

Population Growth Trends in the Rappahannock River Basin & Land Cover Implications



Kevin F. Byrnes, AICP
President
Regional Decision Systems, LLC
(804) 512-0563 kfbyrnes@Verizon.net

The “Rapp” Basin & Watershed...





Sub-Basin Geography: All or *Portions* of....

Upper: Counties of ~~Albemarle~~, Culpeper, *Fauquier*,
Greene, Madison, *Orange* & Rappahannock

Middle: Counties: *Caroline*, *King George*,
Spotsylvania, *Stafford* & **City of Fredericksburg**

Lower: Counties of *Essex*, *Lancaster*, *Middlesex*,
~~Northumberland~~, **Richmond** & *Westmoreland*

2016 Population for Basin

Watershed Population = 280,257 (45.8 %)

- **Upper: 112,390 (40.1%)**
- **Middle: 133,205 (47.5%)**
- **Lower: 34,660 (12.4%)**

● **Basin Communities Population = 611,270 (100%)**

- **Upper: 193,730 (31.7%)**
- **Middle: 358,635 (58.7%)**
- **Lower: 58,905 (9.6%)**

Growth Trends & Projections

Watershed & Basin Communities

Population Trends & Projections 2010-2016-2040

	2010	2016	2020	2030	2040
	Census	Estimate	Projection	Projection	Projection
UPPER	107,123	112,391	113,981	127,004	140,479
	184,457	193,731	196,977	222,774	244,969
MIDDLE	121,121	133,205	137,908	178,701	231,925
	327,773	358,633	371,922	441,817	504,181
LOWER	35,773	34,661	35,025	36,659	38,150
	60,209	58,905	59,972	61,621	62,387
TOTAL	264,017	280,257	290,044	334,939	374,292
	572,439	611,269	628,871	726,212	811,537

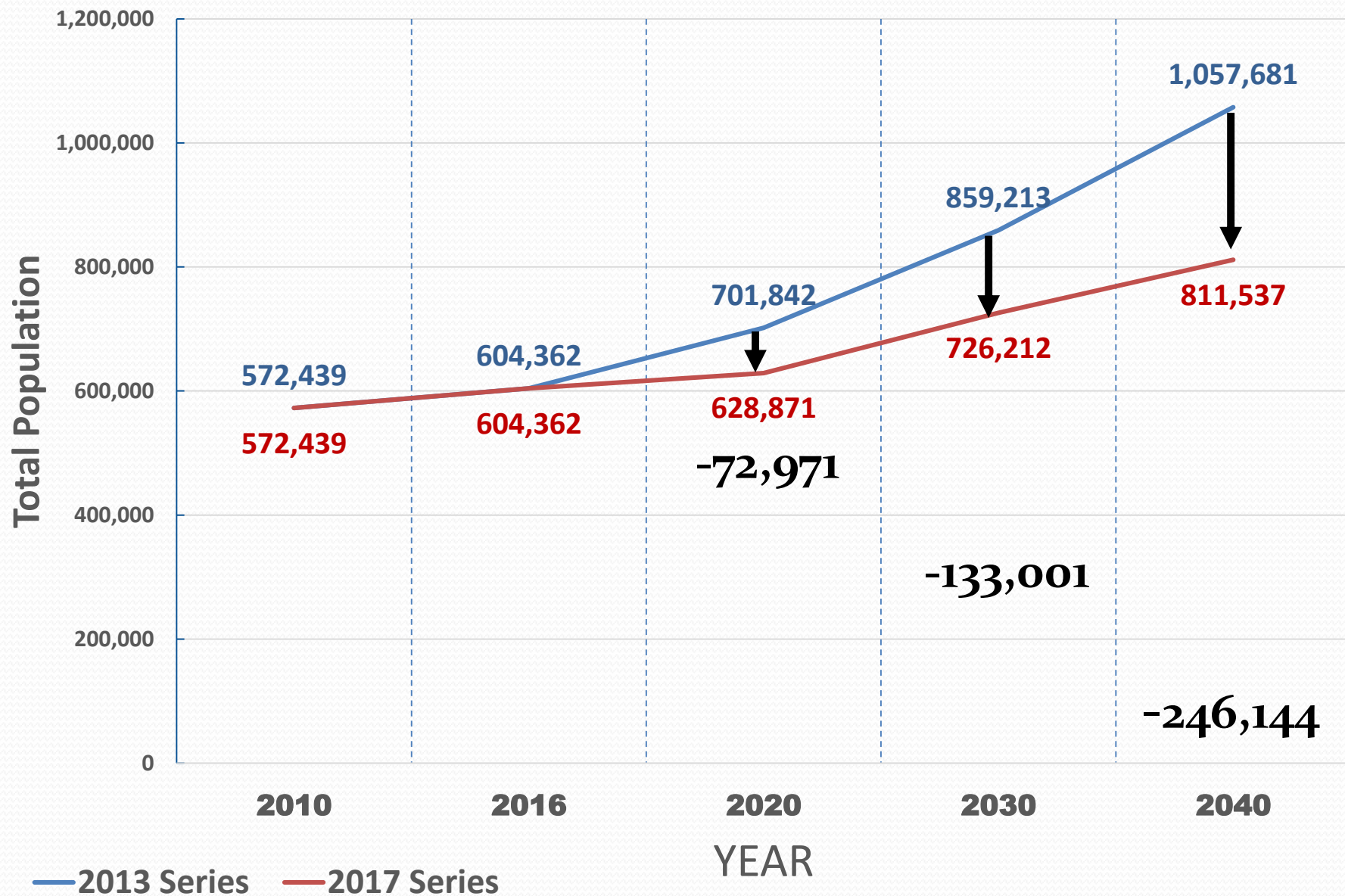
Sources: US Census Bureau, Estimates: 2010-2016; UVA, Weldon Cooper Center, Total Population Projections: 2020-2040 (February, 2017)

Population Change, By Decade:

Watershed & Basin Communities

DIFFERENCE:	2000-2010	2010-2016	2010-2020	2020-2030	2030-2040
UPPER	31,452	5,268	7,271	14,981	12,889
	54,162	9,274	12,520	25,797	22,195
MIDDLE	32,001	12,084	16,314	25,828	23,045
	86,606	30,860	44,149	69,895	62,364
LOWER	1,898	-1,112	-141	980	455
	3,194	-1,304	-237	1,649	766
TOTAL	65,350	16,240	26,027	44,895	39,353
	143,962	38,830	56,432	97,341	85,325

Population Projections for Rappahannock Basin Area



**Implications of
Revised Population
Projections on
Chesapeake Bay
Water Quality
Improvement Effort**

2013 Hi-Resolution Land Cover Imagery

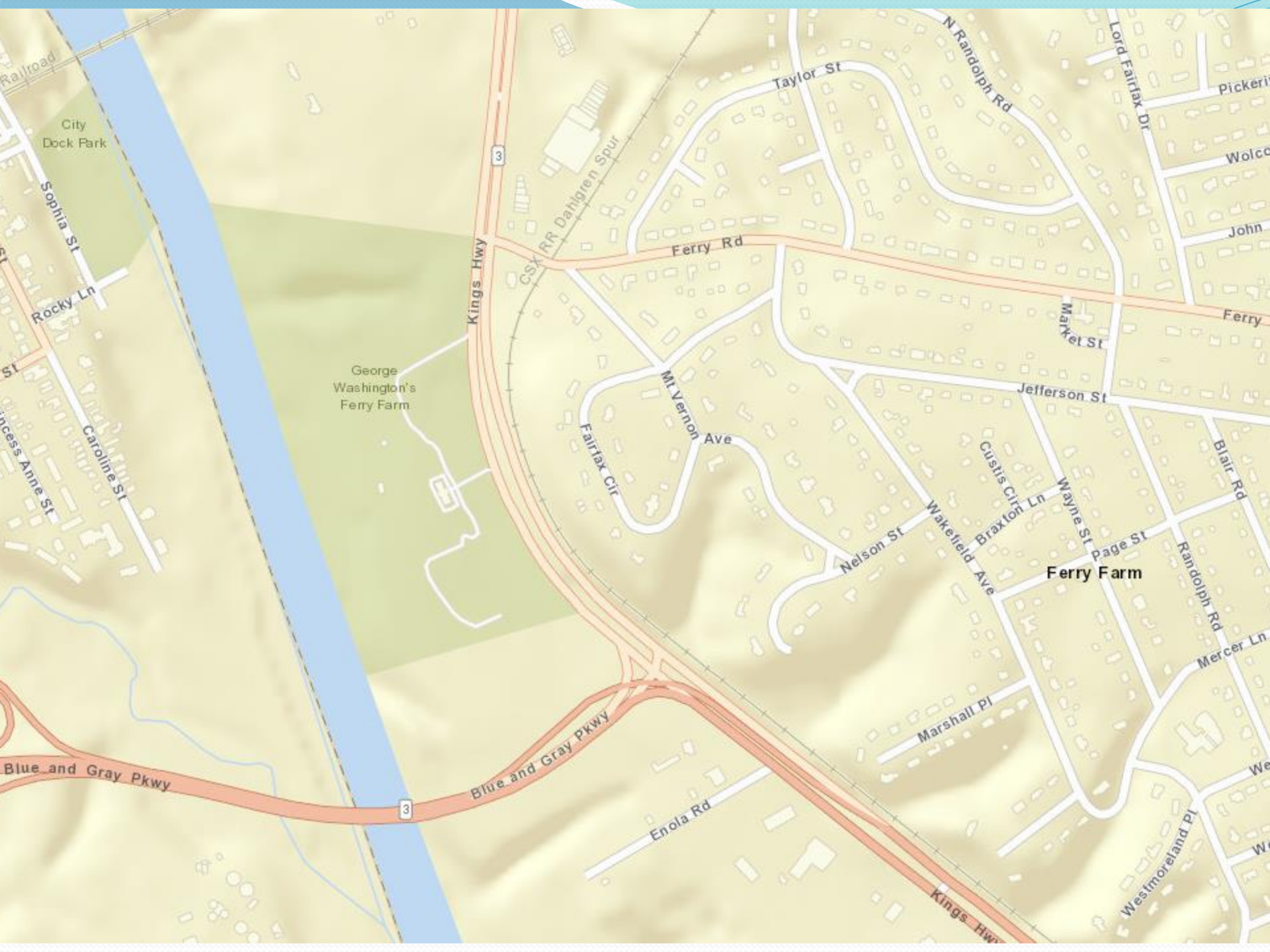
- Collected under State Contract
- Selected as Input to the 2017 Chesapeake Bay TMDL Model 6.0
- 900 times more accurate than previous land cover data in Bay model (1 meter **vs.** 30 meter pixel)
- More than 90% accurate for describing actual land cover at ground level

Land Cover Classifications: (13 types)

VA_Land_Cover

Land Cover

-  11 - Hydro
-  21 - Impervious (extracted)
-  22 - Impervious (Local datasets)
-  31 - Barren
-  41 - Forest
-  42 - Tree
-  51 - Scrub/Shrub
-  61 - Harvested/Disturbed
-  71 - TurfGrass
-  81 - Pasture
-  82 - Cropland
-  91 - Woody Wetlands
-  92 - Emergent Wetlands





Rt 3 River Crossing

Legend
George Washington's Ferry Farm

George Washington Regional Commn
Thomas J Wack Co
Richmond, Fredericksburg and Potomac Railroad Freight Office at Fredericksburg, VA

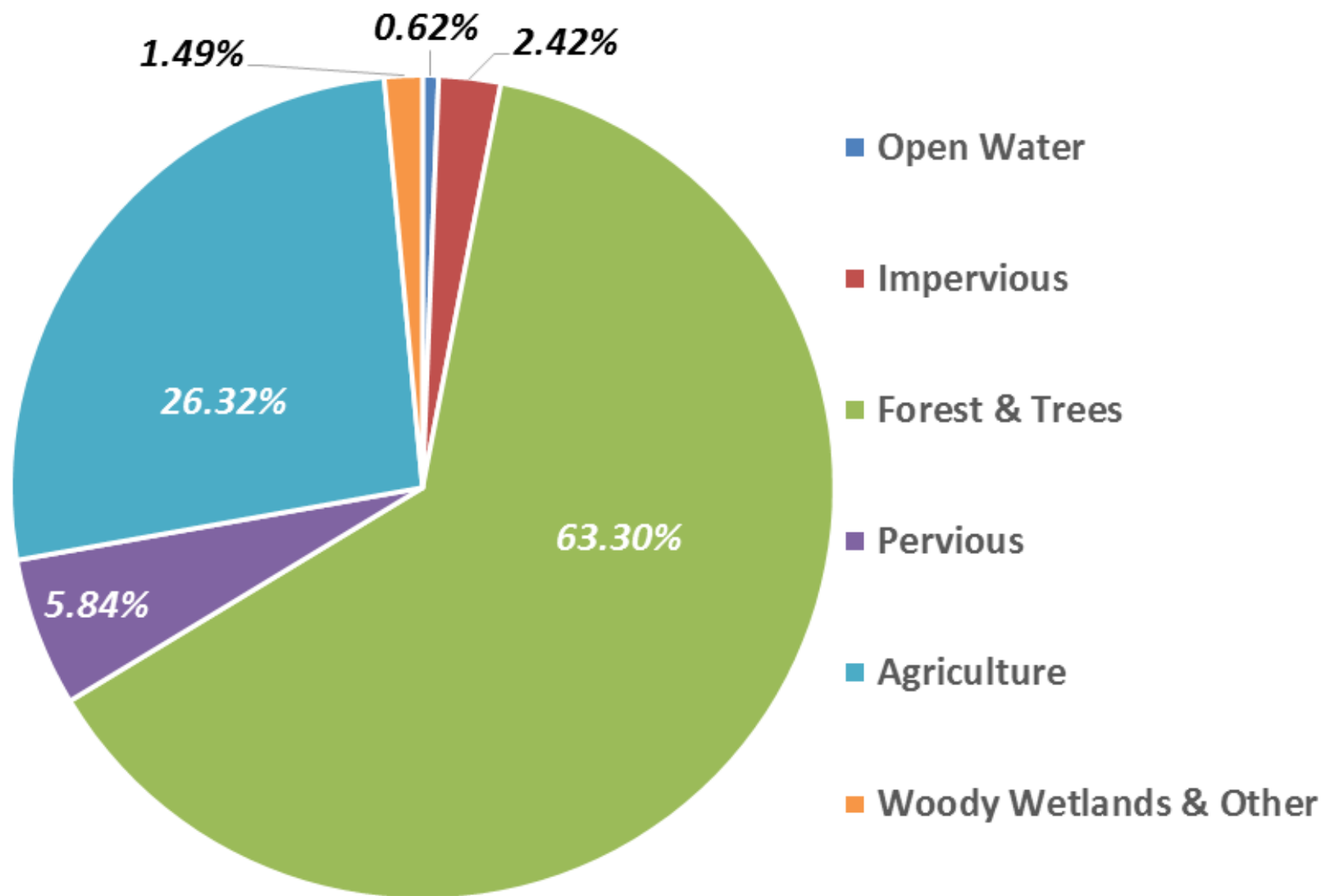
Google Earth
© 2016 Google



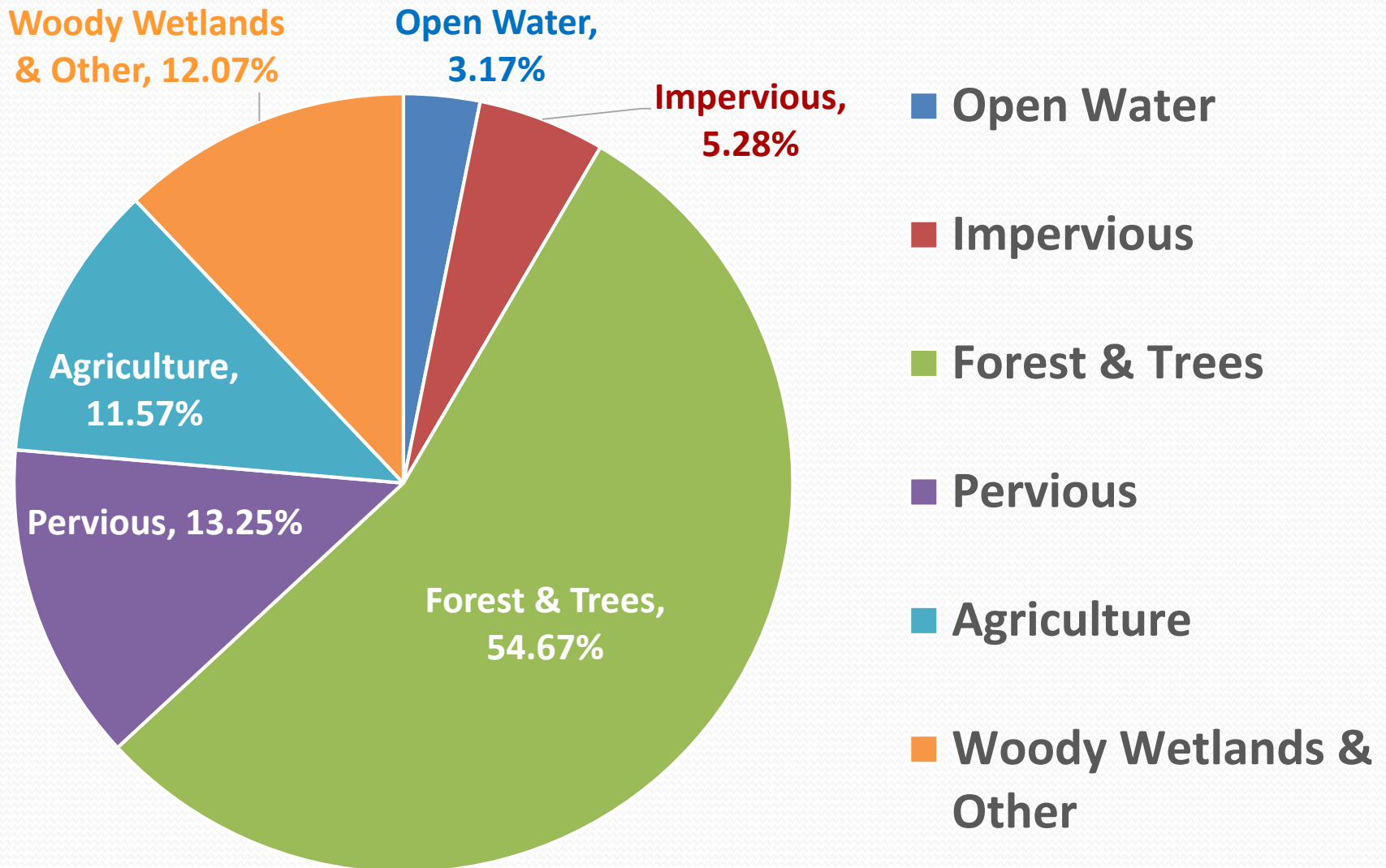
1000 ft



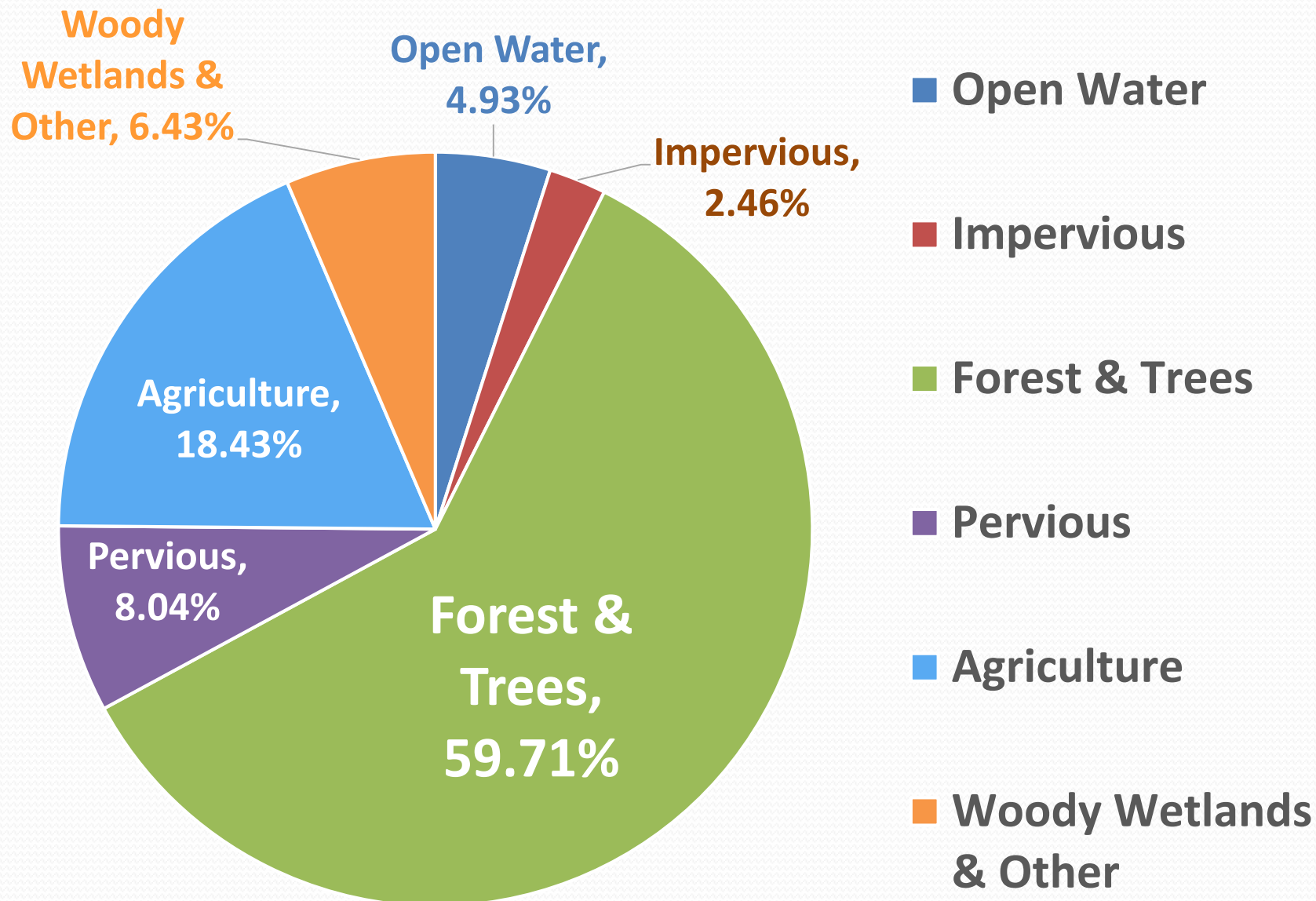
Upper Basin Simplified 2013 Land Cover



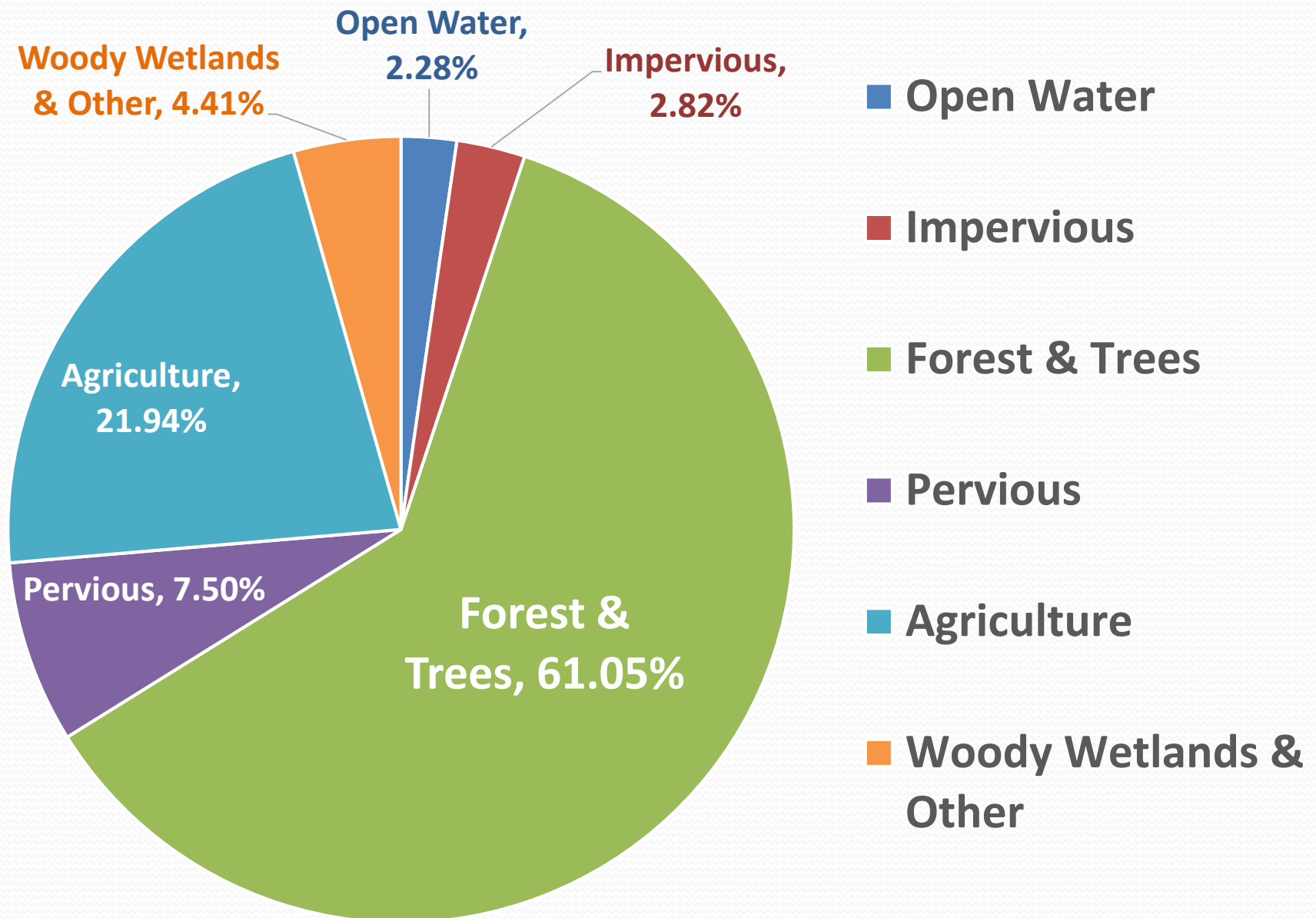
Middle Basin Simplified 2013 Land Cover



Lower Basin Simplified 2013 Land Cover



Total "Rapp" Basin Simplified 2013 Land Cover



Projection Increases, By Decade:

Watershed & Basin Communities

DIFFERENCE:	2000-2010	2010-2016	2010-2020	2020-2030	2030-2040
UPPER	31,452	5,268	7,271	14,981	12,889
	54,162	9,274	12,520	25,797	22,195
MIDDLE	32,001	12,084	16,314	25,828	23,045
	86,606	30,860	44,149	69,895	62,364
LOWER	1,898	-1,112	-141	980	455
	3,194	-1,304	-237	1,649	766
TOTAL	65,350	16,240	26,027	44,895	39,353
	143,962	38,830	56,432	97,341	85,325

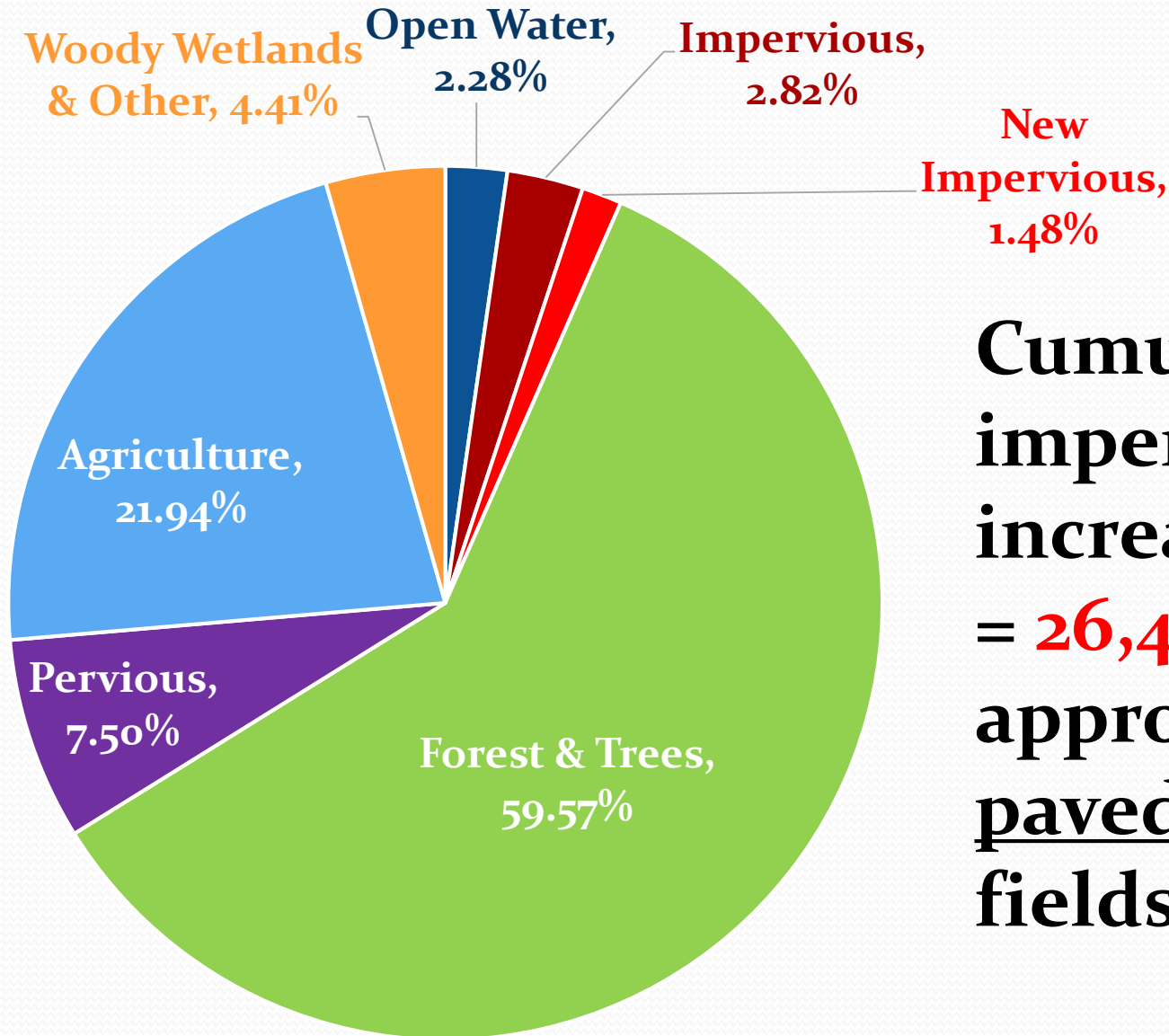
...**200,268** more persons by 2040, or 33% increase over 2016 population level.

RRBC AREA	2013			2020		2030		2040	
	July 1, 2013 Population	Impervious Area (Acres)	Impervious Area (Acres) Per Capita	Population Projection	Impervious Area (Acres) Projection	Population Projection	Impervious Area (Acres) Projection	Population Projection	Impervious Area (Acres) Projection
UPPER BASIN	189,062	31,828	0.1673	196,977	32,957	222,774	36,993	244,969	40,435
MIDDLE BASIN	342,582	37,988	0.1109	371,922	41,076	441,817	45,081	504,181	55,481
LOWER BASIN	60,374	12,921	0.2140	59,972	12,921	62,303	13,284	62,387	13,308
RRBC Area	592,018	82,737	0.1397	628,871	86,954	726,893	95,358	811,537	109,225

	2013-2020		2020-2030		2030-2040	
	Population Change	Impervious Acreage Change	Population Change	Impervious Acreage Change	Population Change	Impervious Acreage Change
Upper	7,915	1,129	25,797	4,035	22,195	3,442
Middle	29,340	3,088	69,895	4,005	62,364	10,400
Lower	-402	0	2,331	363	85	24
Total	36,853	4,217	98,022	8,404	84,644	13,866

**Cumulative
impervious
area increase
in Basin =
26,488 acres or
3.9 x the area of
City of
Fredericksburg
@ 100%
impervious**

Basin-Total Projected 2040 Simplified Land Cover



**Cumulative
impervious
increase in Basin
= 26,488 acres or
approx. 20,066
paved football
fields**

	2013-2020		2020-2025		2013-2025	
	Population Change	Impervious Acreage Change	Population Change	Impervious Acreage Change	Population Change	Impervious Acreage Change
Upper	7,915	1,129	12,899	2,018	20,814	3,147
Middle	29,340	3,088	34,948	2,003	64,288	5,091
Lower	-402	0	1,166	181.5	764	182
Total	36,853	4,217	49,012	4,202	85,865	8,419

Historic & Projected **Total Impervious** Acreage Increase, by Period

RRBC Area	1984- 1992	1992- 2001	2001- 2006	2006- 2013	2013- 2025
Upper RR Basin	3,416	3,1911	2,759	1,406	3,226
Middle RR Basin	4,877	6,175	4,995	2,663	5,411
Lower RR Basin	872	852.9	499	795	819
RRBC Basin Area	9,165	10,219	8,254	4,864	9,456
Ches. Bay Watershed (VA)	84,686	74,803	48,868	40,177	52,078
RRBC Basin Pct of VA CB Watershed	10.8%	13.7%	16.9%	12. 1%	18.2%

(Source: CB LUWG, 2017)

Comparison of Impervious Projection Method Results

- 2013 Population/Impervious Ratio:

Additional Impervious
Acres:

- Upper: 3,147 (-79 ac./ -2.5%)
- Middle: 5,091 (-320 ac./ -6.3%)
- Lower: 182 (-637 ac./ -350%)
- Total RRBC: 8,419

Net Difference: -1,127 acres
(-13.4%)

- CB Land Use Change Model Projection:

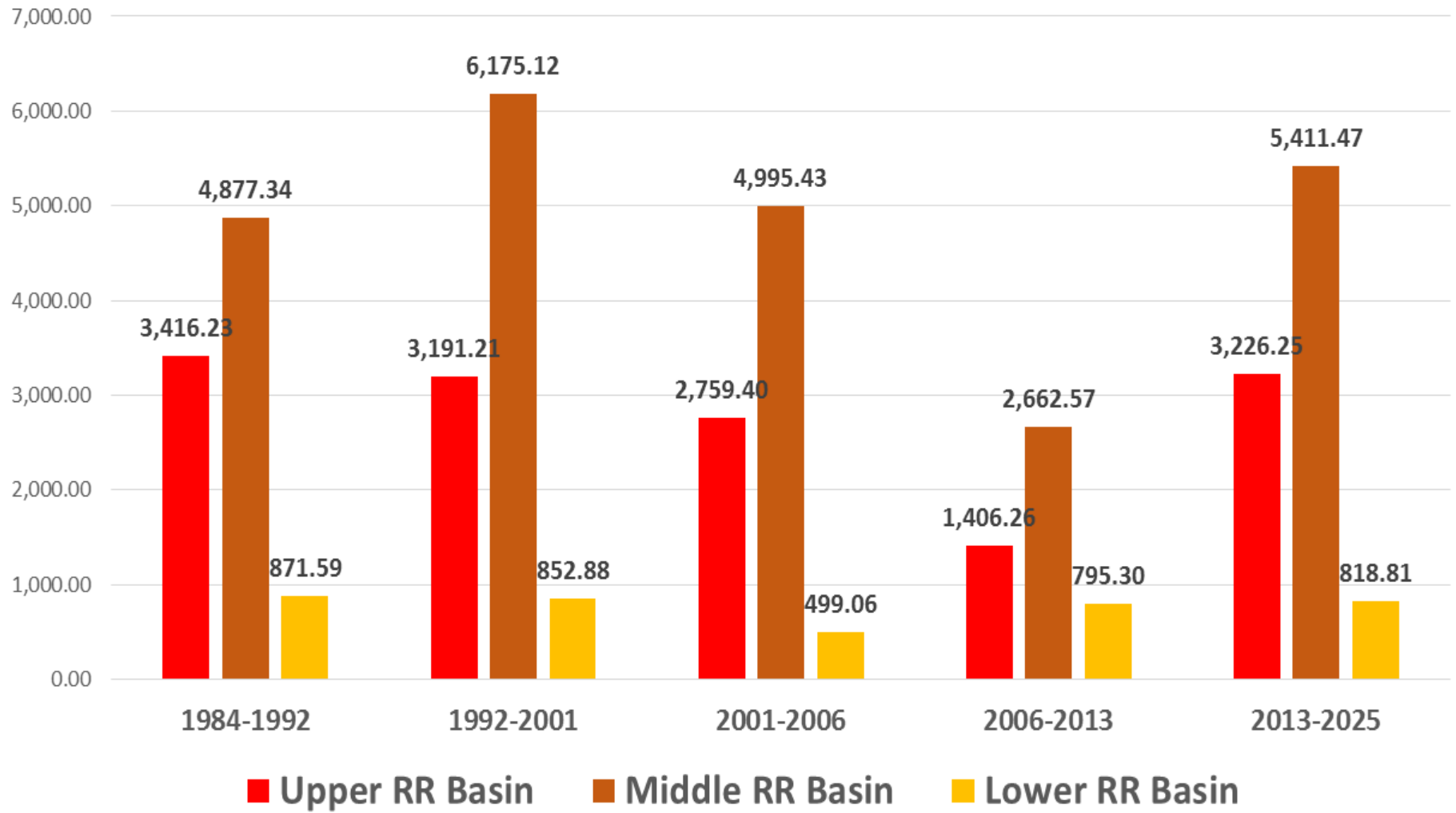
Additional Impervious*

Acres:

- Upper: 3,226
- Middle: 5,411
- Lower: 819 (???)
- Total RRBC: 9,456

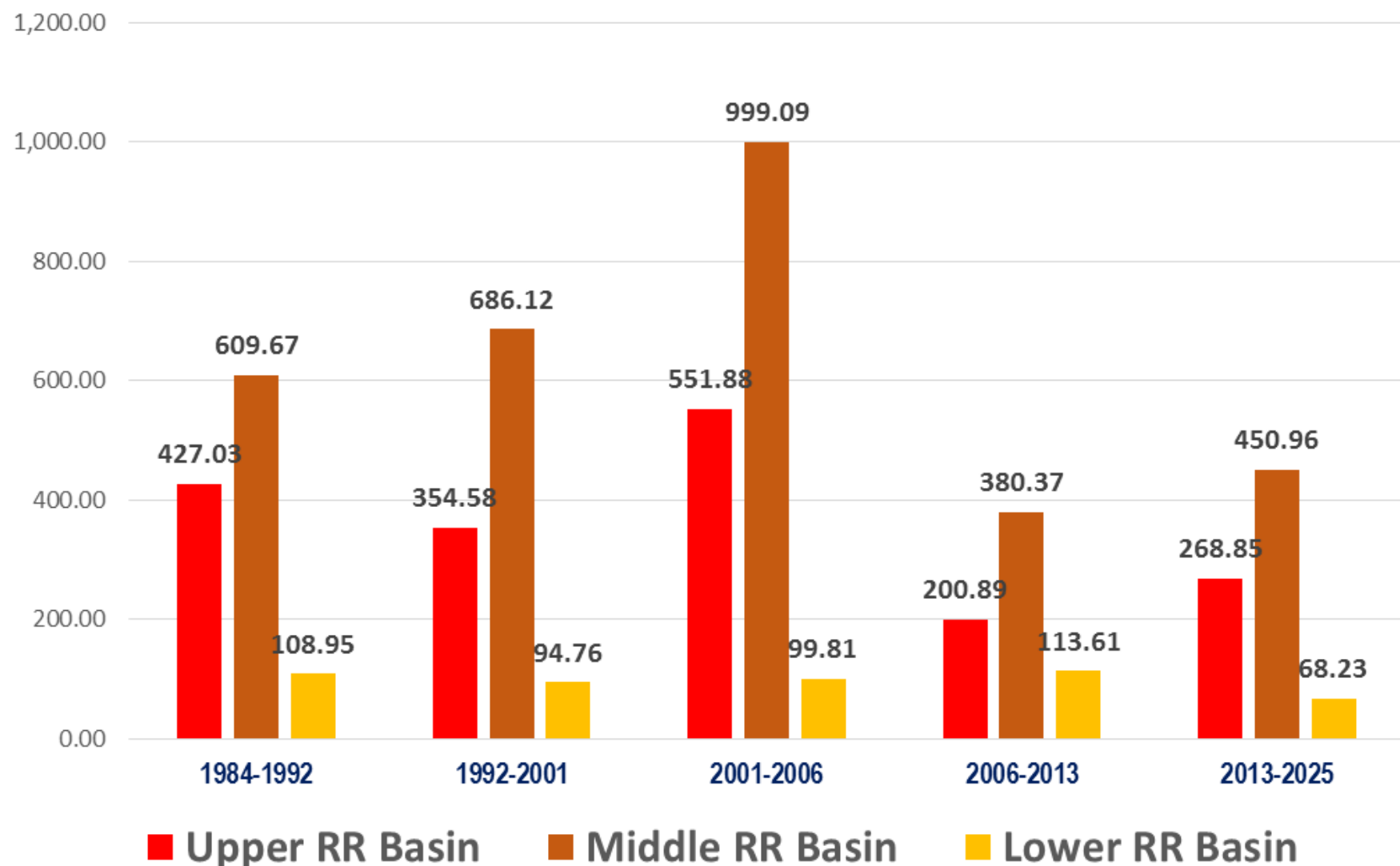
* Including Tree Canopy over Impervious (TCI) estimates

Historic and Projected Trends in Total Impervious Area, by Sub-Basin and Time Period



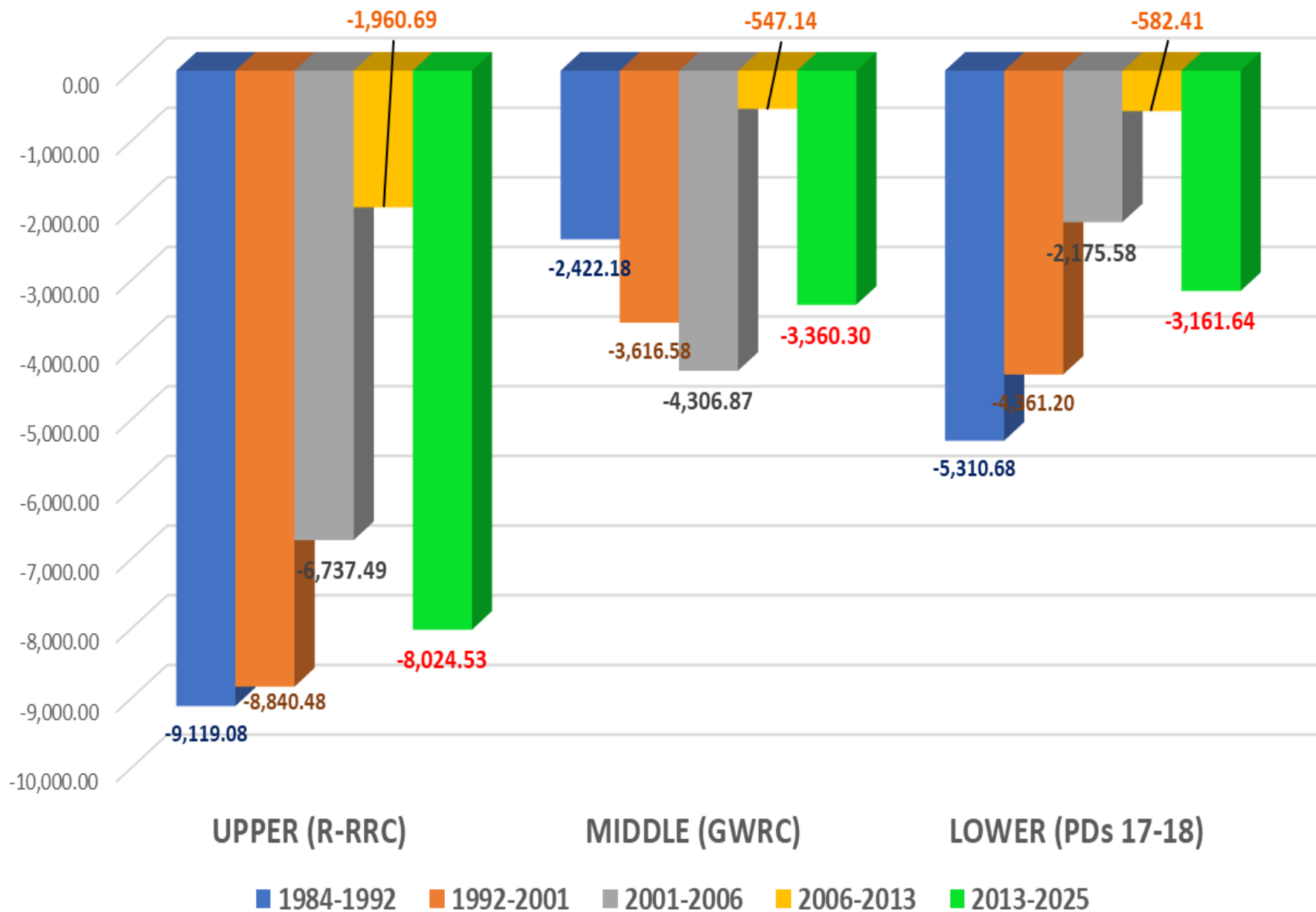
(Source: CB LUWG, 2017)

Annual Average Increase in Impervious Acreage, By Sub-Basin and Time Period

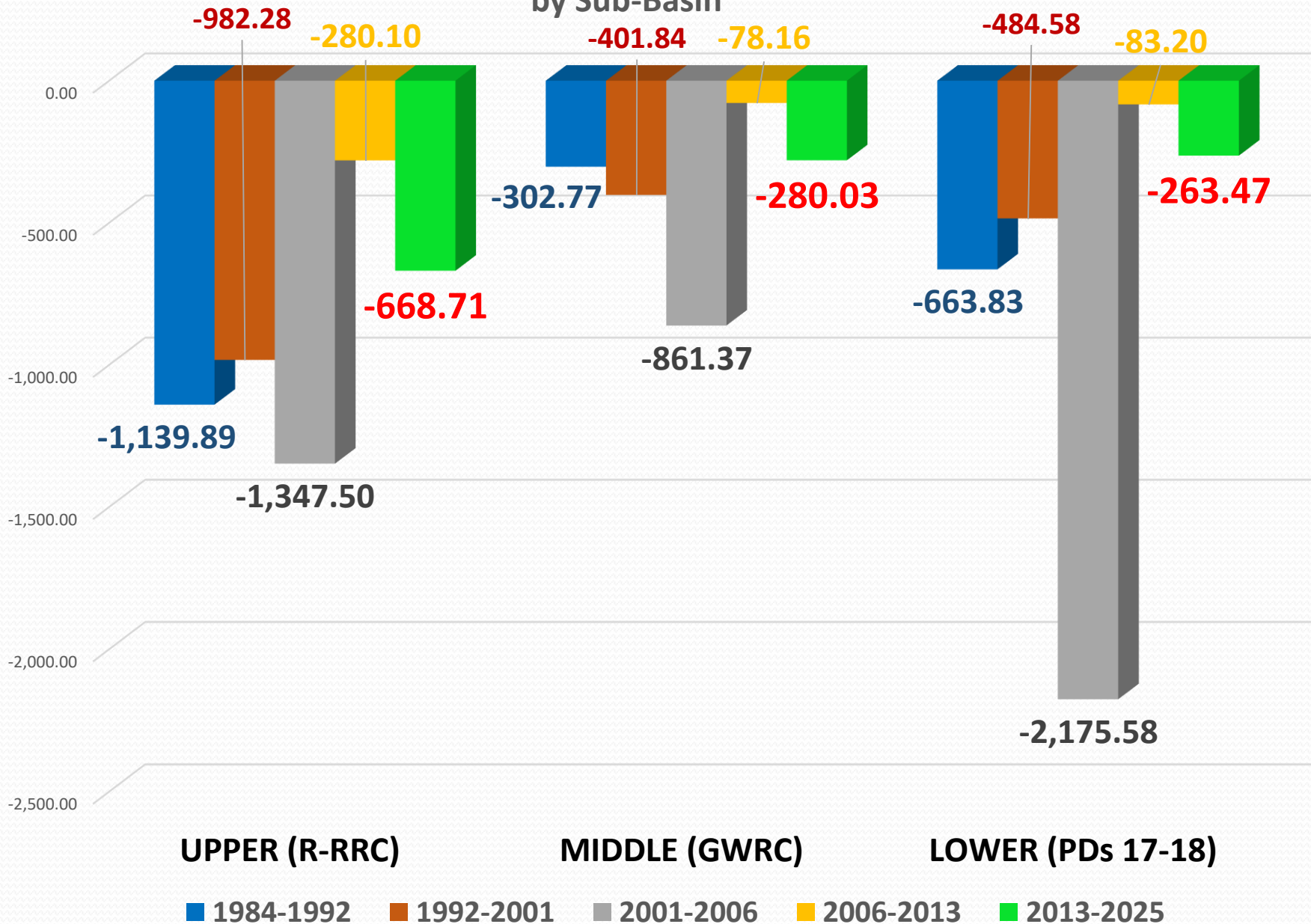


(Source: CB LUWG, 2017)

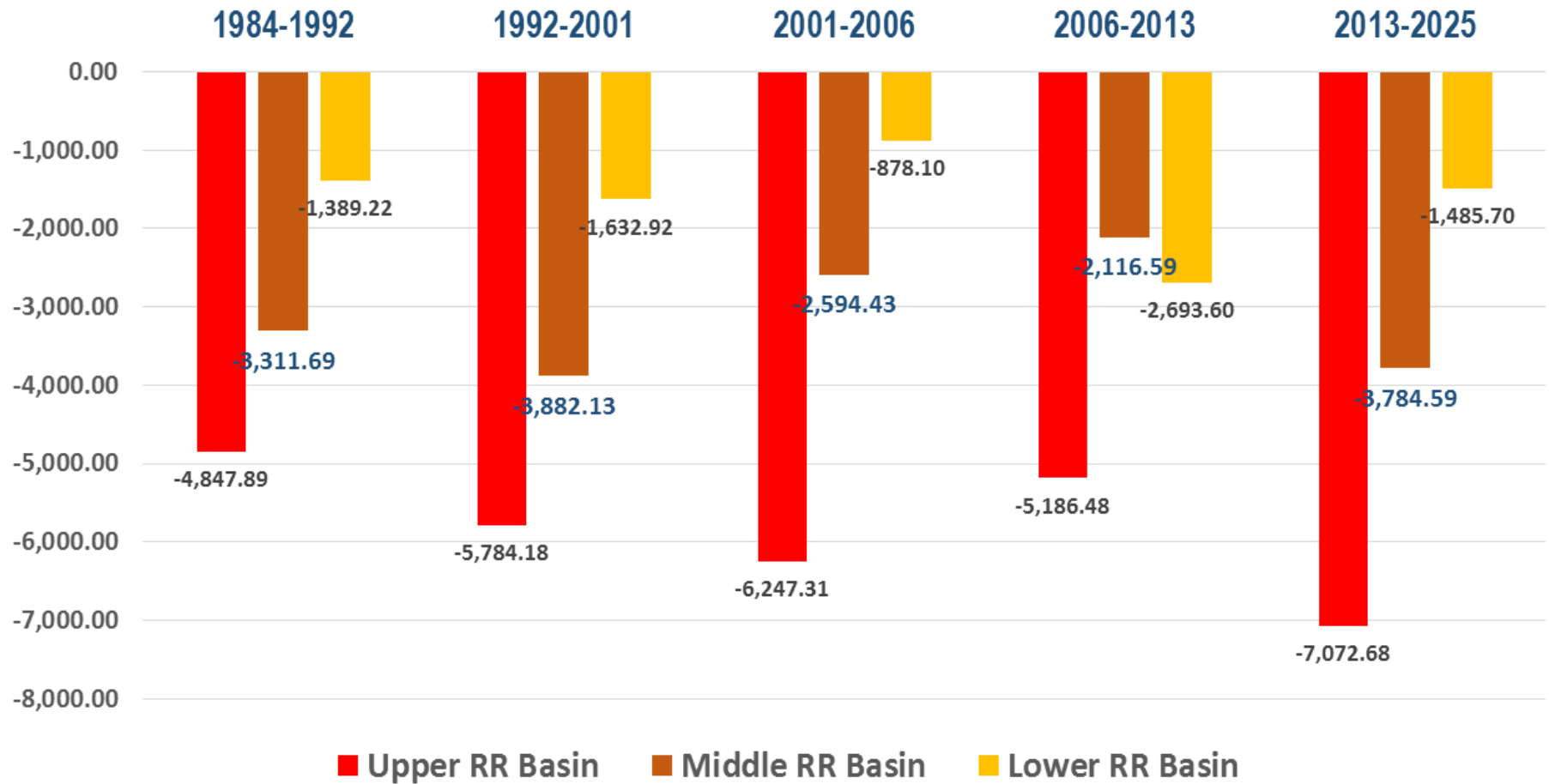
Trends in Historic & Projected Agricultural Landcover Loss by Sub-Basin



Average Annual Trends in Agricultural Landcover Loss, by Sub-Basin

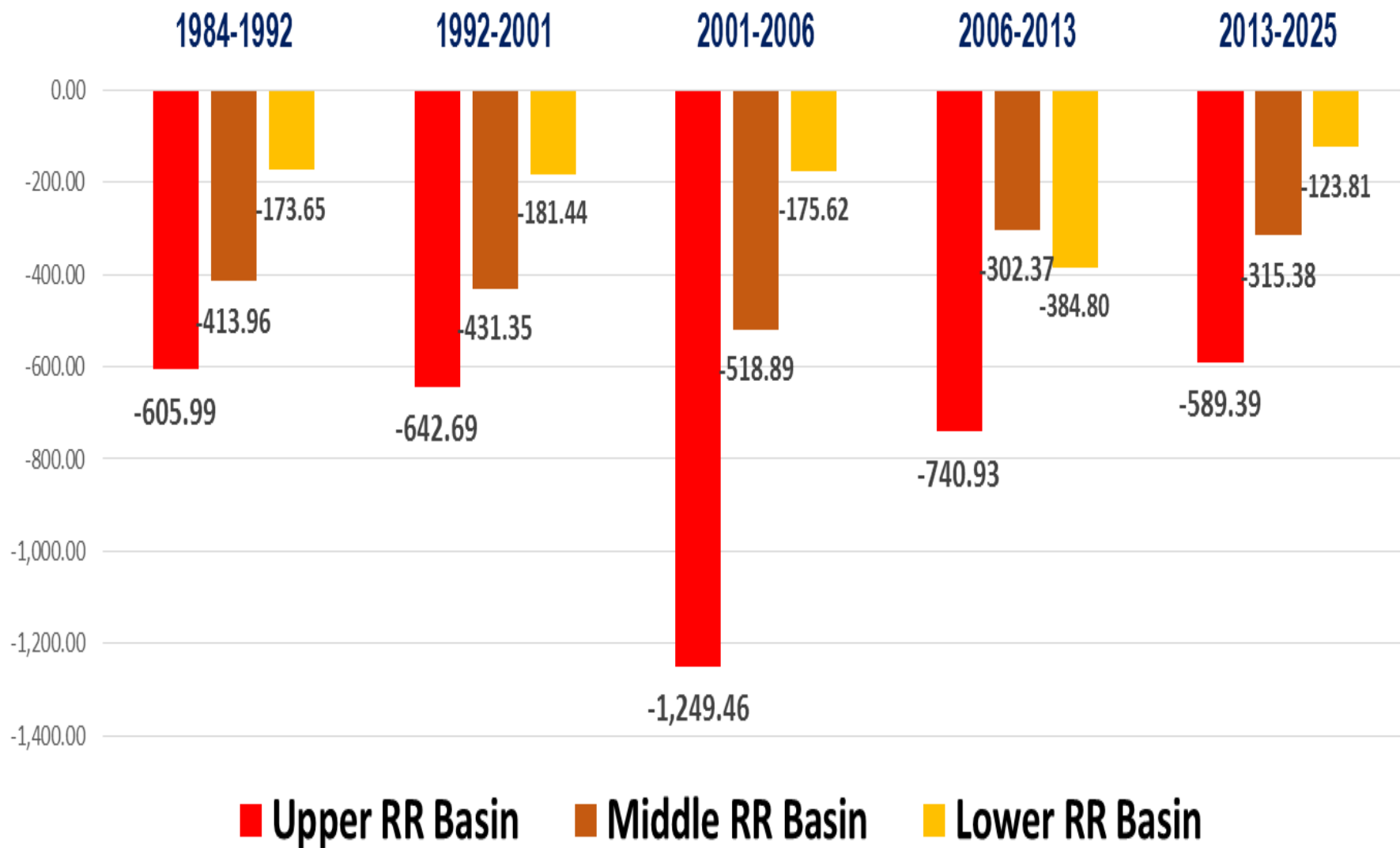


Historic and Projected Forest & Wetland Acreage Loss, By Sub-Basin & Time Period



(Source: CB LUWG, 2017)

Annual Average Historic & Projected Forest & Wetland Acreage Loss, by Time Period



Acknowledgements:

2013 Hi-Resolution Land Cover Data Processing provided by:

- Rappahannock-Rapidan Regional Commission – for data in PDs 9 & 10
- George Washington Regional Commission – for data in PDs 16, 17 & 18



2013-2025 Land Cover Projections provided by: Peter Claggett, USGS

QUESTIONS?



kfbyrnes@Verizon.net