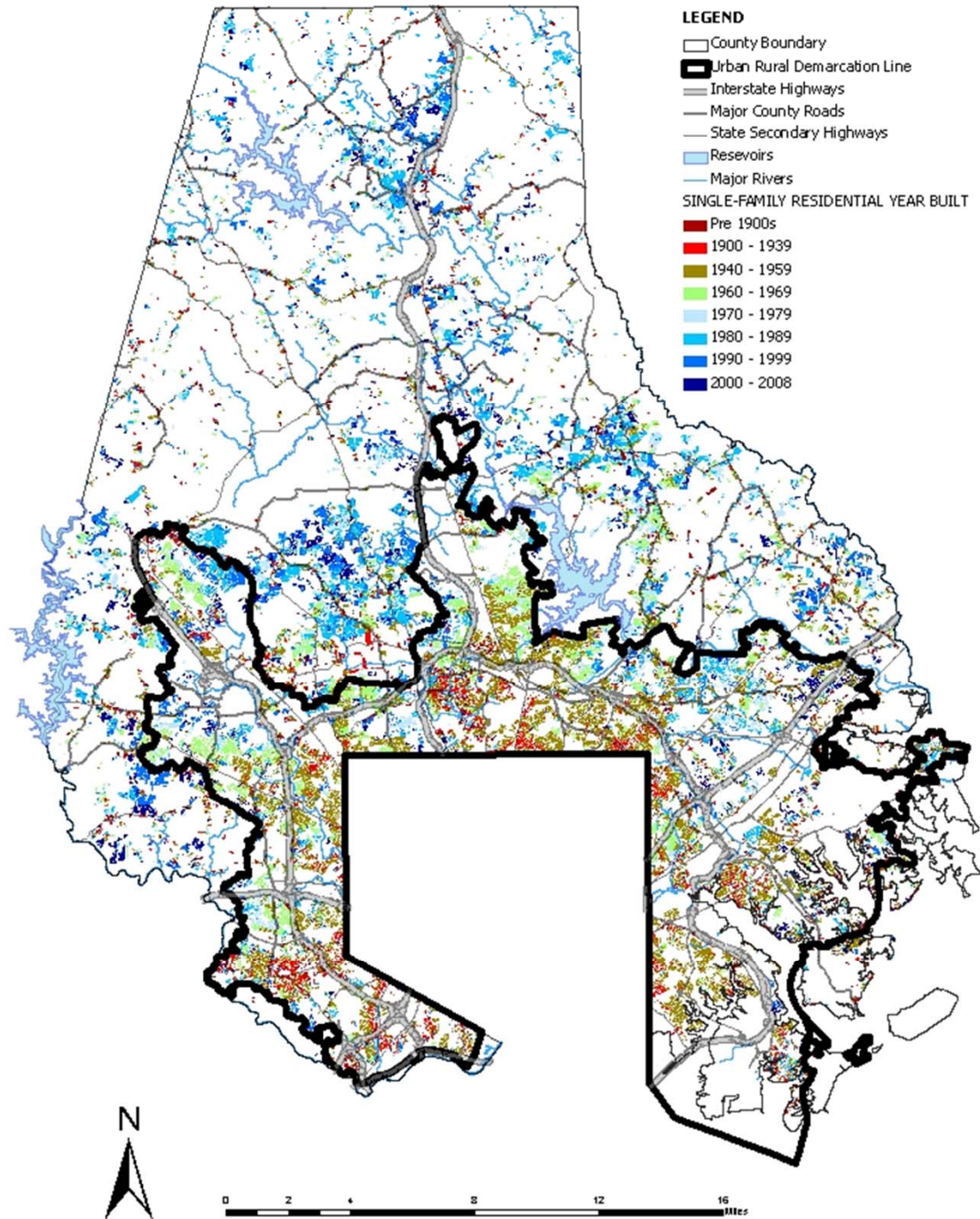


Source: Don Outen (EPS)

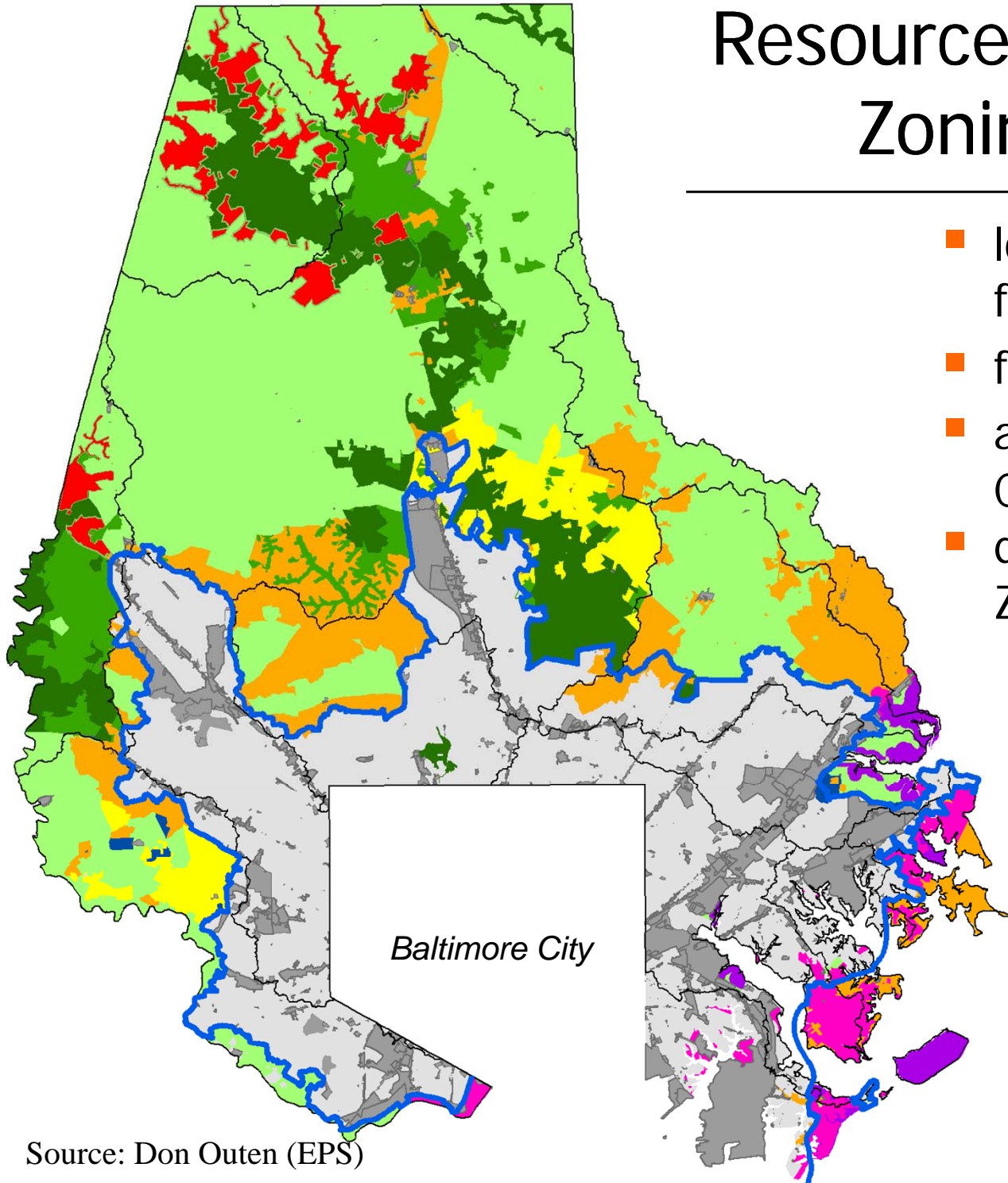
Residential density in 2008



Residential Development by Year Built



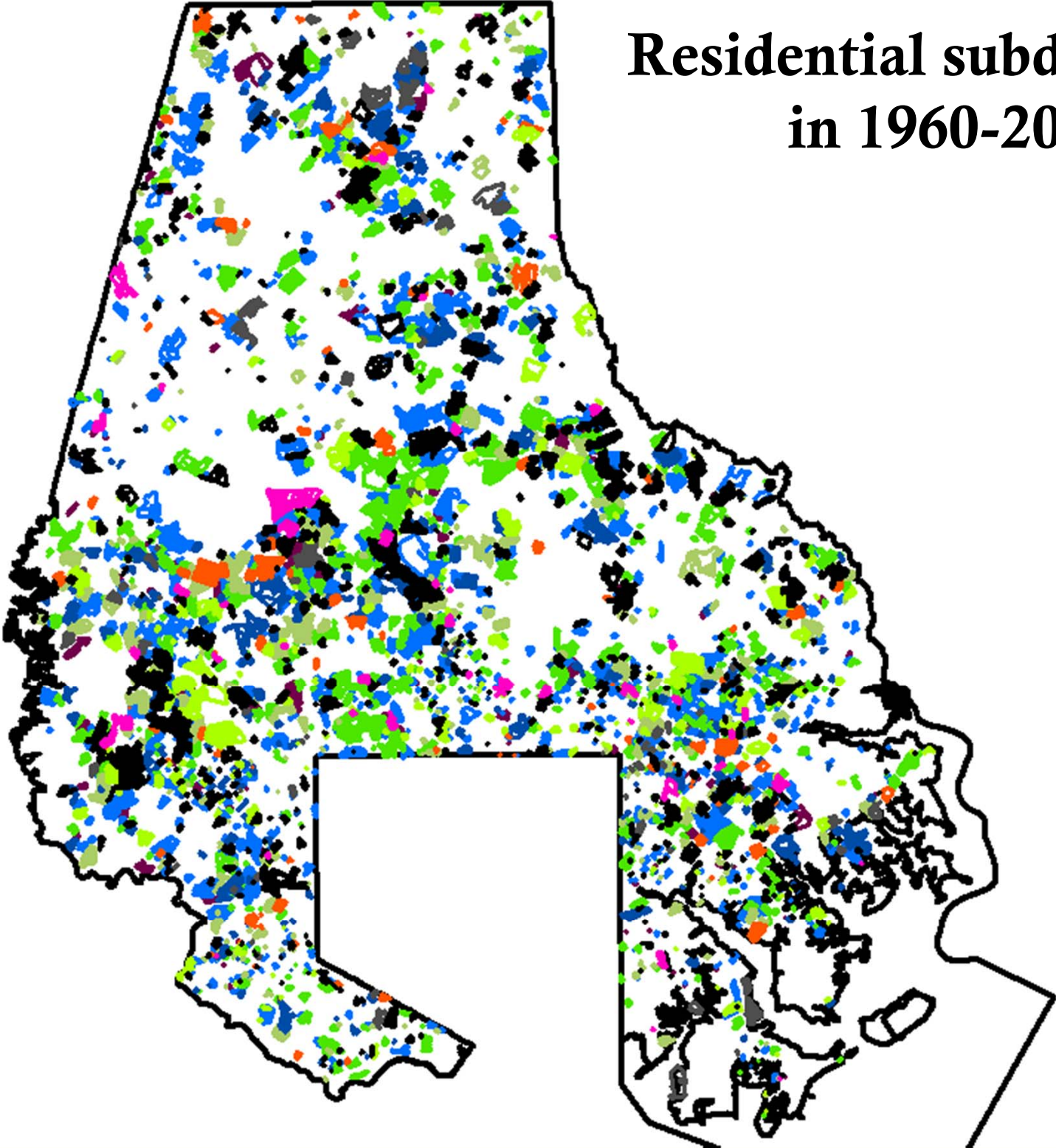
Resource Conservation Zoning - 2008



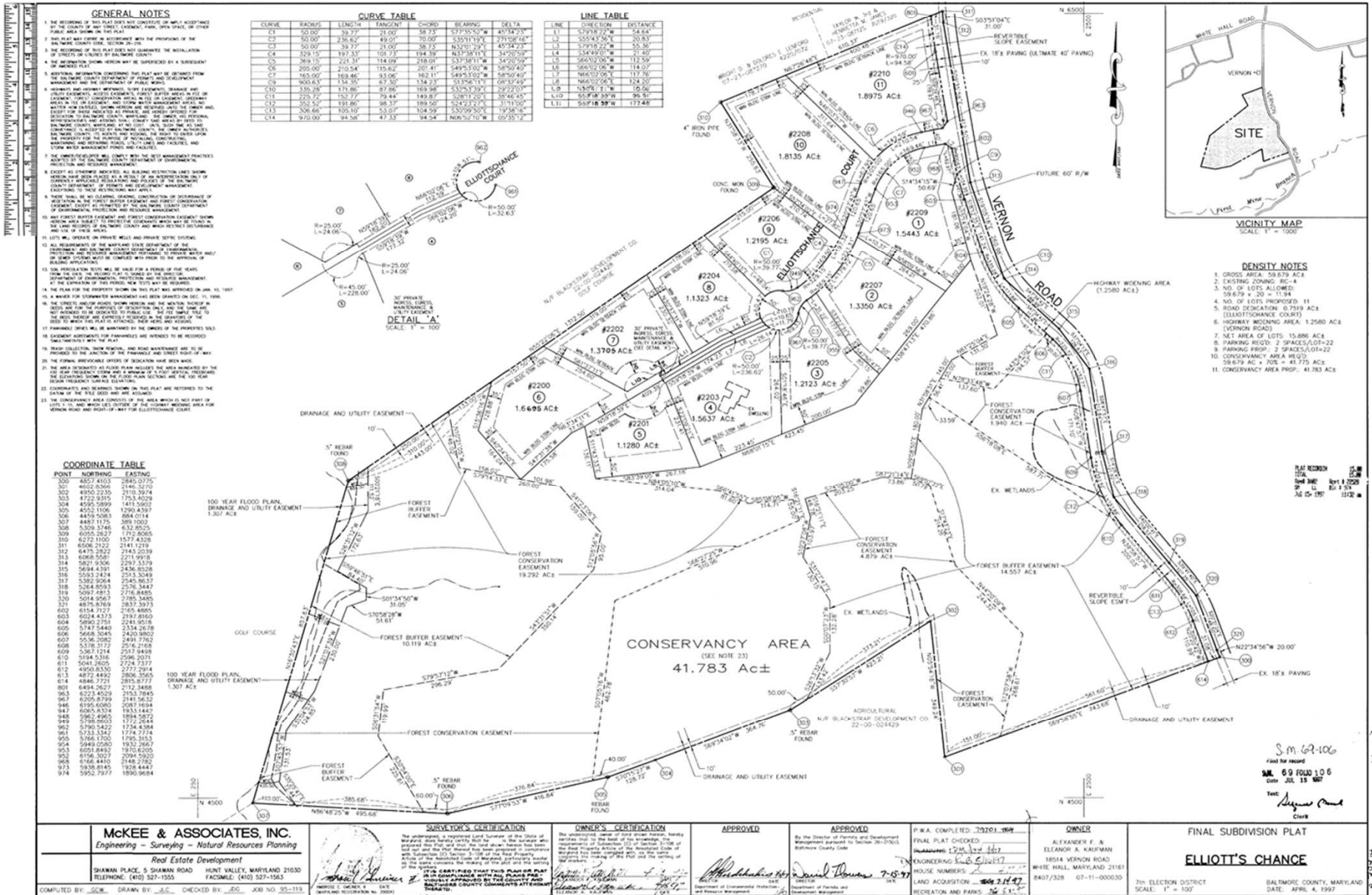
- low-density zoning protects forests and water resources
- first adopted in 1975
- applies to about 2/3 of the County
- quadrennial Comprehensive Zoning Map Process

Source: Don Outen (EPS)

Residential subdivisions in 1960-2008



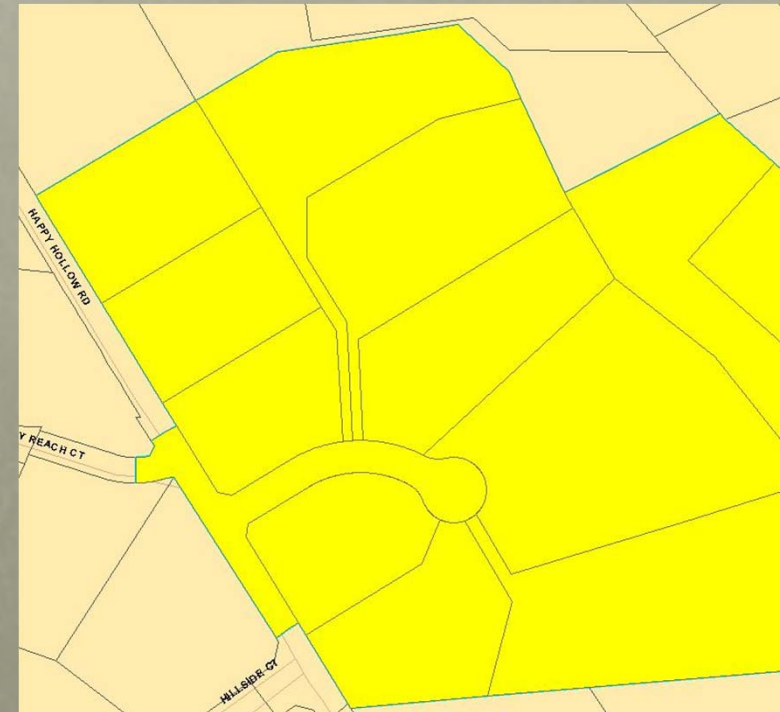
Subdivision in RC4 zoning



Subdivisions

MD Property View parcel data to reconstruct historic subdivisions 1960-2008:

- Identify polygons in MDPV parcel layer within same subdivision
- Dissolve individual parcels into original parent parcel
- Record year start and number of lots in subdivision



Internal subdivision characteristics

Multiple phases of development (subevents)

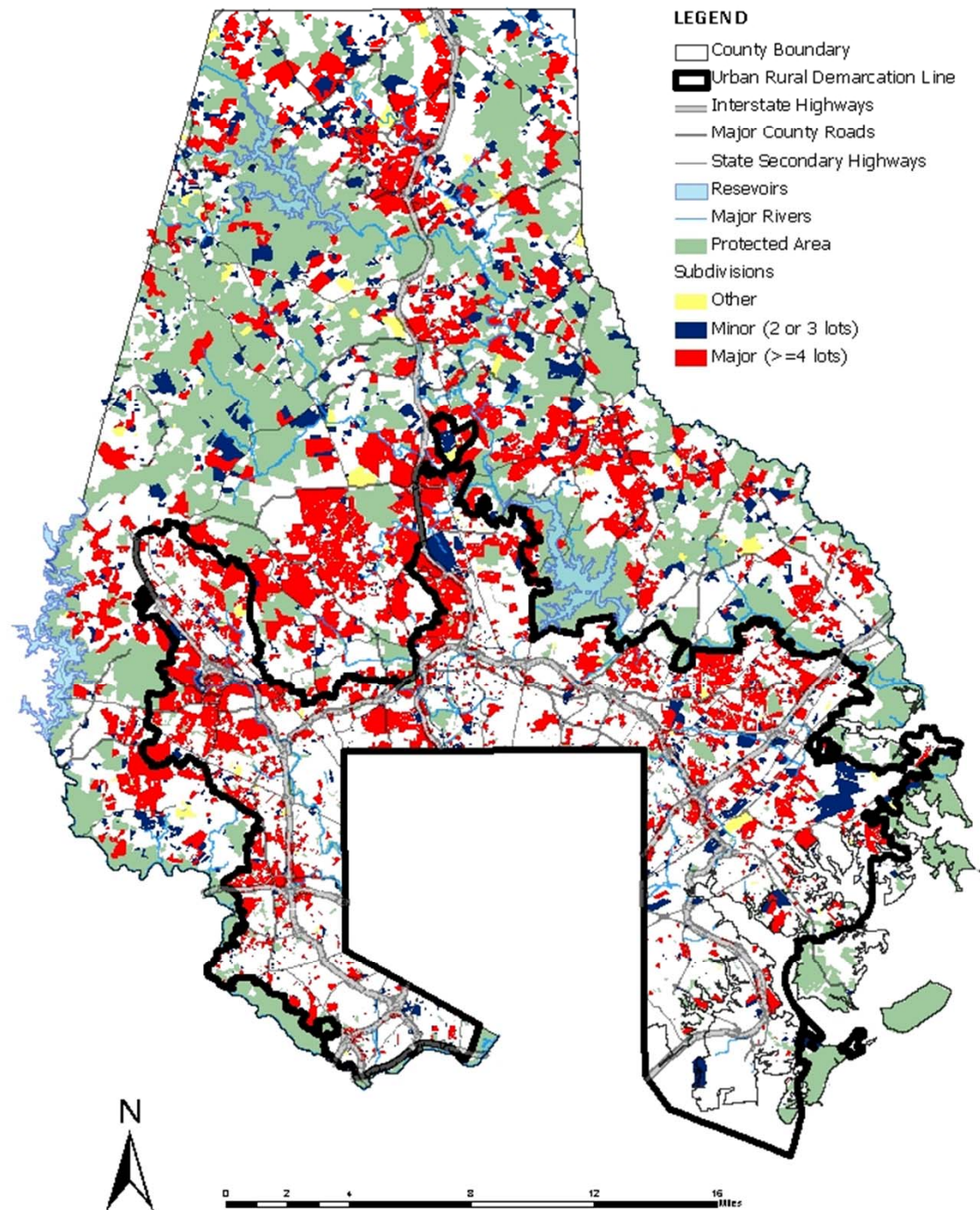
Land code on each parcel within subdivision

- Buildable lot
- Open space
- Remain developable
- Internal road
- Commercial, Industrial, Multifamily

Open space types

- Storm water management; Floodplain; Wetlands; Forest conservation; Forest buffer; Local open space; HOA

Residential Subdivisions in 1960-2008



Major versus minor subdivisions

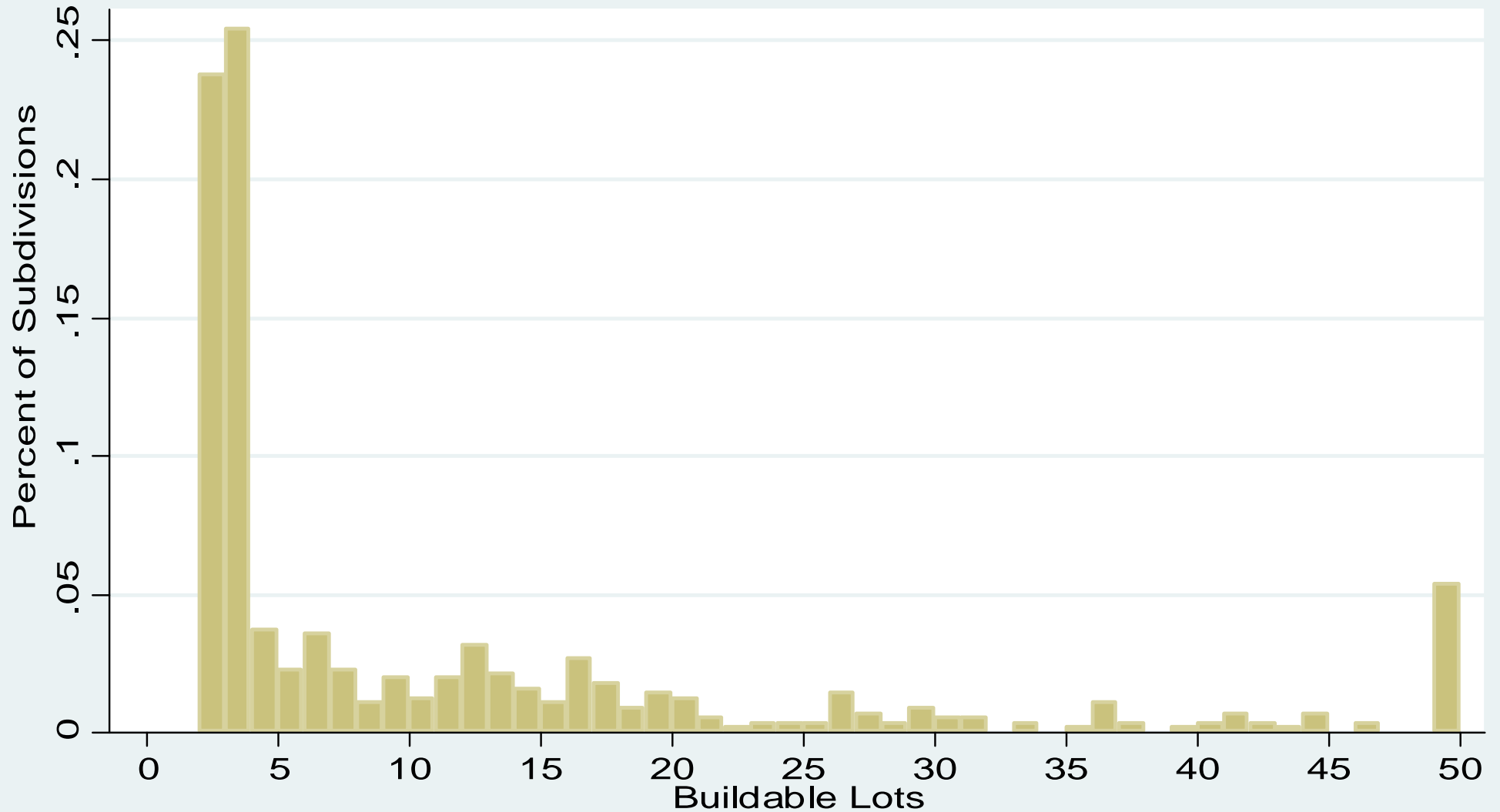
Major subdivisions (4+ lots)

- Formal public hearing for subdivision approval
- Longer permit review process

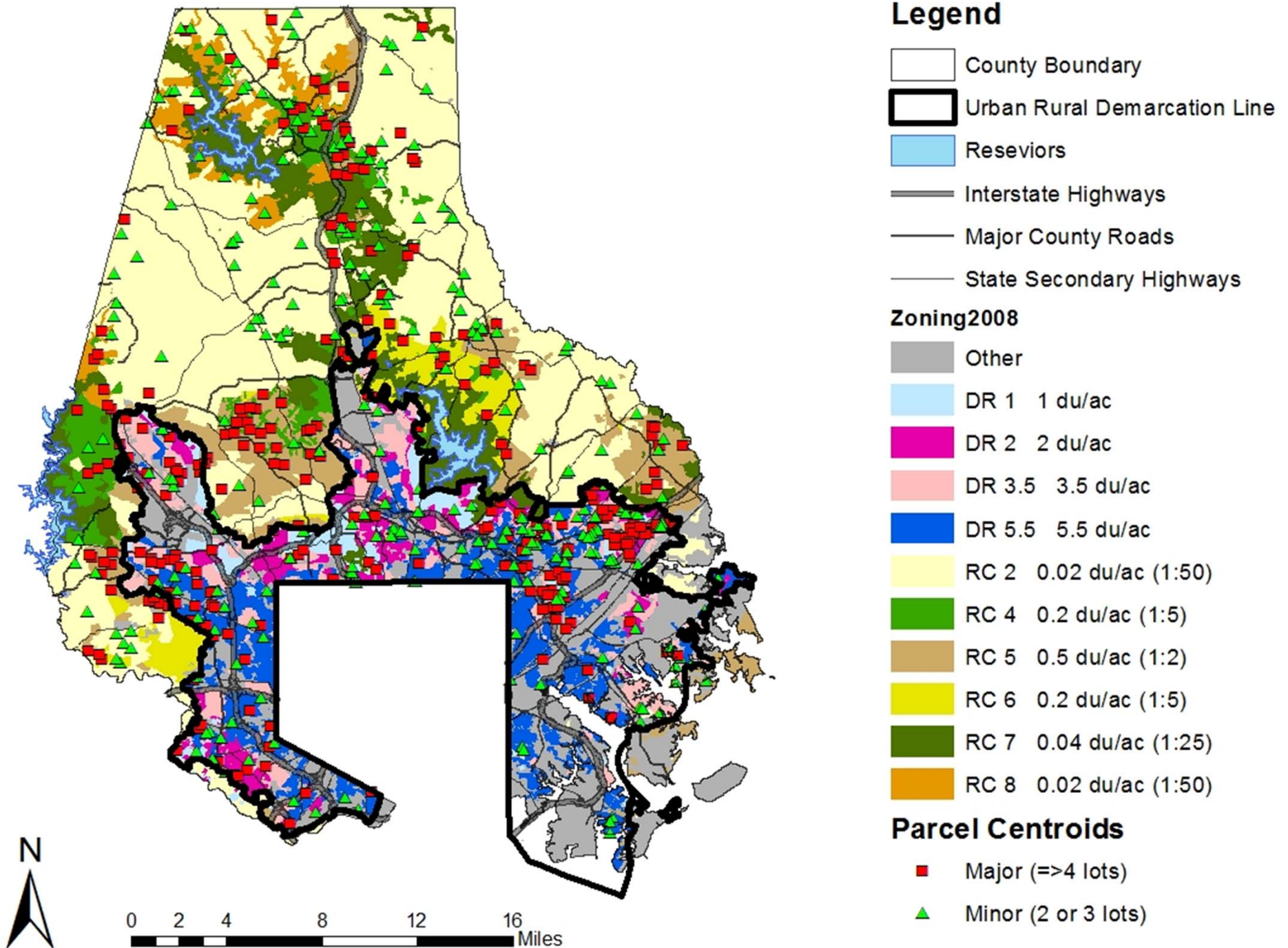
Minor subdivisions (2 or 3 lots)

- No formal public hearing (only planning board approval needed)
- Shorter permit review process
- Minor exemption rules in RC2 and RC4 zoning
 - RC2 zoning (50-acre min lot size): Allows 2 lots for parcels between 2 and 100 acres
 - RC4 zoning (5-acre min lot size): Allows 2 lots for parcels between 6 and 10 acres

Subdivision size by buildable lots



Residential subdivisions in 1996-2007



Legend

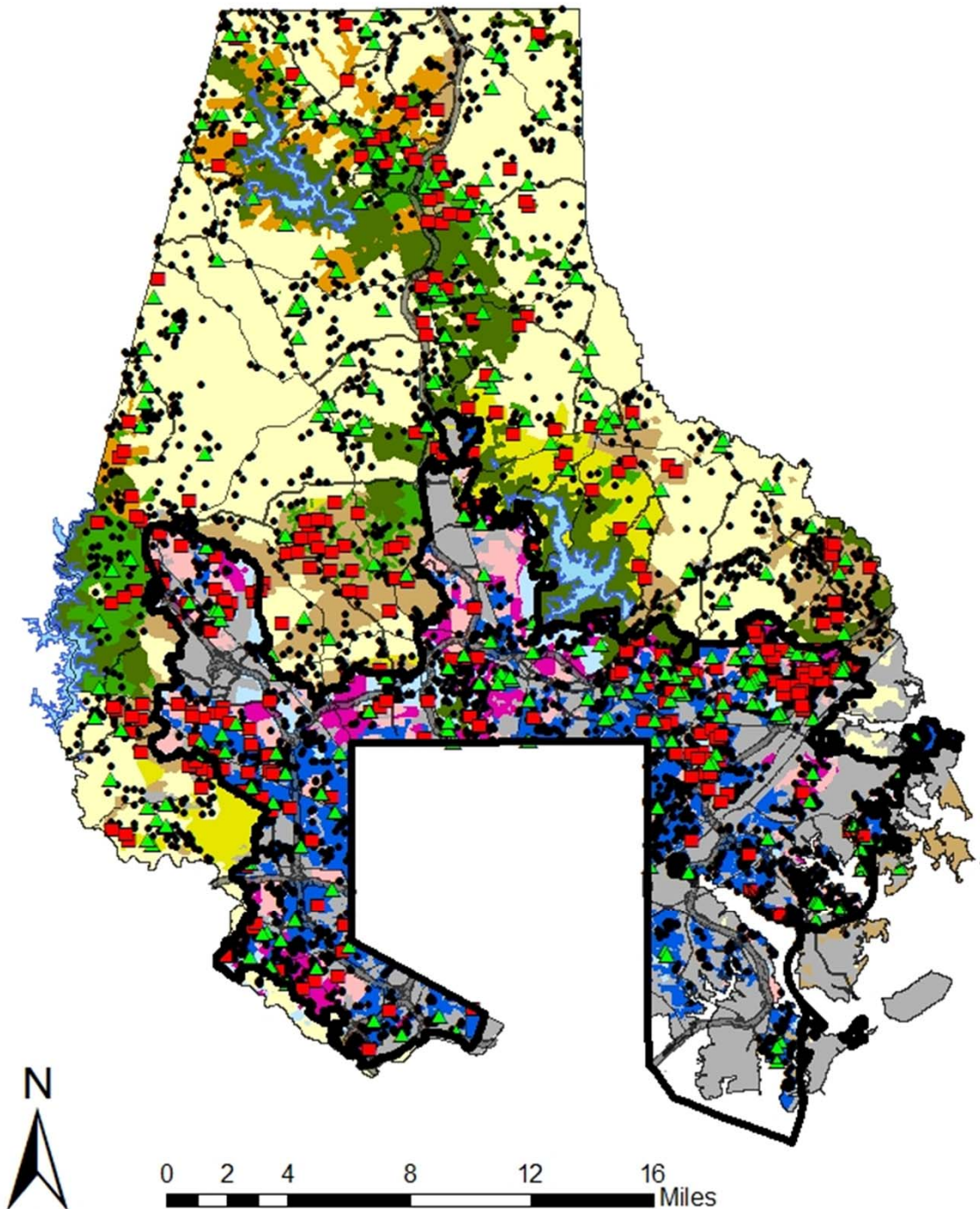
- County Boundary
- Urban Rural Demarcation Line
- Reservoirs
- Interstate Highways
- Major County Roads
- State Secondary Highways

Zoning2008

- Other
- DR 1 1 du/ac
- DR 2 2 du/ac
- DR 3.5 3.5 du/ac
- DR 5.5 5.5 du/ac
- RC 2 0.02 du/ac (1:50)
- RC 4 0.2 du/ac (1:5)
- RC 5 0.5 du/ac (1:2)
- RC 6 0.2 du/ac (1:5)
- RC 7 0.04 du/ac (1:25)
- RC 8 0.02 du/ac (1:50)

Parcel Centroids

- Major (≥ 4 lots)
- Minor (2 or 3 lots)
- Undeveloped



Residential land-use change model

Binary model specification

Baseline data

Developable parcels in 1996 (zoning allows 2 or more lots)

Residential development model (first-stage)

Binary probit model for land-use transitions in 1996-2007

Categories: Develop or remain developable

Truncated count model (second-stage)

Number of buildable lots in subdivision, conditional on development in 1996-2007

Truncated negative binomial model

Subdivision must have 2 or more lots (truncated at zero or one)

Explanatory variables

Zoning attributes

Zoning type

Authorized lots minor

Accessibility attributes

Distance to Baltimore City

Distance to major road

Physical land attributes

Parcel area

Slope

Elevation

Soil quality (good/fair, poor, very poor)

Water table depth

100-year floodplain

Existing house

Rural Legacy area

Residential land-use change model

Variables	Binary Probit Model		Truncated Negative Binomial Model	
	Coefficient	Rob. St. Err.	Coefficient	Rob. St. Err.
RC2 (0.02 du/ac)	-0.795**	(0.136)	-4.574**	(0.247)
RC8 (0.02 du/ac)	-0.908**	(0.242)	-4.421**	(0.836)
RC7 (0.04 du/ac)	-0.617**	(0.235)	-2.683**	(0.438)
RC6 (0.2 du/ac)	-0.566*	(0.242)	-1.928**	(0.316)
RC4 (0.2 du/ac)	-0.516**	(0.109)	-3.014**	(0.188)
RC5 (0.5 du/ac)	-0.420**	(0.083)	-2.292**	(0.134)
DR1 (1 du/ac)	-0.266**	(0.093)	-1.497**	(0.174)
DR2 (2 du/ac)	-0.278**	(0.071)	-0.767**	(0.129)
DR3.5 (3.5 du/ac)	-0.044	(0.050)	-0.350**	(0.093)
Auth lots_2	-0.293**	(0.080)	-0.518*	(0.236)
Auth lots_3	-0.131*	(0.057)	-0.457*	(0.183)

Baseline zoning = DR5.5 (5.5. du/ac)

Significance at the 1 %, and 5% level are represented by ** and * respectively

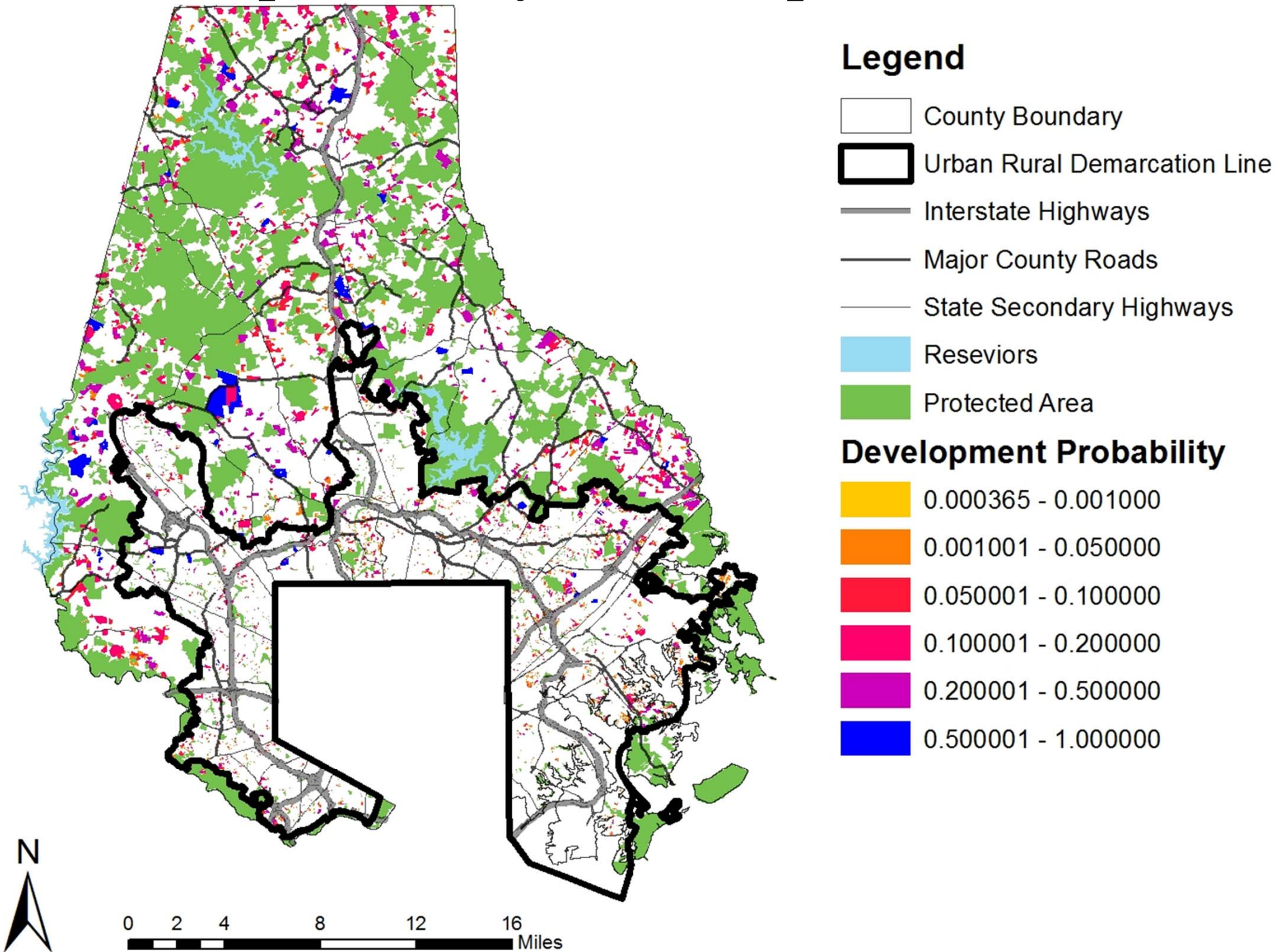
Residential land-use change model (cont'd)

Variables	Binary Probit Model		Truncated Negative Binomial Model	
	Coefficient	Rob. St. Err.	Coefficient	Rob. St. Err.
Distance to Baltimore City	-0.003	0.003	-0.001	0.006
Distance to major road	-0.045	0.029	-0.054	0.058
Ln(parcel area)	0.336**	0.021	1.166**	0.033
Slope	-0.014**	0.004	-0.015	0.008
Elevation	0.024**	0.004	0.014	0.007
Poor soil	0.066	0.046	-0.067	0.090
Very poor soil	-0.071	0.109	-0.778**	0.210
Water table depth	-0.011	0.018	0.005	0.032
Floodplain_100yr	-0.637**	0.159	-1.125**	0.410
Existing house	-0.302**	0.039	-0.096	0.058
Rural Legacy	0.263**	0.061	-0.241*	0.121
Alpha	-	-	0.177**	0.023
Constant	-2.580**	0.102	0.438*	0.202
Number of observations	68,531		559	

Time fixed effects for 1996-2006 are estimated but not shown here.

Significance at the 1 %, and 5% level are represented by ** and * respectively

Predicted probability of development in 1996-2007



Simulations on predicted development

- **Predictions on development and subdivision size**
 - Binary probit model (first stage)
 - Estimate site-specific probability of development for each developable parcel
 - Compare to random uniform number to determine conversion events
 - Truncated count model (second stage)
 - Conditional on development, estimate probability for each subdivision size for buildable lots $y = 2, 3, 4, 5, \dots, 1000$
 - Compare to random uniform number to determine number of buildable lots in subdivision
- **Policy scenarios**
 - Current zoning (business as usual)
 - Septic bill regulations

Predicted development in 1996-2007

Subdivisions			
	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	116	112	228
Major small (4-19 lots)	141	112	254
Major large (20+ lots)	47	35	83
Total	304	259	564
Buildable lots			
	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	277	256	534
Major small (4-19 lots)	1116	966	2084
Major large (20+ lots)	3739	1467	5209
Total	5133	2689	7827
Acreage developed			
	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	193	2429	2622
Major small (4-19 lots)	671	5303	5976
Major large (20+ lots)	1507	4025	5533
Total	2370	11757	14131

Excess zone capacity and septic law in Maryland

Septic Law

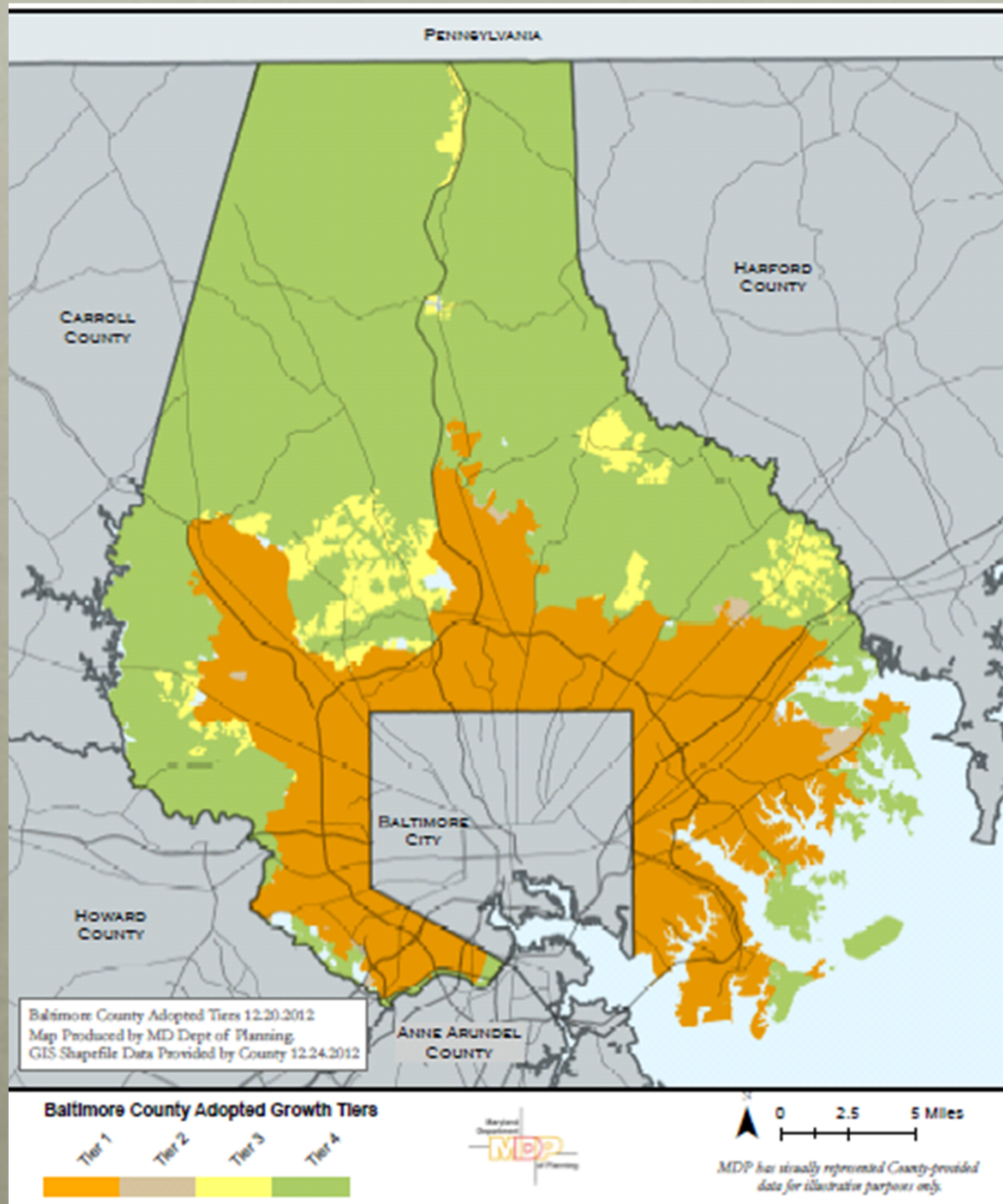
Sustainability Growth and Agricultural Preservation Act (“septic bill”) passed by State of Maryland in 2012

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

Four tier system:

- Tier 1 = Existing sewer service areas
- Tier 2 = Planned sewer areas (future growth areas)
- Tier 3 = Major subdivisions on septic allowed (Large-lot residential development and rural villages)
- Tier 4 = No major subdivisions on septic (Agricultural and forest dominated areas)
 - Only minor subdivision are allowed

Baltimore County Growth Tiers



Tier 1 and Tier 2 = Inside URDL
(existing and planned sewer)

Tier 3 = RC5 zoning mainly

Tier 4 = All other RC zoning types
and portion of RC5 zoning

- Only minor subdivision with 3 lots are allowed

Excess zoned capacity (EZC)

$$\text{EZC} = \frac{\text{Parcel area}}{\text{Minimum lot zoning}} - \text{Number of existing houses}$$

Example #1: 75-acre vacant parcel in RC4 zoning (5-acre min lot zoning).

$$\text{EZC} = \frac{75}{5} - 0 = 15 \text{ lots remaining}$$

Septic bill impact on EZC = 15 – 3 = 12 lot reduction

Assumes minor subdivision with 3 lots built in Baltimore County.

In contrast, Carroll County has redefined minors to 7 lots.

Excess zoned capacity (EZC)

$$\text{EZC} = \frac{\text{Parcel area}}{\text{Minimum lot zoning}} - \text{Number of existing houses}$$

Example #2: 200-acre vacant parcel in RC2 zoning (50-acre min lot zoning).

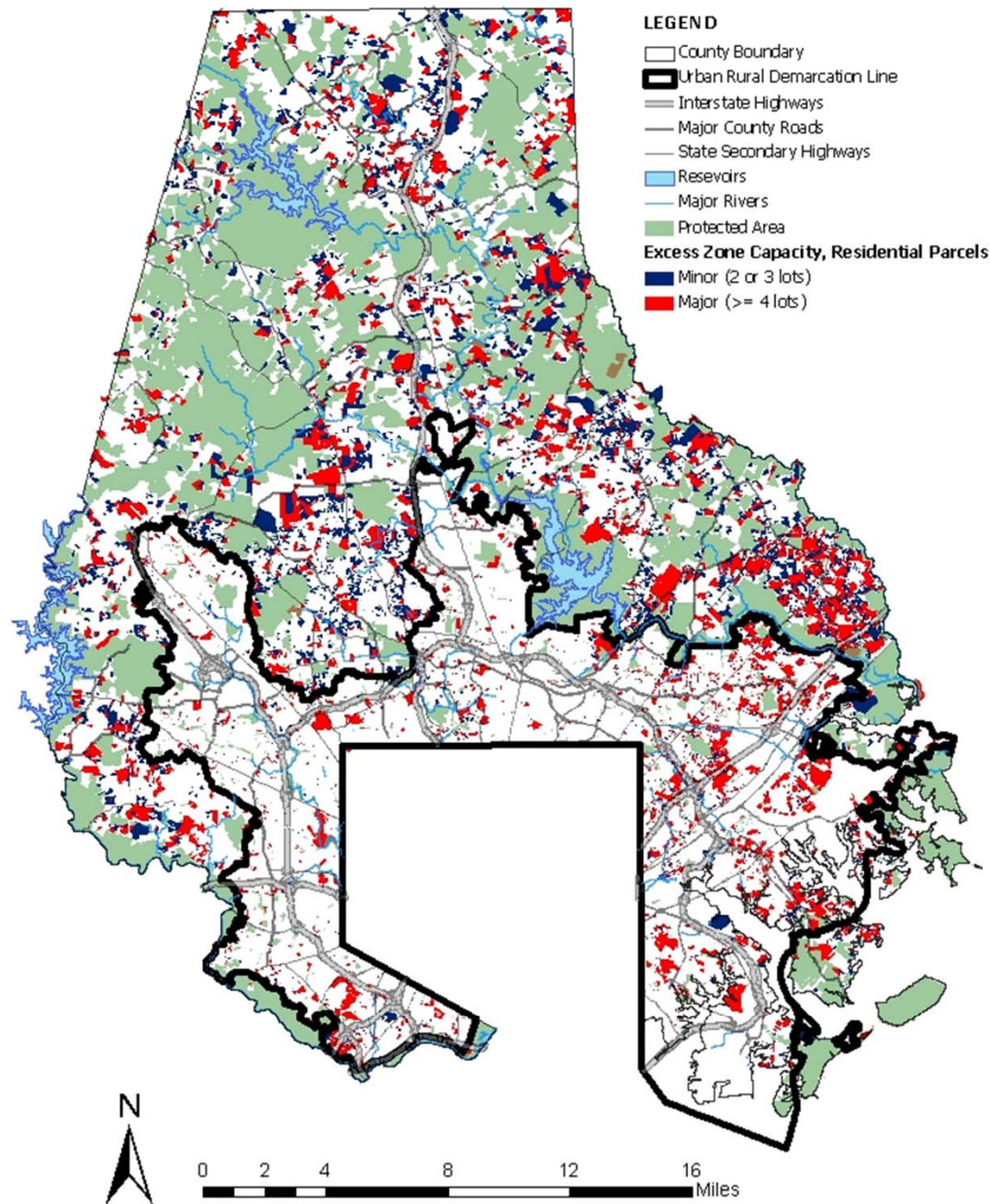
$$\text{EZC} = \frac{200}{50} - 0 = 4 \text{ lots remaining}$$

Septic bill impact on EZC = $4 - 3 = 1$ lot reduction

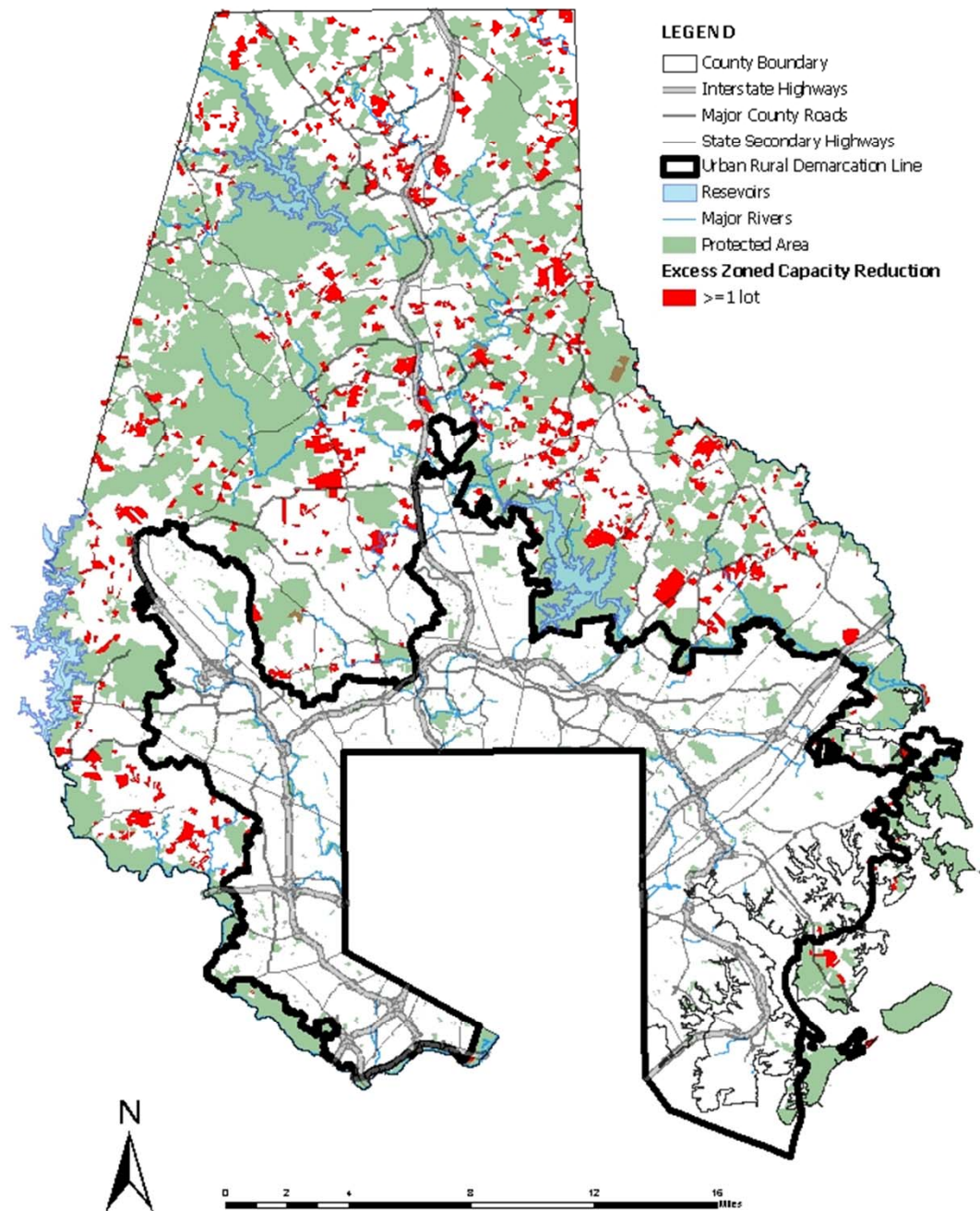
Example #3: 12-acre vacant parcel in RC2 zoning

Still allows subdivision into 2 lots (EZC=2) due to minor exemptions

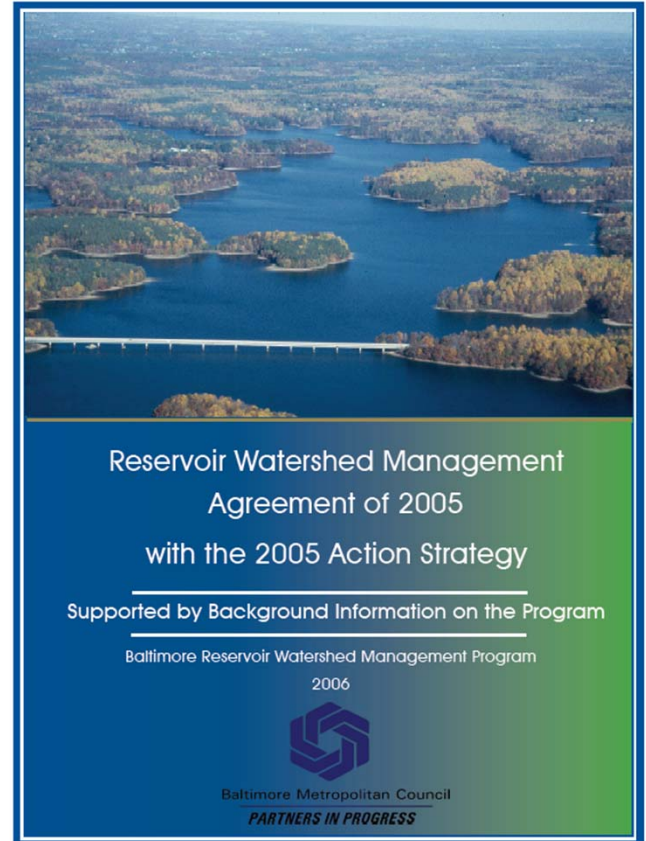
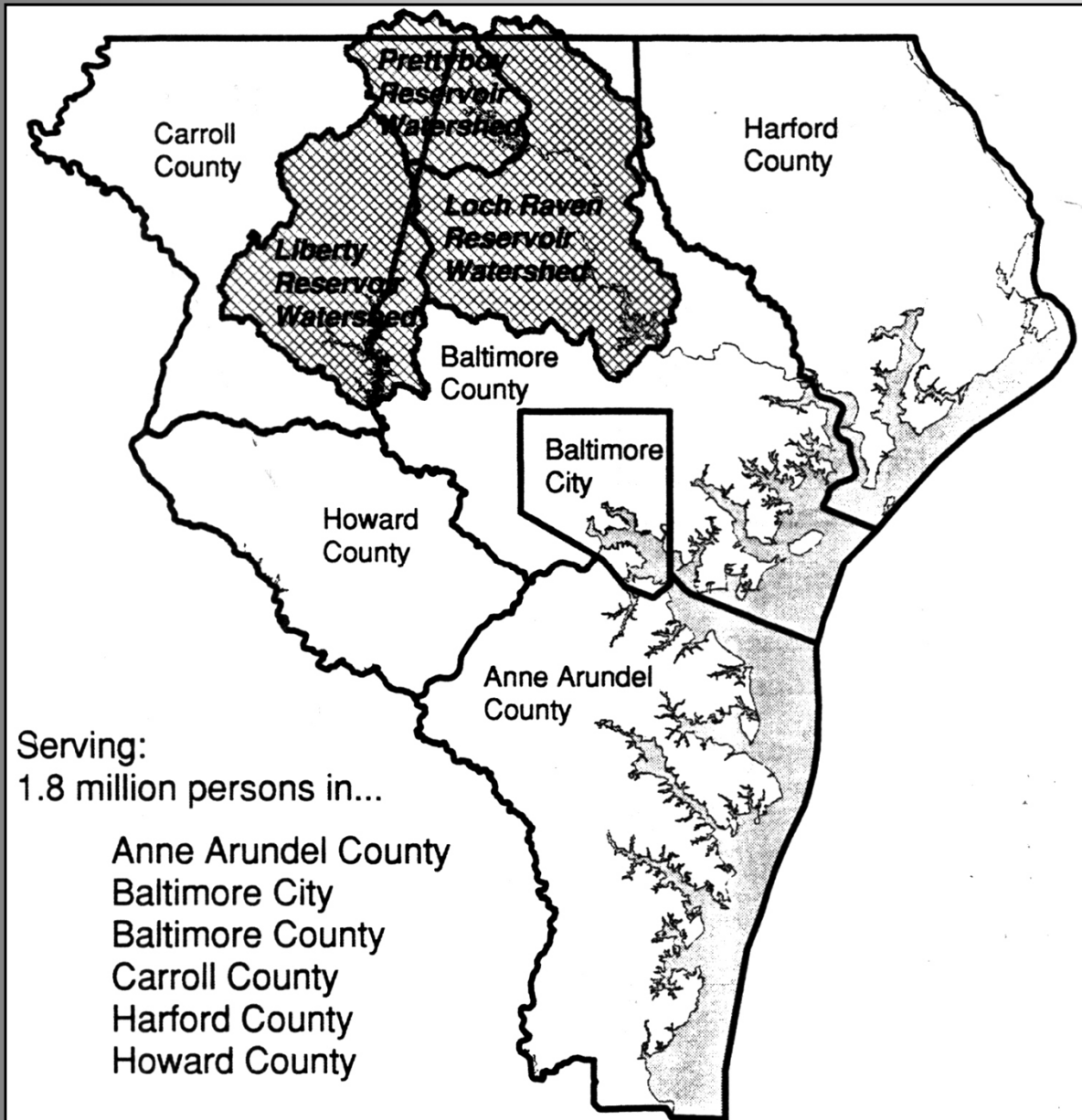
Excess Zoned Capacity



Excess Zoned Capacity Reduction



Protecting Drinking Water Sources



www.baltometro.org

Baltimore County

- 63% of the region's 294 sq. mi. of reservoir watersheds
- 48% of the County

Source: Don Outen (EPS)

Septic bill impacts in Tier 4 (Baltimore County)

	Subdivision potential	RC2	RC4	RC5	RC6	RC7	RC8	RC20/50	Total
Parcels	Developed already	9,058	3,704	2,807	3,373	1,499	1,490	372	22,356
	Potential minor (2 lots)	4,476	175	160	58	7	78	10	4,965
	Potential minor (3 lots)	9	35	76	24	7	17	3	171
	Potential major (4+ lots)	10	81	226	61	22	0	7	408
Buildable lots	Existing house	5,899	2,738	1,868	2,828	987	1,032	127	15,528
	Potential minor (2 lots)	8,952	350	320	116	14	156	20	9,930
	Potential minor (3 lots)	27	105	228	72	21	51	9	513
	Potential major (4+ lots) (BEFORE)	57	659	2,156	558	407	0	41	3,912
	Potential major (4+ lots) (AFTER)	30	243	678	183	66	0	21	1,224
	Septic bill impact (CHANGE in Lots)	27	416	1,478	375	341	0	20	2,688
	% Septic impact/Potential major	47%	63%	69%	67%	84%	NA	49%	69%
	% Septic impact/Potential major + minor	0%	37%	55%	50%	77%	0%	29%	19%
	% Septic impact/Existing + potential	0%	11%	32%	10%	24%	0%	10%	9%

Lot reduction in major subdivisions in Tier 4 are mainly in RC5 and RC4/RC6.

RC2 has 8,952 potential buildable lots in minor subdivisions, due to minor exemption rule (i.e. parcels with 2-100 acres allowed 2 lots).

Main findings in Baltimore County

Zoning impacts

Minimum lot size zoning regulations strongly affect both the probability of development and density

Urban vs. Rural impacts

Majority of new buildable lots occur within urban area
(5,133 lots inside URDL vs. 2,689 outside URDL)

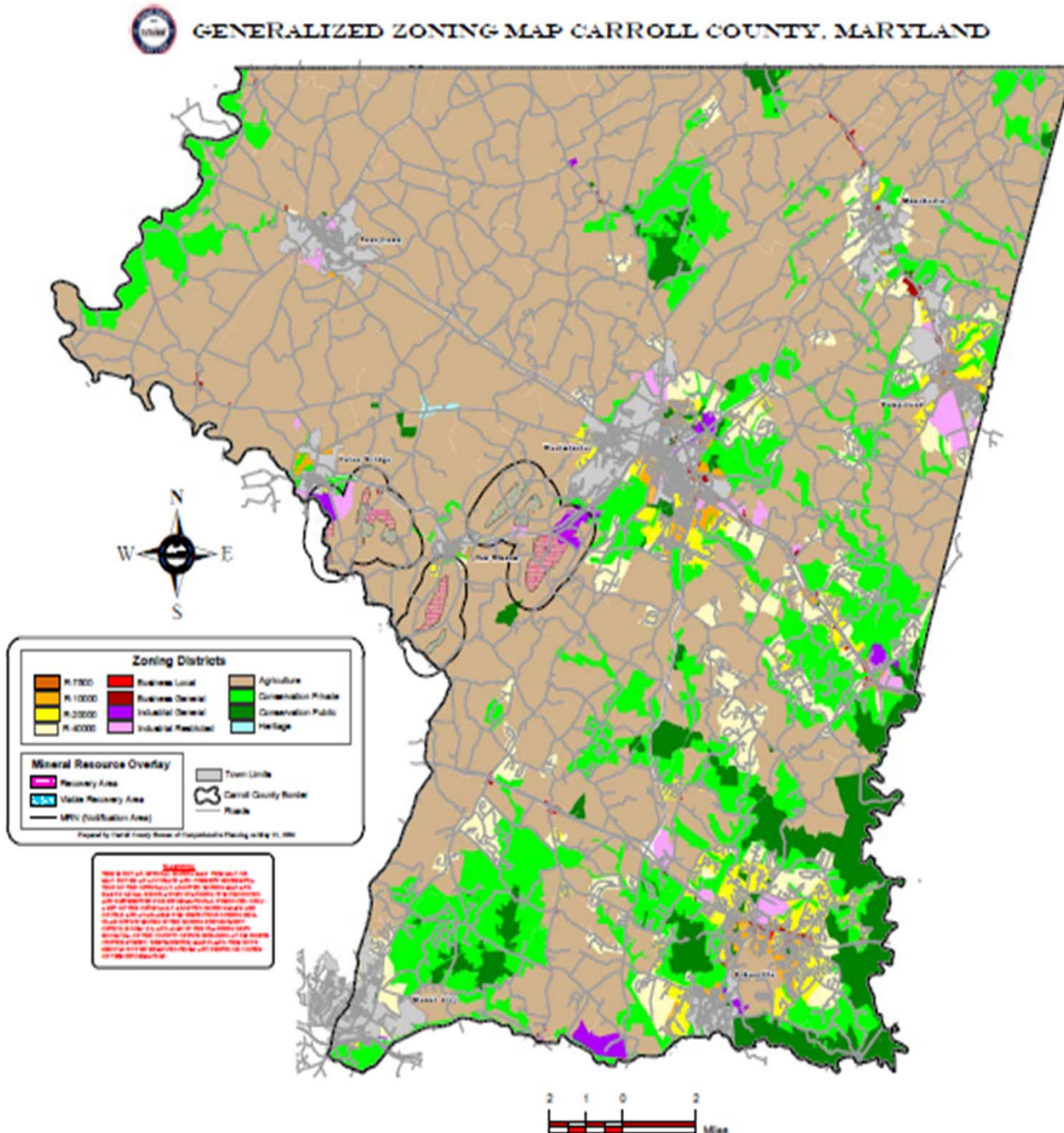
But majority of acreage developed still occurs within rural area
(2,370 acres inside URDL vs. 11,757 outside URDL)

Septic bill regulations

Septic bill results in 69% reduction on major subdivisions in Tier 4 areas.

But there is still a significant number of potential minor subdivisions on septic systems in Tier 4.

Zoning in Carroll County



Carroll vs. Baltimore County

Designation on Tier 3 versus Tier 4 areas

Carroll County has not publicly released growth tier map

Baltimore County designated about 90% of rural area in Tier 4 (most preservation-oriented in State of MD)

Redefinition of minor subdivision (Increased to 7 lots)

Carroll County redefined minors to include 2 to 7 lots

Baltimore County continued to define minors as 2 or 3 lots

Minor exemptions

Agricultural zoning in Carroll County has 20-acre min lot size, with minor exemption for 2 lots on parcels between 6 to 40 acres

Existing development

Existing development is much greater than potential minor and majors in both Baltimore and Carroll Counties (septic retrofits with BAT)

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

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