Phase 7: Land Use Time Series (1985-2021)

Sarah M. McDonald

USGS, Lower Mississippi Gulf Water Science Center

Land Use Work Group Office Hours

March 3, 2026

U.S. Department of the Interior
U.S. Geological Survey

Agenda

- What is the review timeline?
- What kind of feedback should I be giving?
- When will my counties be available?
- What review materials are available?
  - How do I use the web-app?
  - How do I access the Land-River Segment land use data?
  - Where can I find updated methods?
- Examples

Review Timeline and Feedback

Timeline

- **Review Period:** March 3rd – March 27th, 2026
- **CAST Input Due Date:** April 1st, 2026

- **What if we need more time for review?** Short answer – keep reviewing and sharing feedback and email me by March 27th telling me how much more time is needed.
  - If nothing in that feedback requires data updates, the timeline will still be met.
  - If changes are required that will delay the April 1st delivery, we'll cross that bridge when we get there.

What Feedback should I Provide?

- All feedback is welcome!

- I request you identify each piece of feedback as one of the following categories:
  - **Question** – want to better understand the data/methods/etc. and/or not sure yet if it is an issue or error
  - **Issue** – you want the feedback documented but are okay if it cannot be addressed in the data
  - **Error** – you request the feedback to be addressed, even if it affects the timeline

- Other helpful information to provide with the feedback
  - Is it something you've seen in multiple places (i.e. systematic error)?
  - Is it something you've only seen in 1 out of x number of counties you've reviewed (i.e. local error)?

When should I Provide Feedback?

- As you identify issues, please share them
  - This gives me more time to address it, and more time for iteration if needed
  - This also prevents me receiving all feedback at the end of the review period

- For example, if you've set aside a week to review 15 counties, I'd prefer an email per day of any issues identified

When will my counties be available?

- Counties will be released in batches
- First batch will be available today/tomorrow
- Remaining counties will be released daily as they are available

Review Materials

Land Use Trends Web-App

https://gis.chesapeakebay.net/lulctrends/

- Source to view and access data for review

- Charts on the web-app for comparing Watershed-portion of counties sector-level Phase 7 trends with Phase 6
- Access to download the Land-River Segment scale data (includes counties and HUCs)
- Access to watershed portion of county trend reports

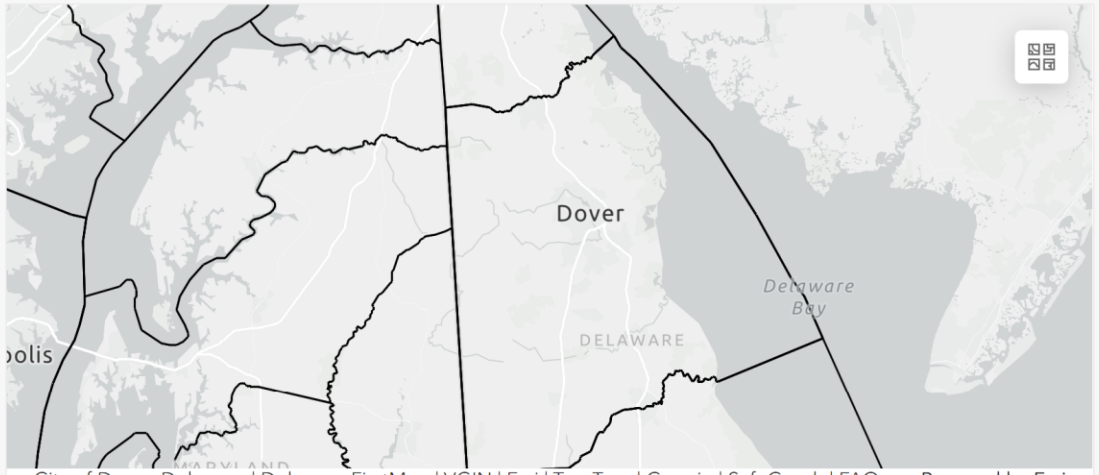
https://gis.chesapeakebay.net/lulctrends/

Land Use Trends by County and Watershed Model Phase

Select a State: Delaware

Select a County: Kent County

Total Non-Tidal Acres Within the Watershed for Kent County, DE: 131,427



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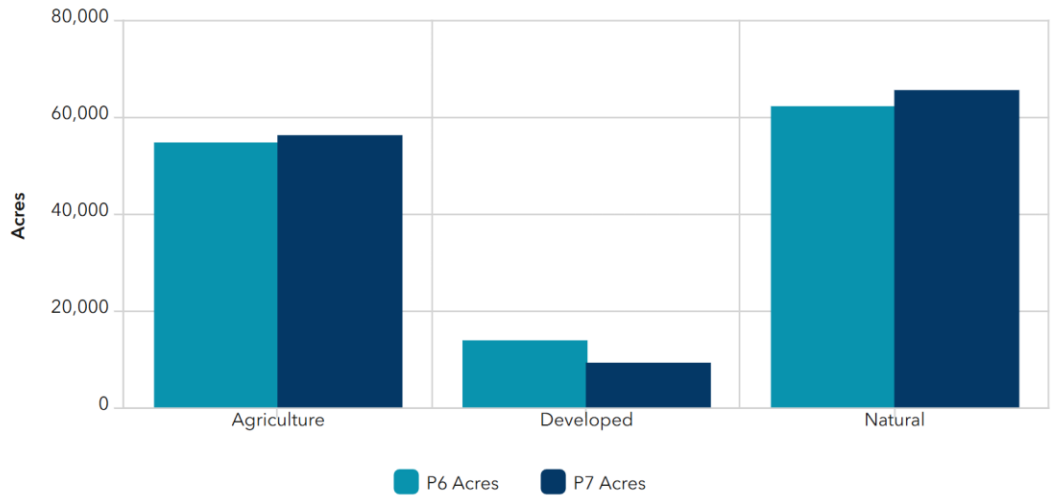

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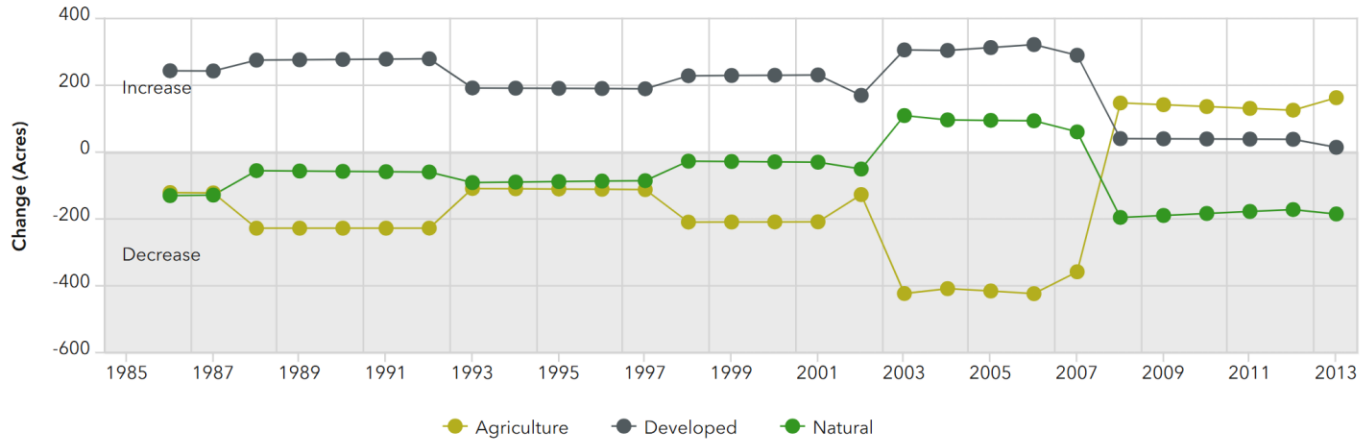

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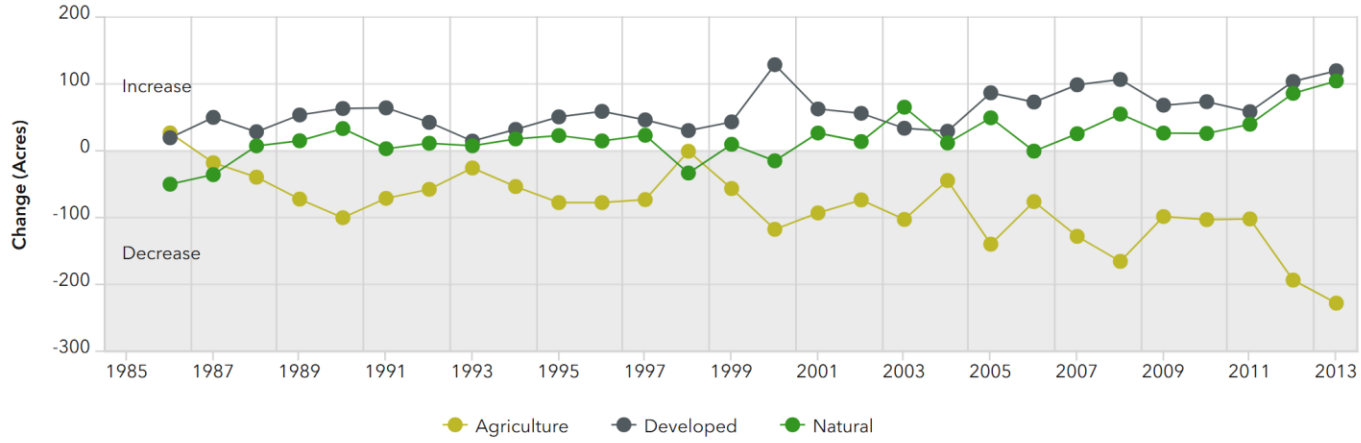

Download the PDF report for Kent County, DE here. The full datasets for acreage by model phase and annual change are also available for download. **Land use acreages are only for areas within the Chesapeake Bay watershed.** Areas outside the watershed are excluded from these data.

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Select state and county of interest using the drop-down lists

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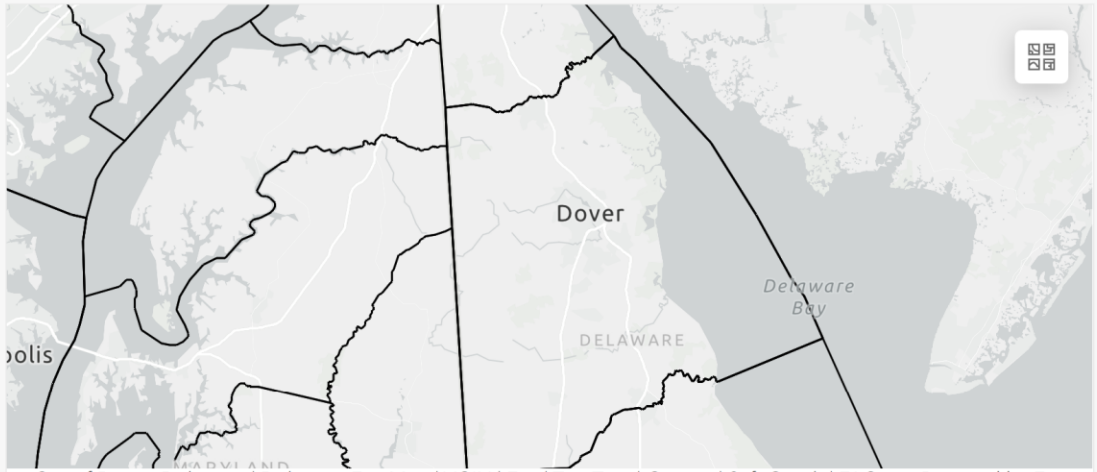

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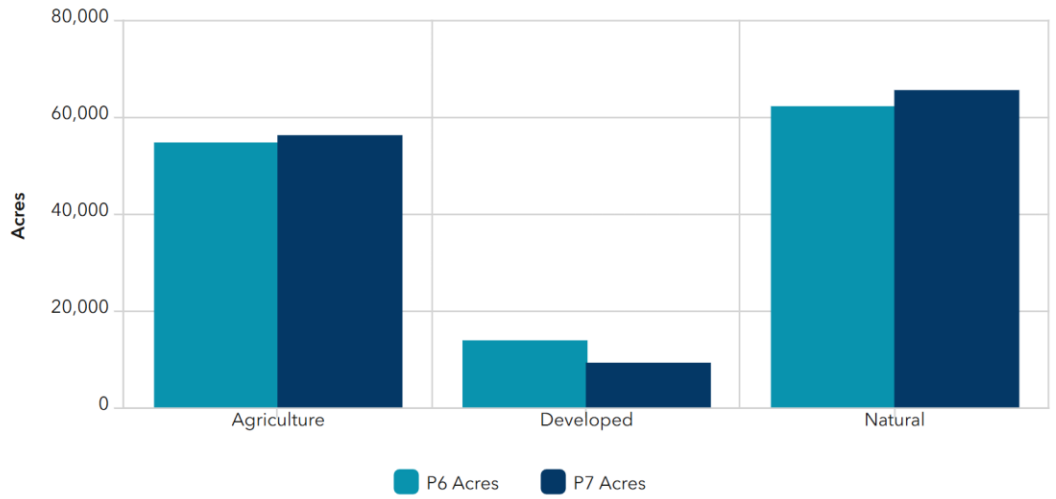

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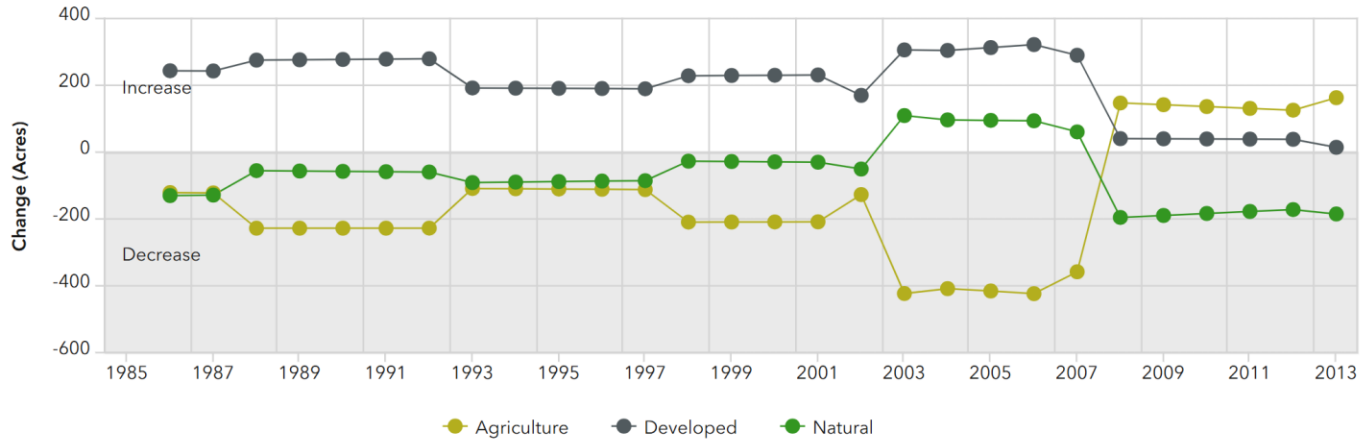

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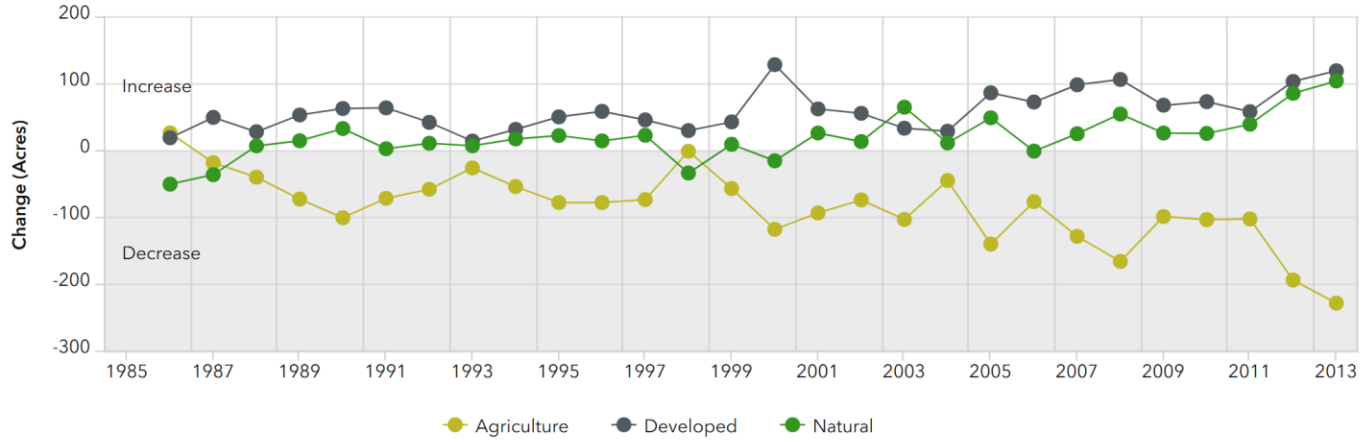

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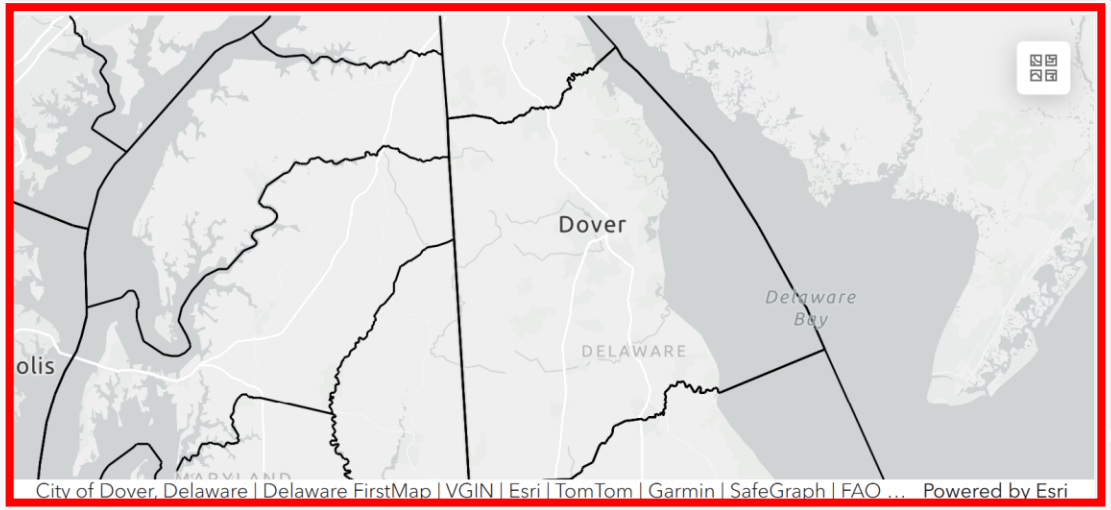
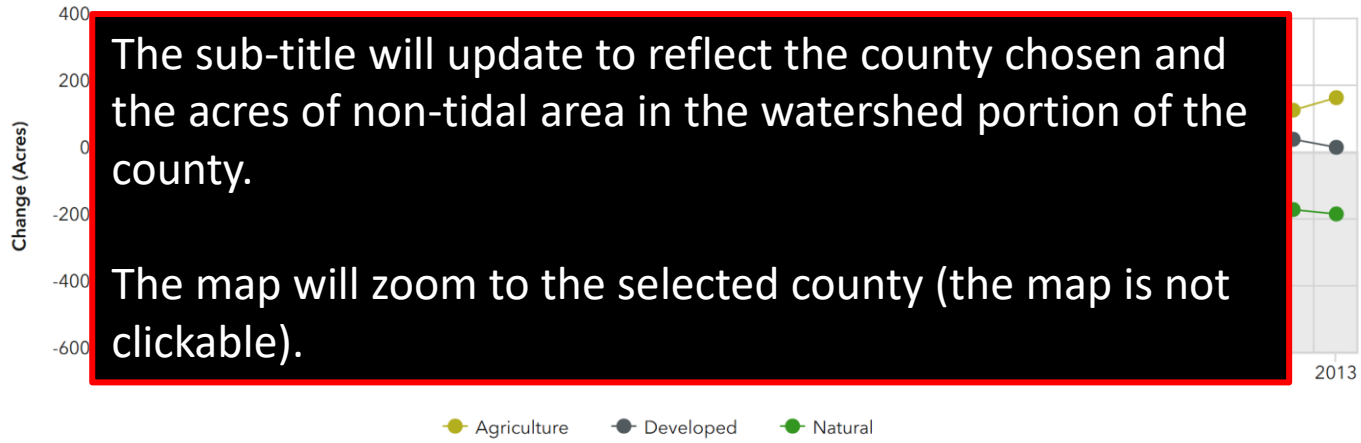


The sub-title will update to reflect the county chosen and the acres of non-tidal area in the watershed portion of the county.

The map will zoom to the selected county (the map is not clickable).

Phase 6 Change in Acres by Year



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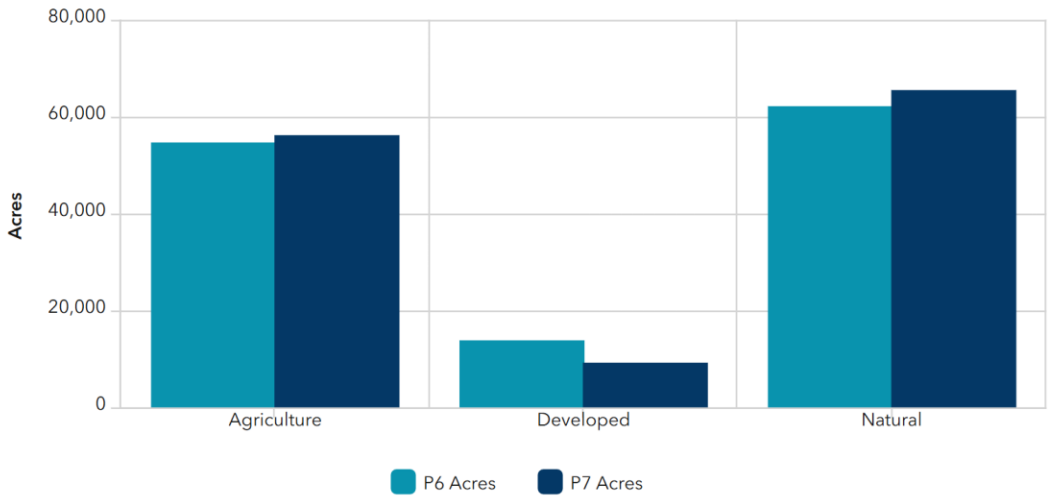

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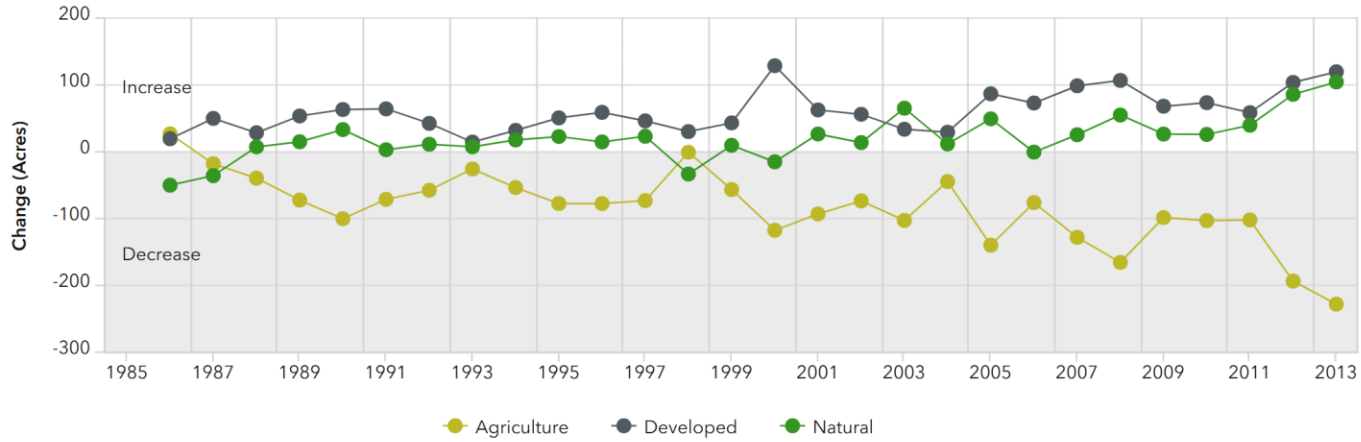

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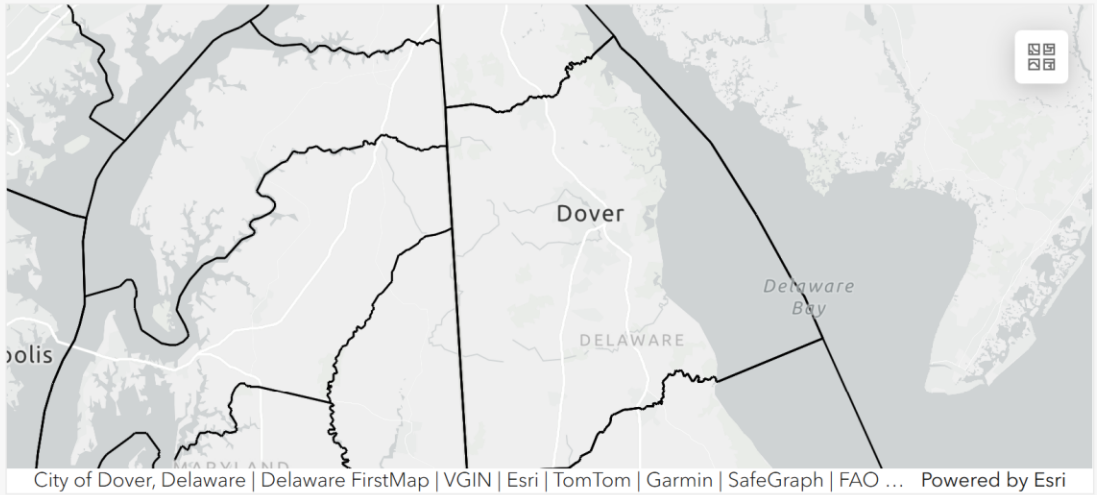

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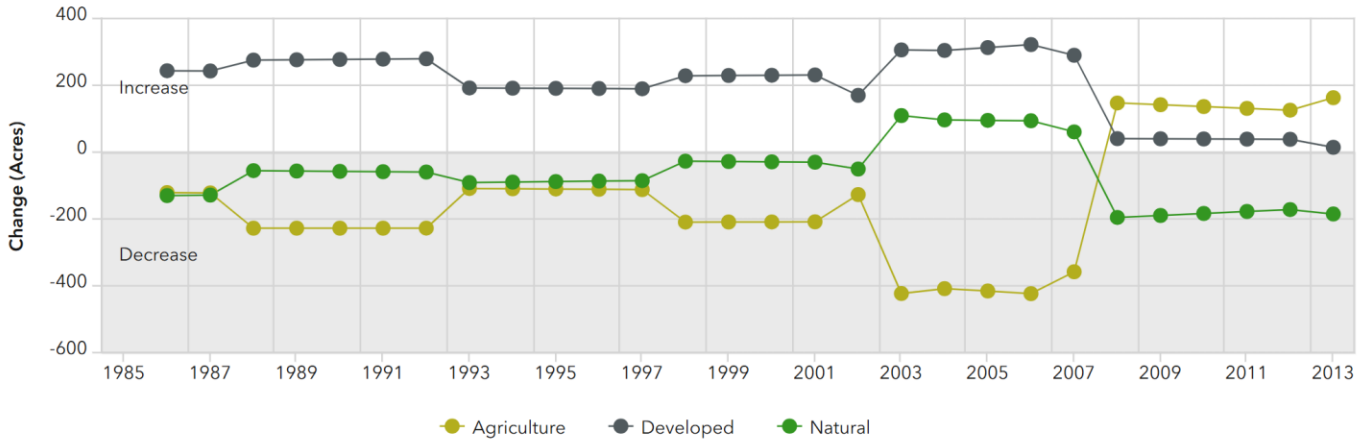

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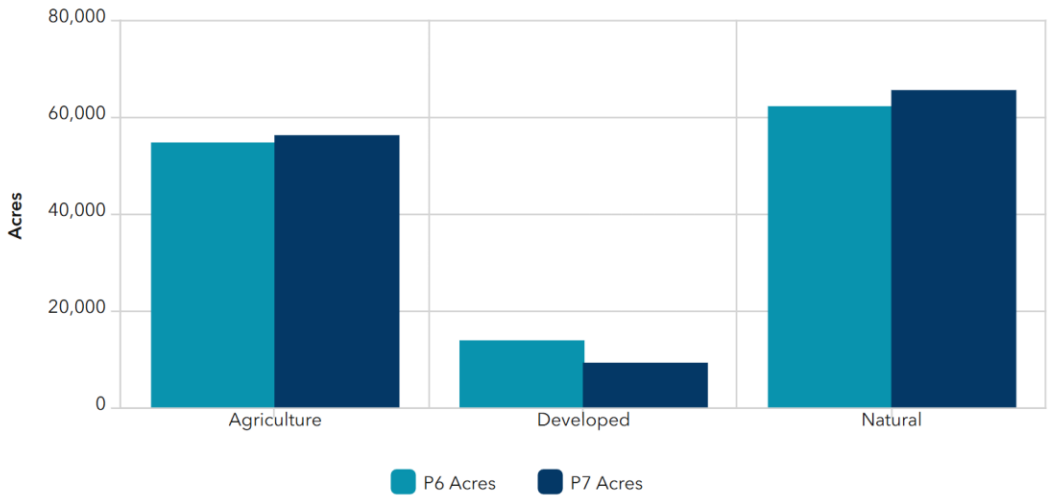

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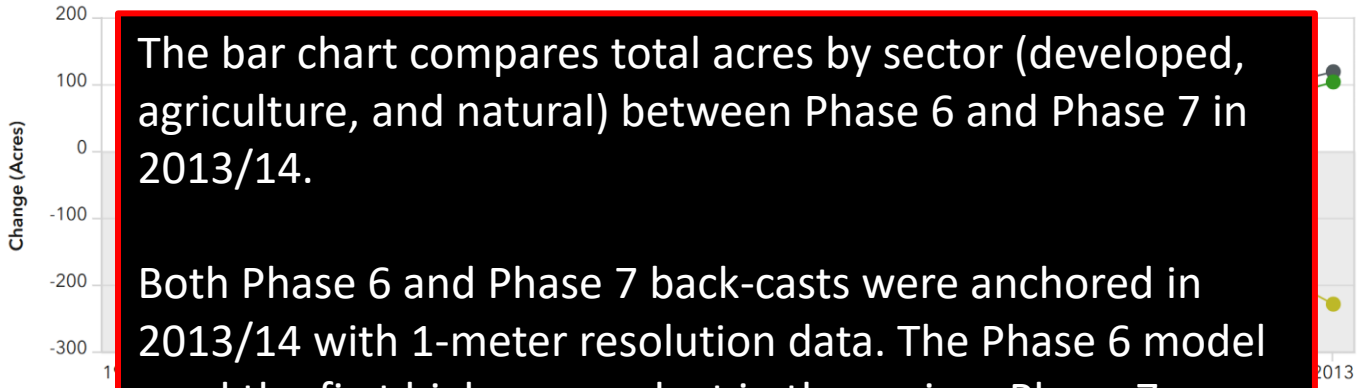

The bar chart compares total acres by sector (developed, agriculture, and natural) between Phase 6 and Phase 7 in 2013/14.

Both Phase 6 and Phase 7 back-casts were anchored in 2013/14 with 1-meter resolution data. The Phase 6 model used the first high-res product in the region. Phase 7 uses the most up-to-date iteration of the high-res 2013/14 map. This chart compares the “starting points” of the backcasts.

Downloa... for downl... from these data.

https://gis.chesapeakebay.net/lulctrends/

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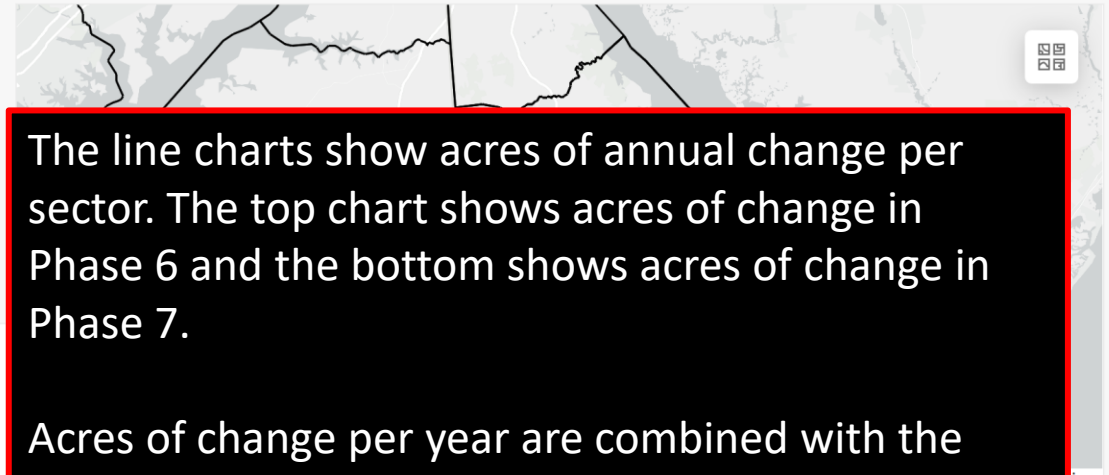
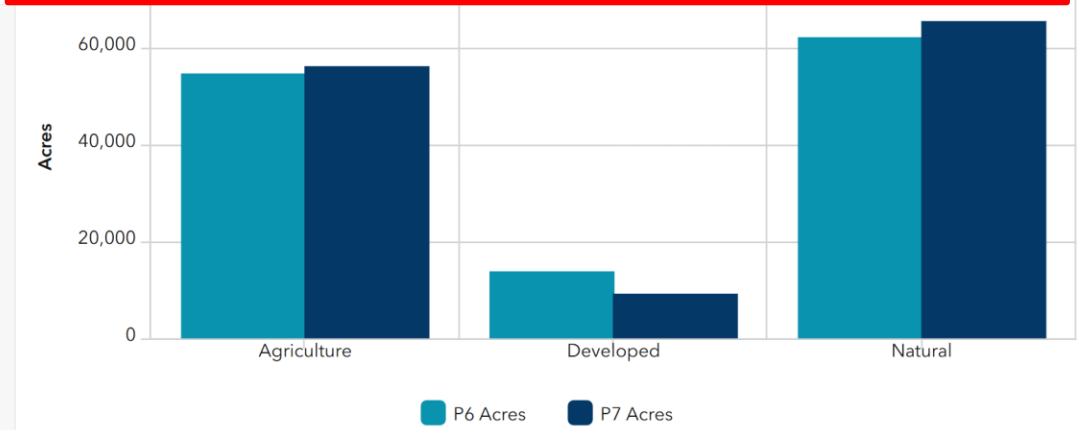
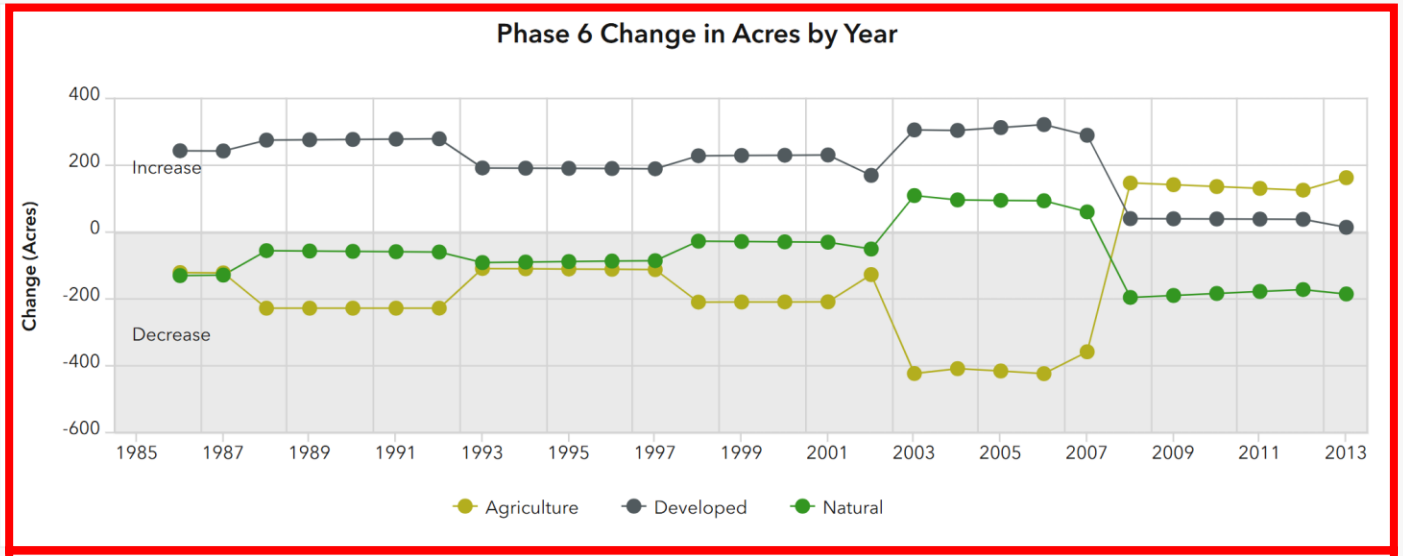
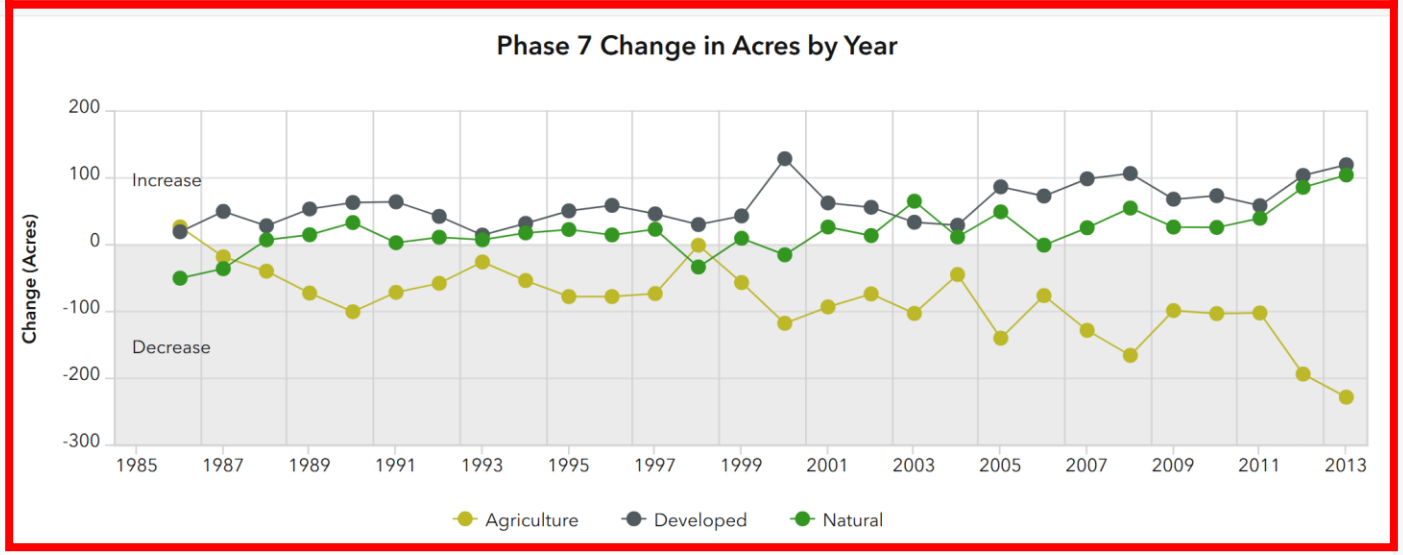


The line charts show acres of annual change per sector. The top chart shows acres of change in Phase 6 and the bottom shows acres of change in Phase 7.

Acres of change per year are combined with the 2013/14 starting point to generate total acres over time. Comparing annual change between the phases is one way to compare trends.







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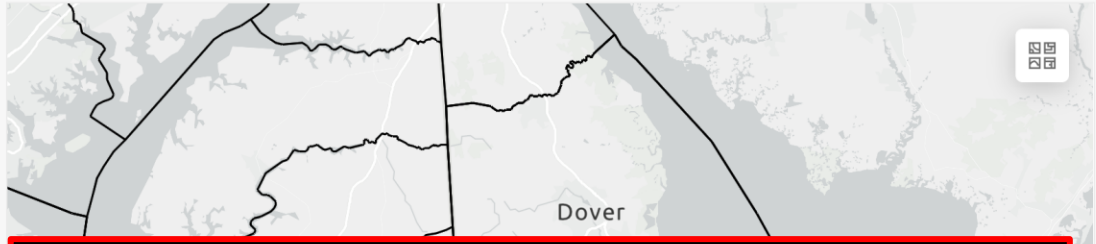
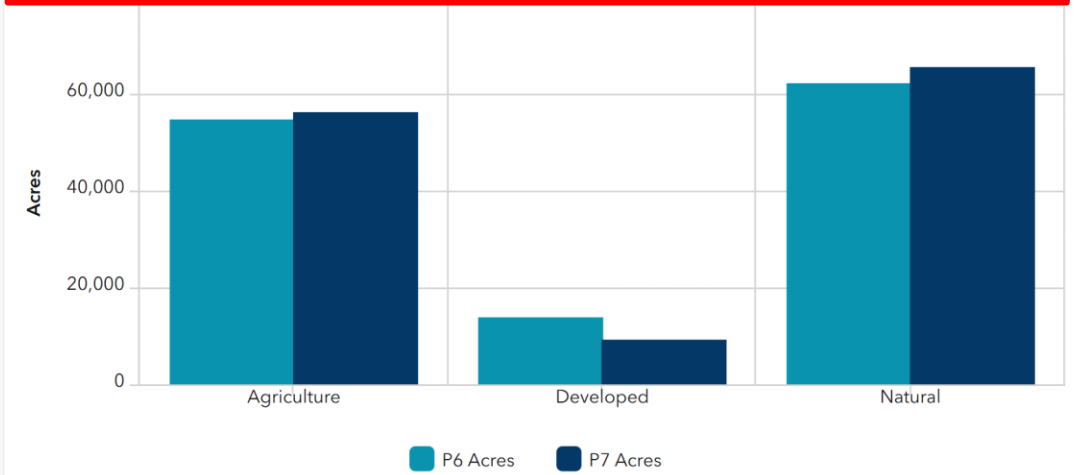


You can click the sector names in the legends of the line charts to toggle them on/off.

In the example shown here, I've toggled off Developed and Natural to focus on comparing agriculture trends between the phases.



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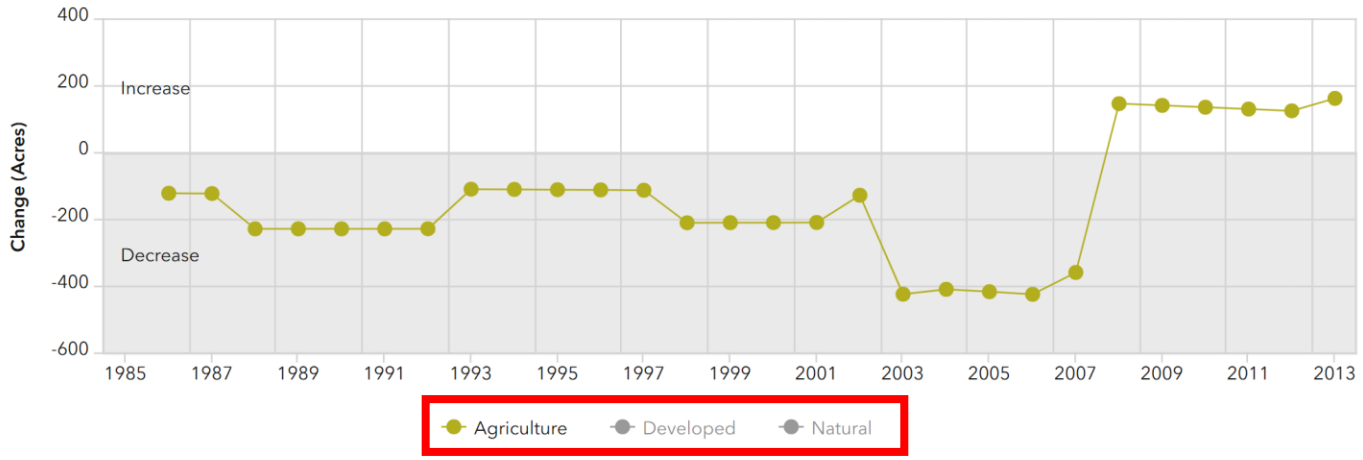
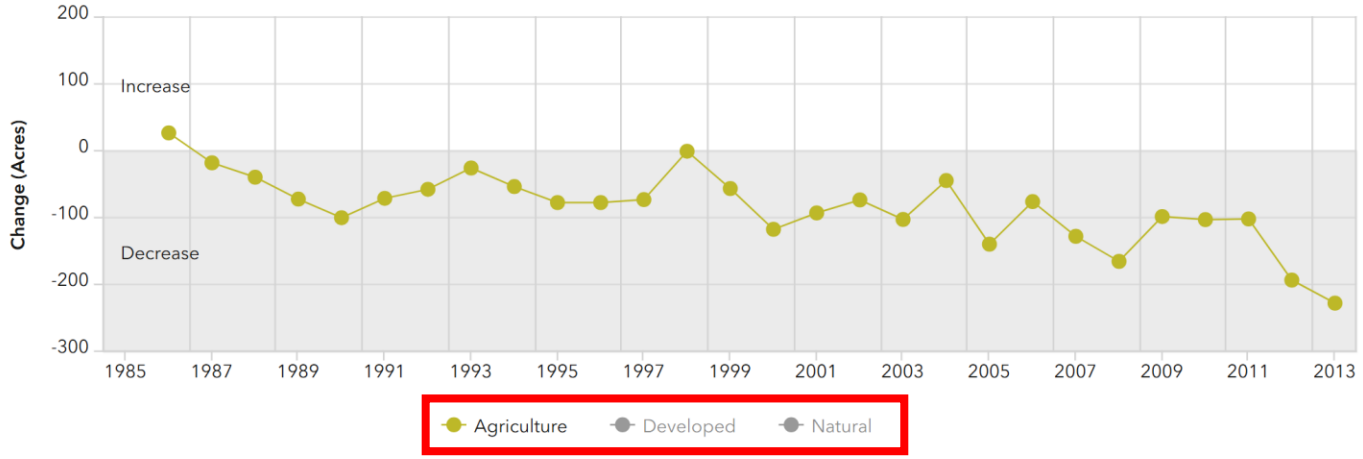


Phase 7 Change in Acres by Year



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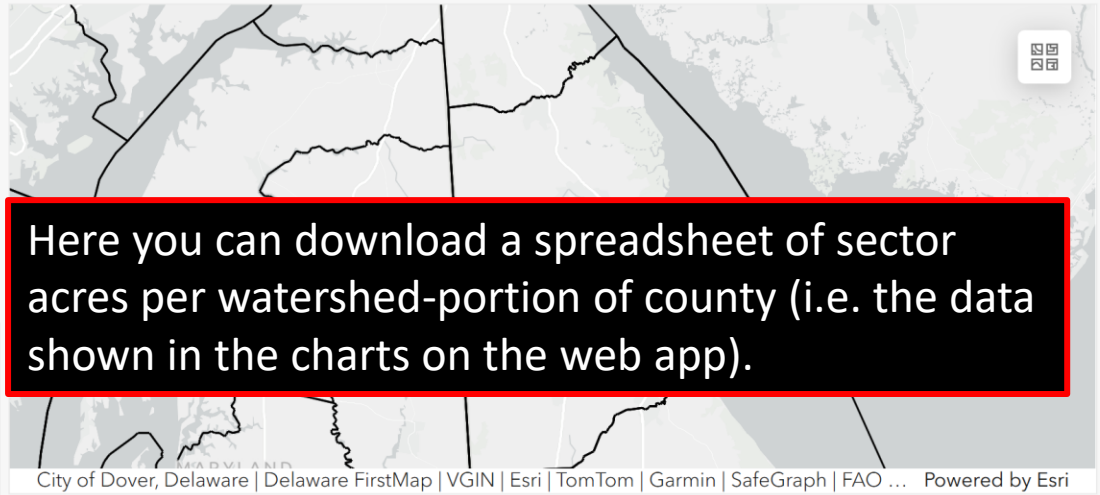
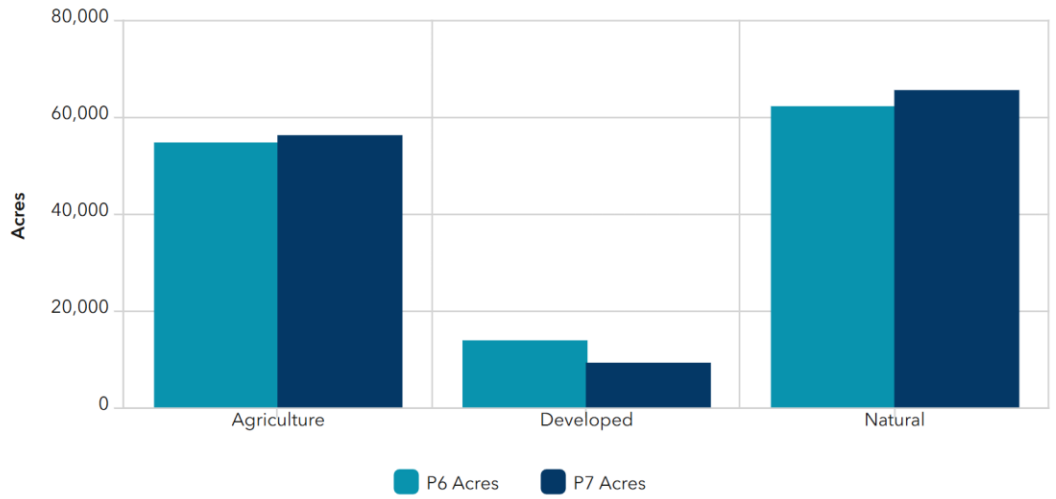


Here you can download a spreadsheet of sector acres per watershed-portion of county (i.e. the data shown in the charts on the web app).

Phase 6 and Phase 7 Acres by Sector (2013/2014)



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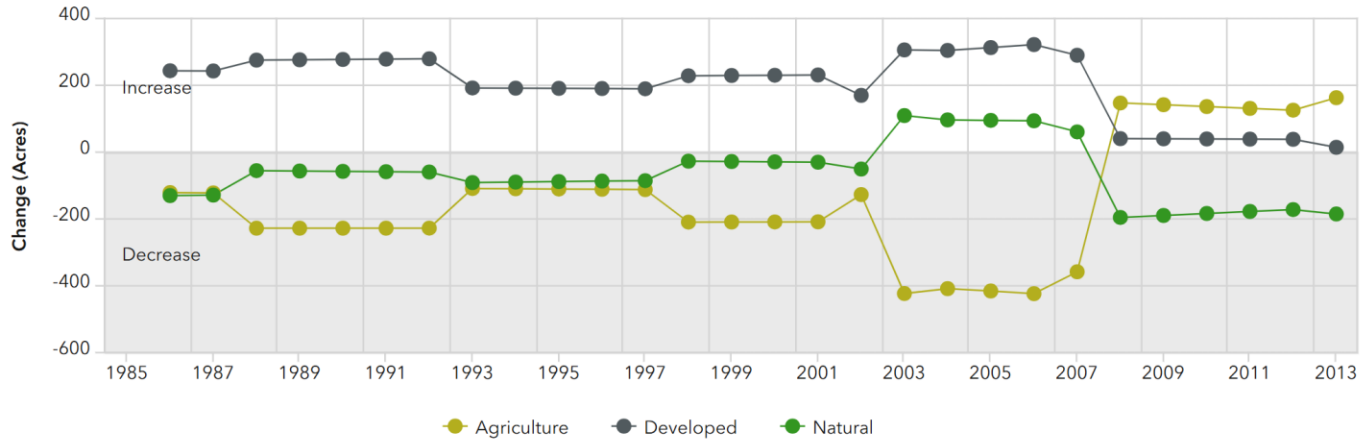

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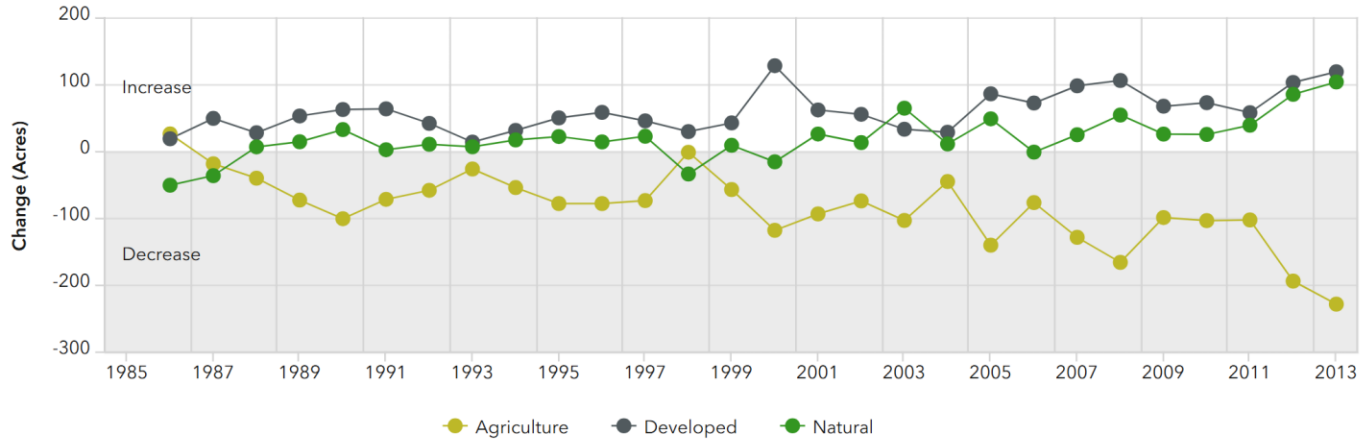

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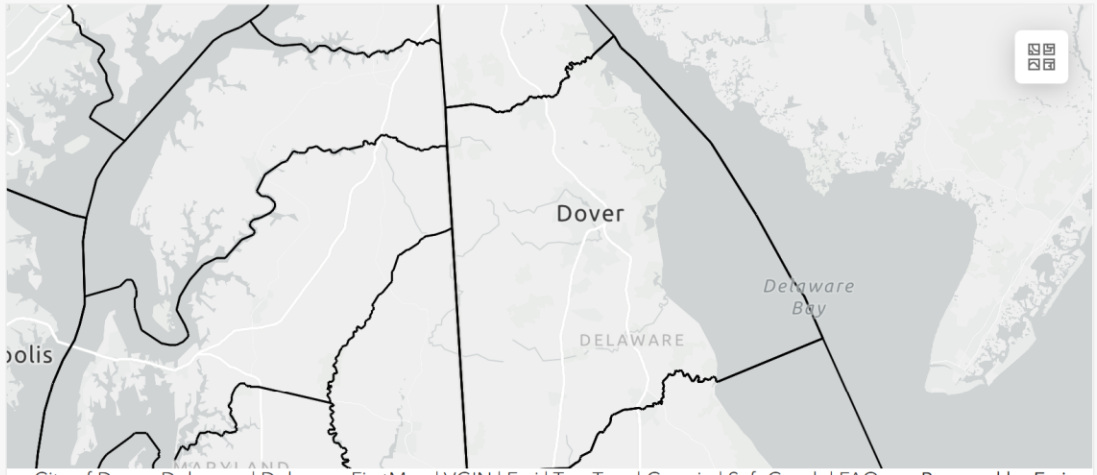

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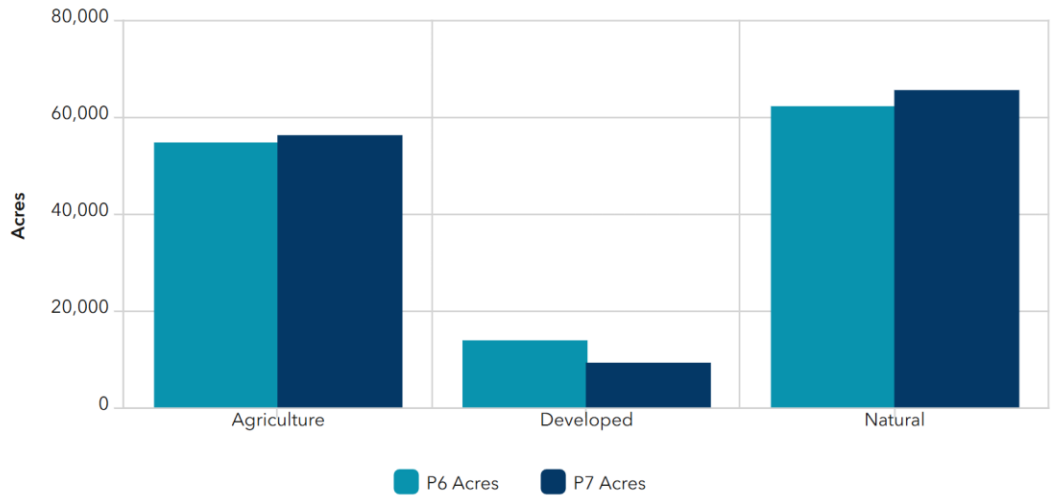

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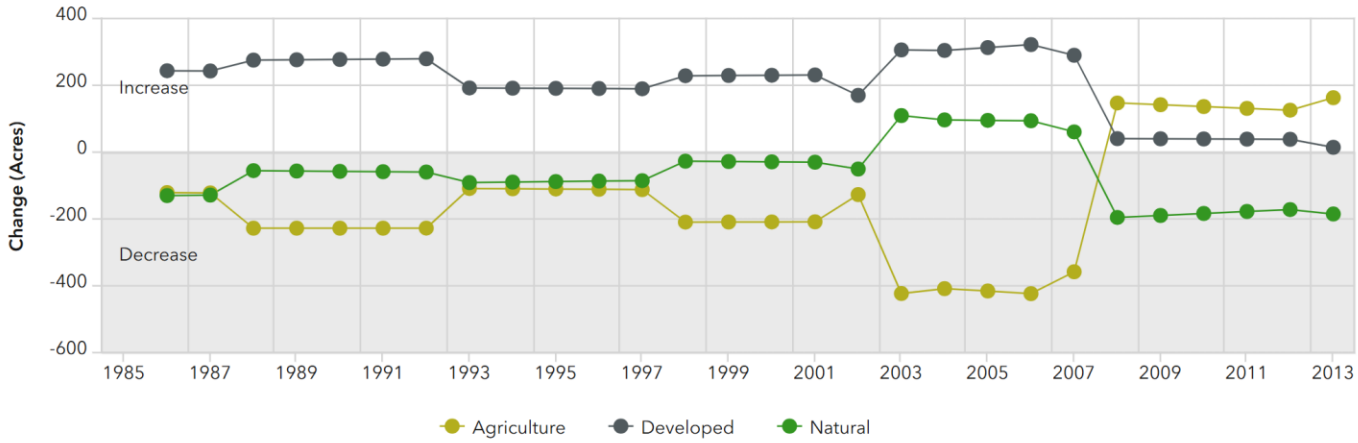

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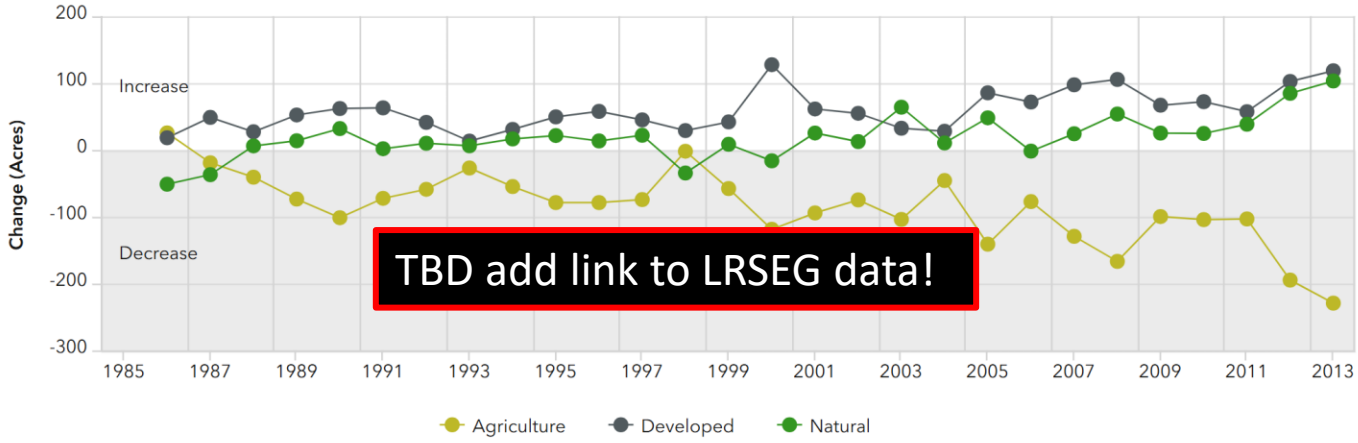

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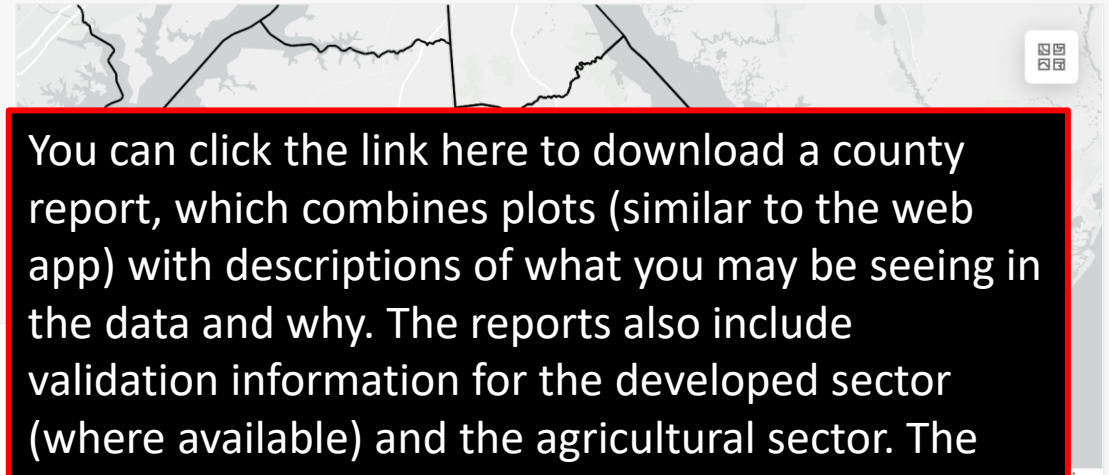
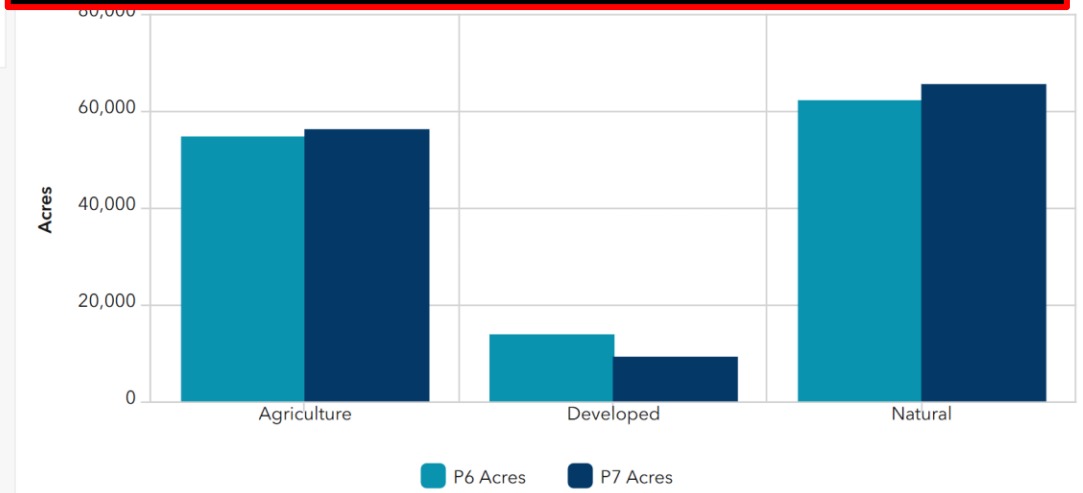


You can click the link here to download a county report, which combines plots (similar to the web app) with descriptions of what you may be seeing in the data and why. The reports also include validation information for the developed sector (where available) and the agricultural sector. The reports also include a look at overall Phase 7 land use trends.



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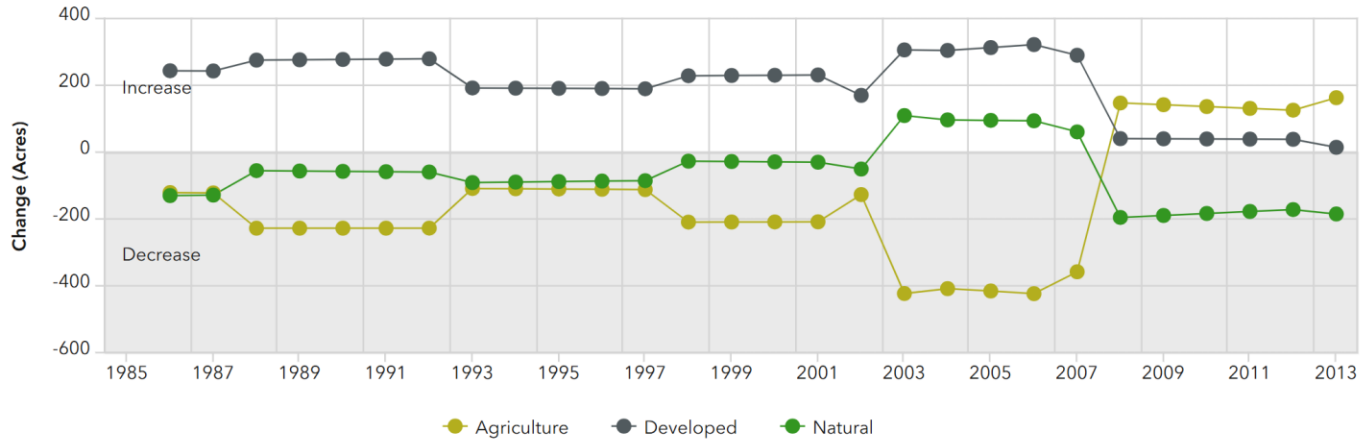

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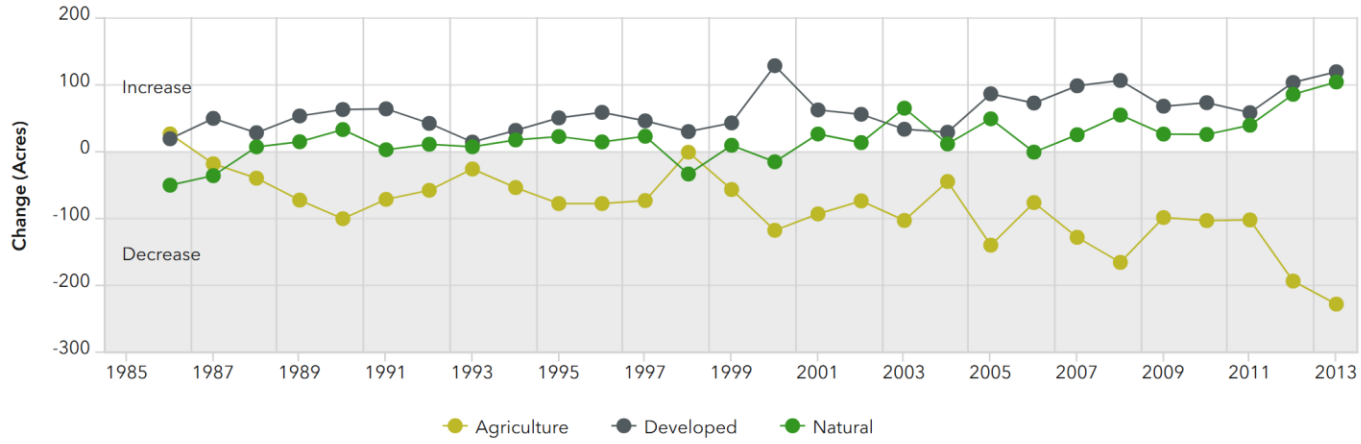

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This Presentation

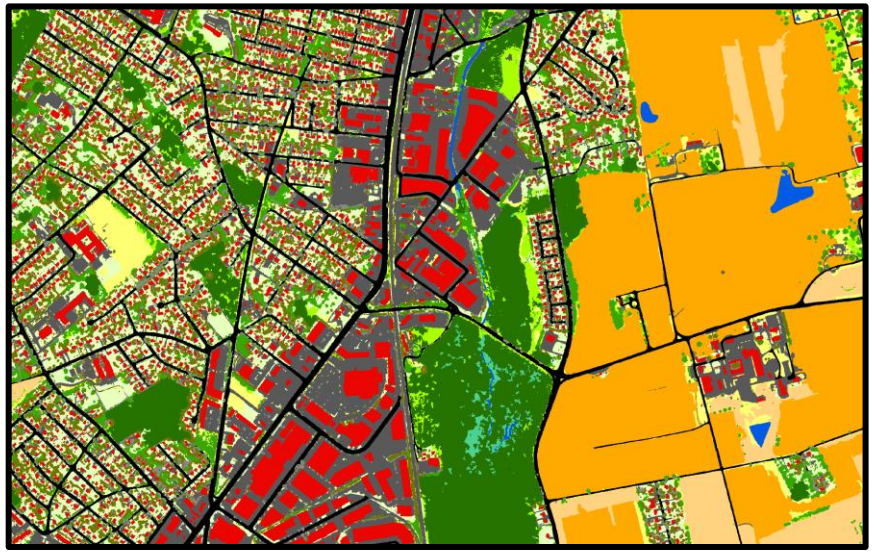
- Phase 7 documentation is not yet complete. Methods are described in the next section of this presentation for your reference during the review period.

Methods

Data

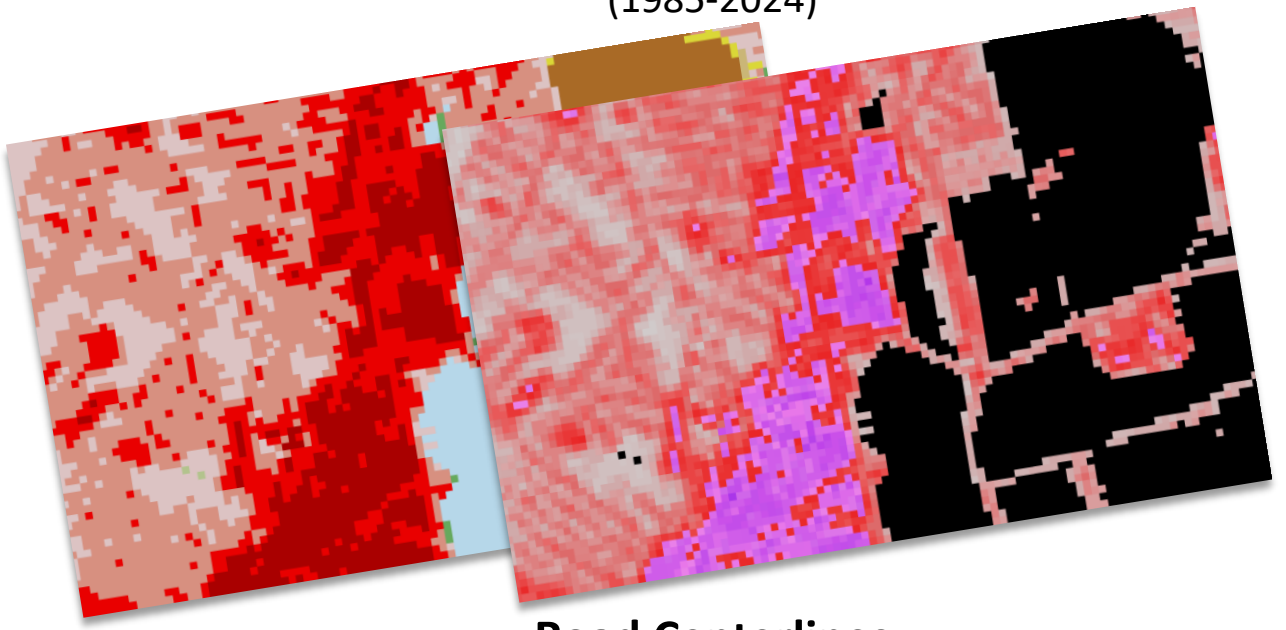
High-Resolution Land Use/Land Cover

Land Use
2013/14, 2017/18, 2021/22



National Land Cover Database (NLCD)

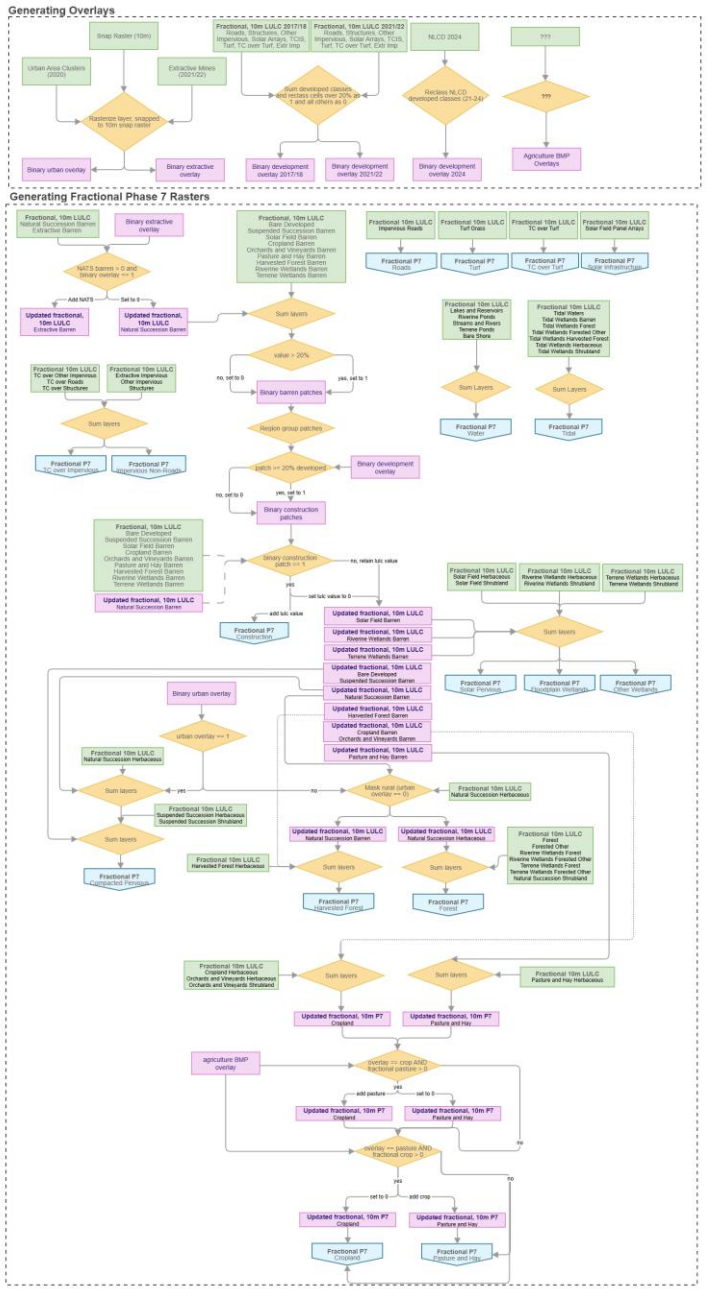
Annual Land Cover and % Impervious
(1985-2024)



Parcel Boundaries

Road Centerlines

1. Generate Phase 7 Maps for 2013/14, 2017/18, 2021/22



- To speed up processing, the 1-meter, 56-class Land Use/Land Cover is resampled to 10-meter resolution fractional datasets, where each 10-meter pixel is the % of class area (e.g. A pixel with value 25 in the “Turf” 10-meter raster means that pixel is 25% turf). This is done for all 56 classes and all 3 mapping periods.

- The data are reclassified from the 56-classes to the Phase 7 classes, incorporating decisions made by the workgroups.

2. Aligning LULC and NLCD Classifications

% of LULC Class Area Shared with NLCD in 2013/14

NLCD (x) LULC (y)	Water	Forest and wetlands	Agriculture	Open Space	Development
Water	70%	0%	0%	0%	0%
Forest and wetlands	18%	87%	3%	18%	9%
Agriculture	5%	6%	91%	24%	16%
Open Space	3%	2%	1%	28%	1%
Development	4%	5%	6%	29%	74%

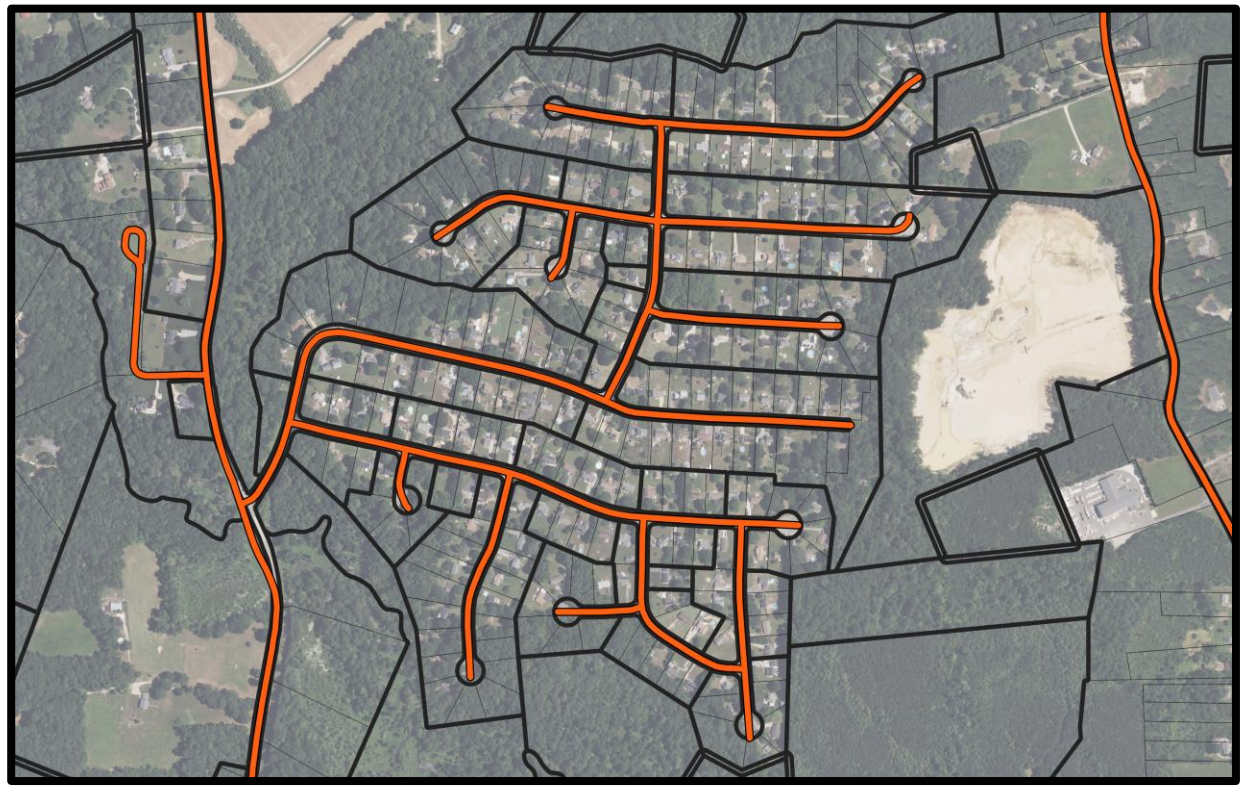
Schema and Crosswalk for Mapping Land Cover Through Time (1985-2013/14)

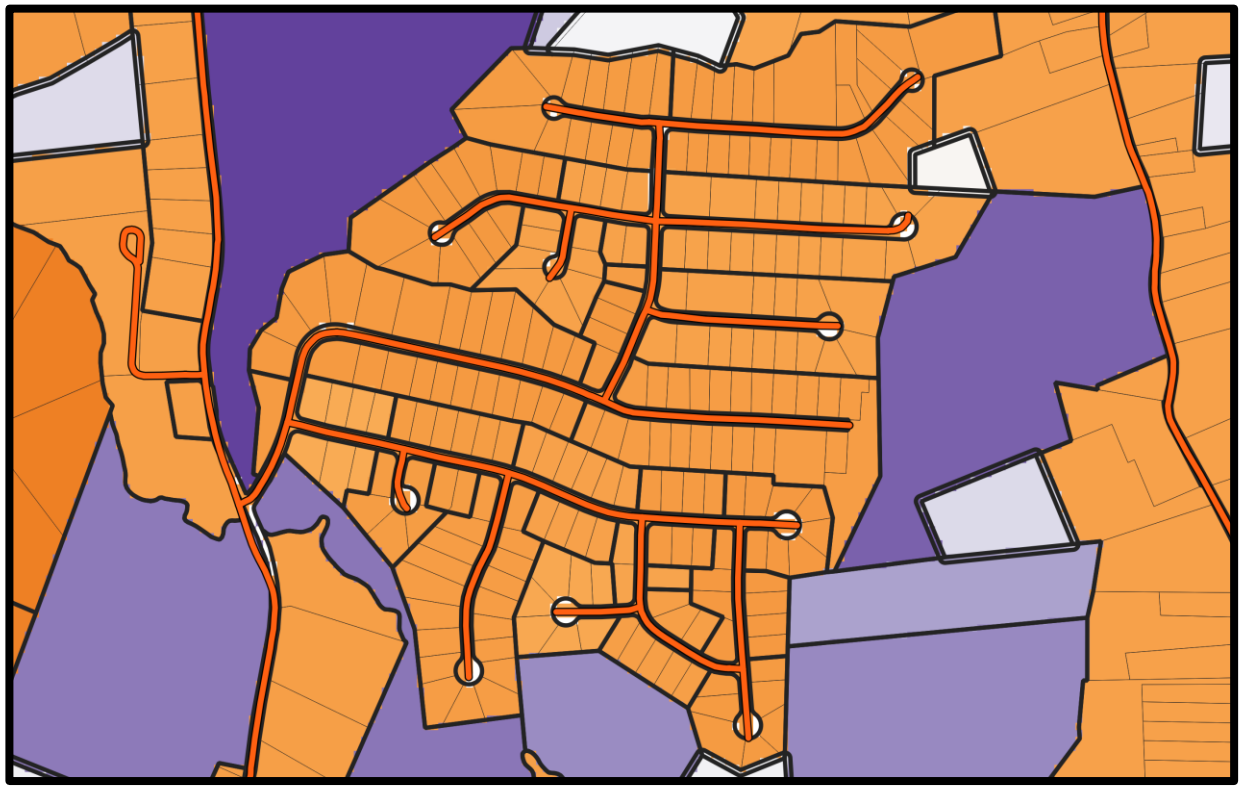
Macro	NLCD	Phase 7
Water	11	water
Forest and wetlands	41, 42, 43, 90,95	forest, floodplain wetlands, other wetlands
Agriculture	81, 82	cropland, pasture and hay
Open Space	31, 52, 71	compacted pervious, construction, harvested forest
Development	21, 22, 23, 24	roads, non-roads, turf, tc over turf, tc over impervious, solar infrastructure, solar pervious

3. Generate “Neighborhoods” for Spatial Context

- Spatial context can be used to differentiate noise (speckles) from real change by creating a landscape-scale assessment of change. This is especially useful in assessing development change over time (i.e. if the road is not constructed, that parcels are less likely to be developed).
- “Neighborhoods” are generated using parcel boundaries and roads by associating parcels with the nearest road segment. For parcels that have no roads nearby, they are grouped with other nearby parcels of similar size and shape. Parcels alone can be too small (especially in more developed areas) to provide such context.

Example of Neighborhood Groupings

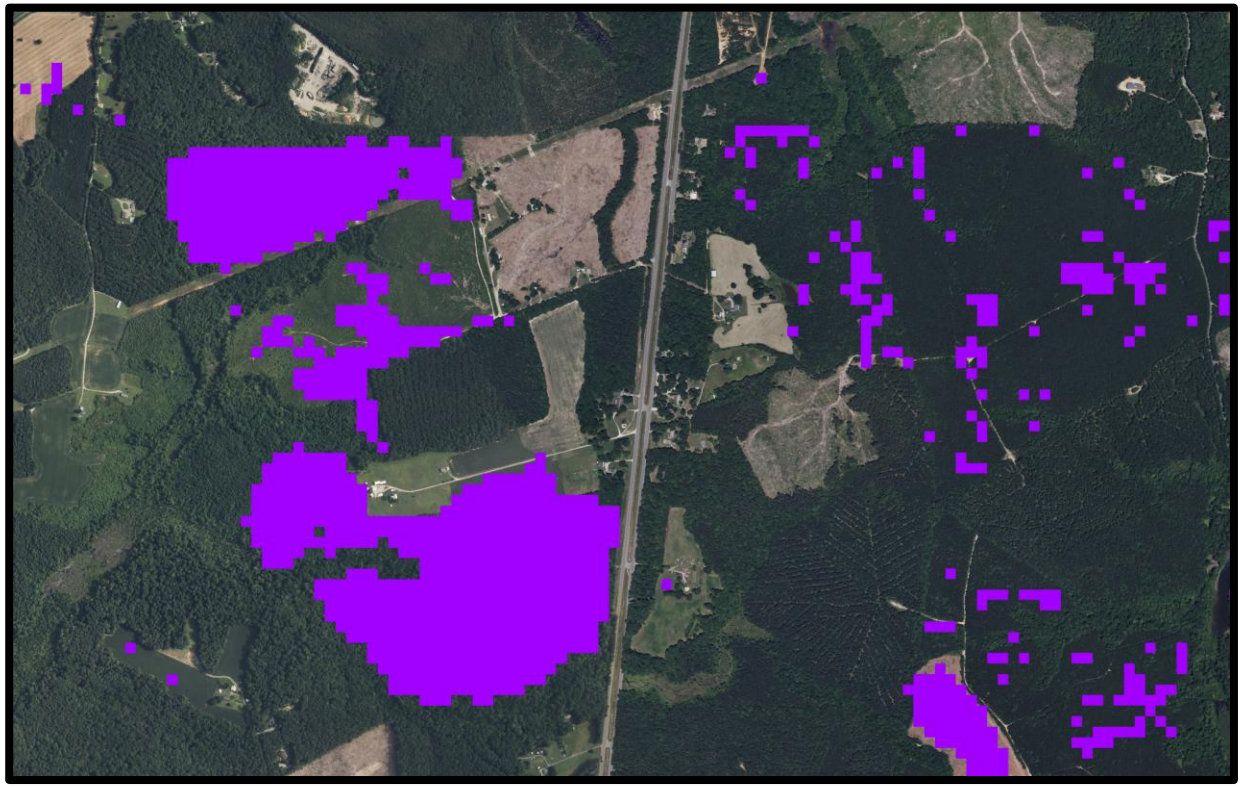




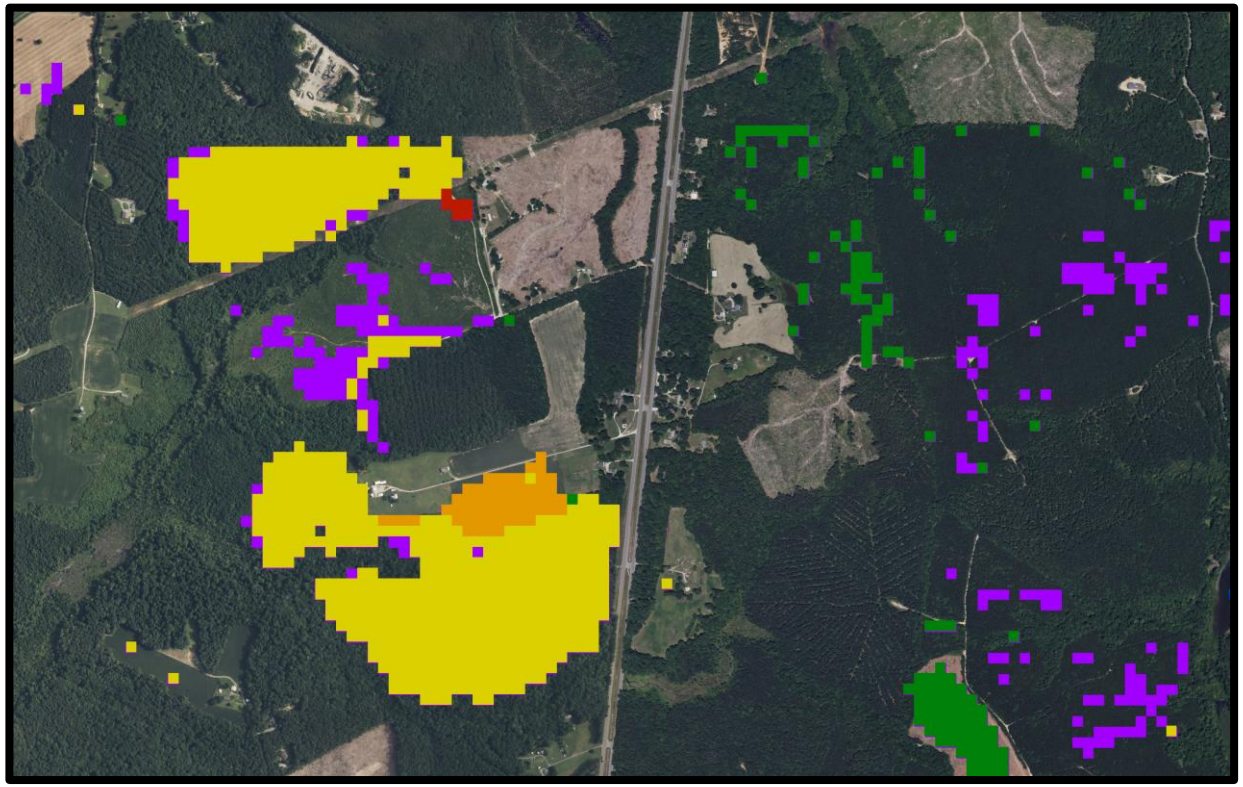
4. Generate Annual Macro Change Maps

- Reclassified NLCD from its native 16 classes to the 5 macro classes from step 1
- Resampled from 30m resolution to 10m resolution to match the Phase 7 fractional land use data

NLCD Land Cover Change

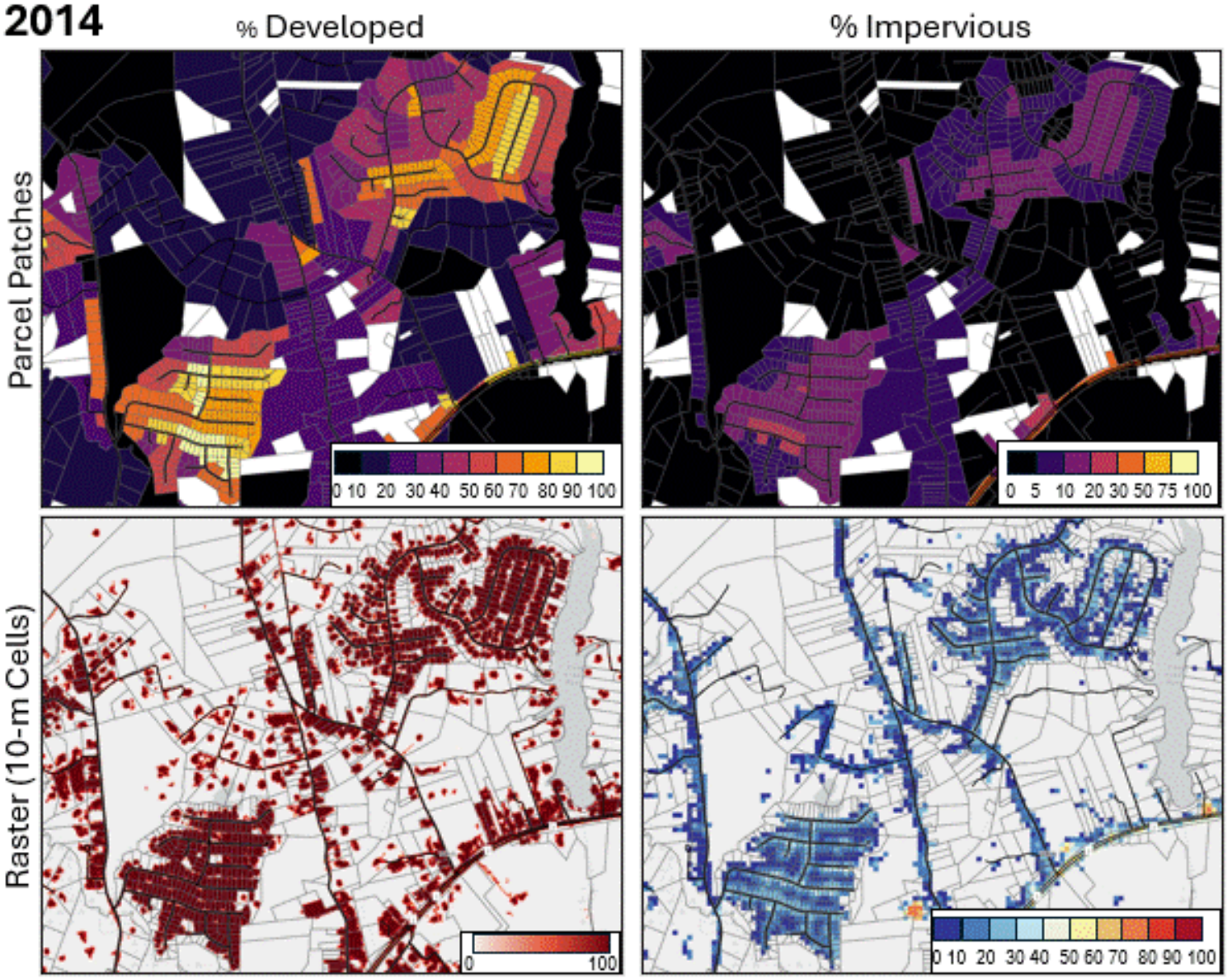


Reclassified NLCD Land Cover Change



5. Prep Annual % Impervious Maps

- Resampled from 30m resolution to 10m resolution to match the Phase 7 fractional land use data
- Compute impervious change between year x and x+1
- Add change to x+1, capped at 0% and 100%
- Identify neighborhoods where impervious associated with roads no longer exists and remove impervious in the neighborhood

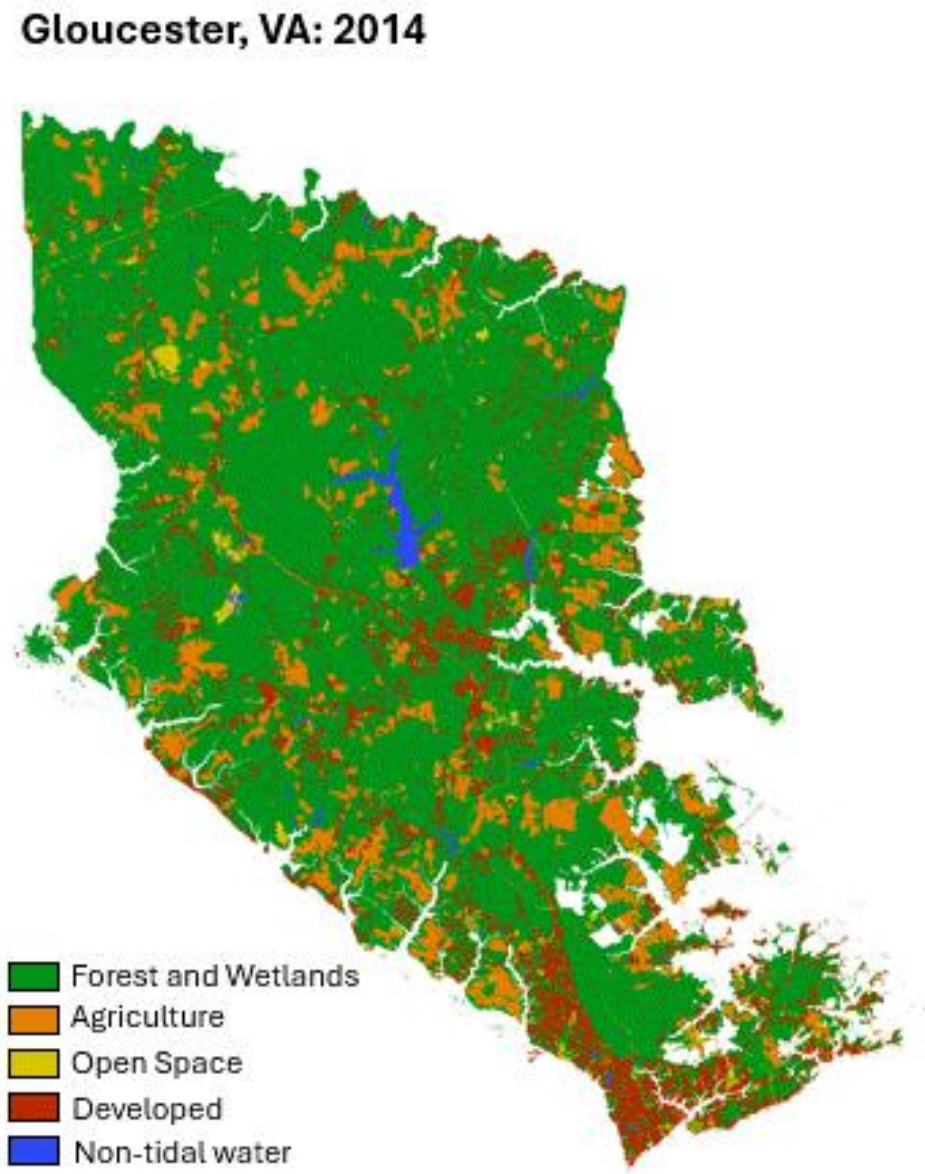


6. Iteratively Update Macro Maps Back Through Time

- Update 2013/14 macro-class maps using annual macro change and % impervious

- Use neighborhoods to identify developed patches without impervious that should no longer be developed

- Flip neighborhoods to majority non-developed cover (natural, agriculture, open space)



7. Summarize Macro Data by Modeling Segmentation

- Produce table of annual macro-class acres per modeling segment for 1985-2013/14

8. Expand Macro Classes to Phase 7 Classes

- **Agriculture**
  - Cropland and Pasture are separated using % crop and % pasture from the Census of Ag and high-res (annually interpolated between 1982 and 2007 (CoA) and 2013/14 mapped ratio)
- **Natural**
  - Forest, Floodplain Wetlands, Other Wetlands are separated using the mapped proportion of the three classes in 2013/14. If a geography doesn't have 2013/14 data and an older year does, the county ratio is used.
- **Open Space**
  - Construction for year is calculated as 1.127 * area of development change (year to year+1)
  - Compacted Pervious is ratio of compacted pervious to development in T1 * remaining open space area
  - Harvested Forest is remaining open space area
- **Development**
  - Solar Infrastructure and Solar Pervious are deconstructed using annual % impervious, holding ratio of the two classes constant based on 2013/14
  - Ratio of Impervious Roads, Impervious Non-Roads, and TC over Impervious is applied to annual impervious area
  - Turf and TC over Turf is remaining Developed area, holding ratio between the two classes the same as in 2013/14
- **Water**
  - Water is same as mapped

9. Weighted Interpolation Between High-Res Years

- Compute total amount of annual change detected by NLCD between 2013/14, 2017/18, 2021/22
- Compute % of change occurring each year between the two change periods
  - If no NLCD change is mapped by there is High-res change for the period, it is linearly interpolated
- Multiply annual % change with the area of mapped change from the high-res

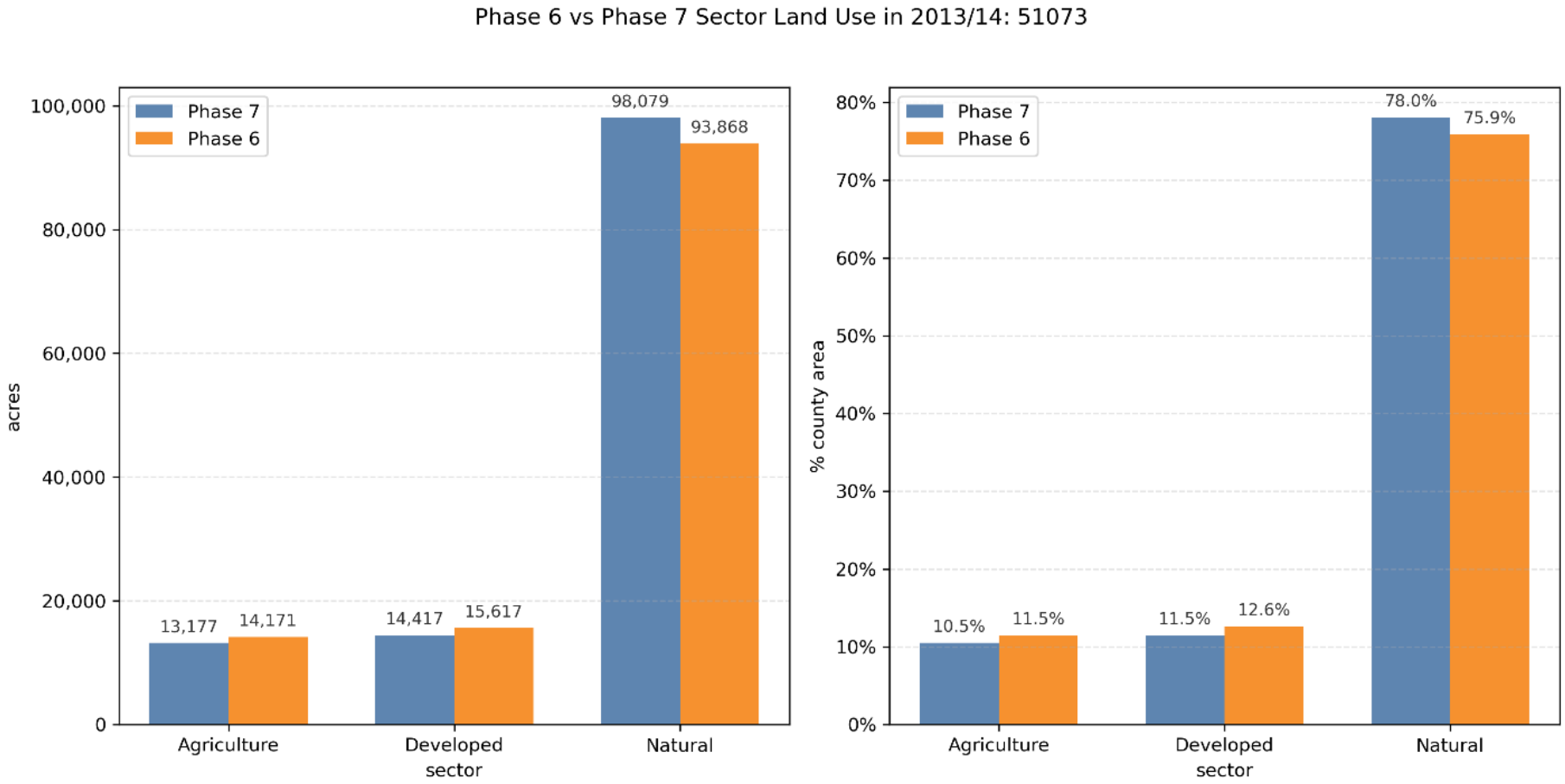
- Example:
  - HR maps 500 acres of net forest loss between 2013 and 2018

	2013-14	2014-15	2015-16	2016-17	2017-18	Total
NLCD Change (Acres)	0	100	50	30	20	200
NLCD % Change in Period	0	50%	25%	15%	10%	100%
Annual Change Area (Acres)	0	250	125	75	50	500

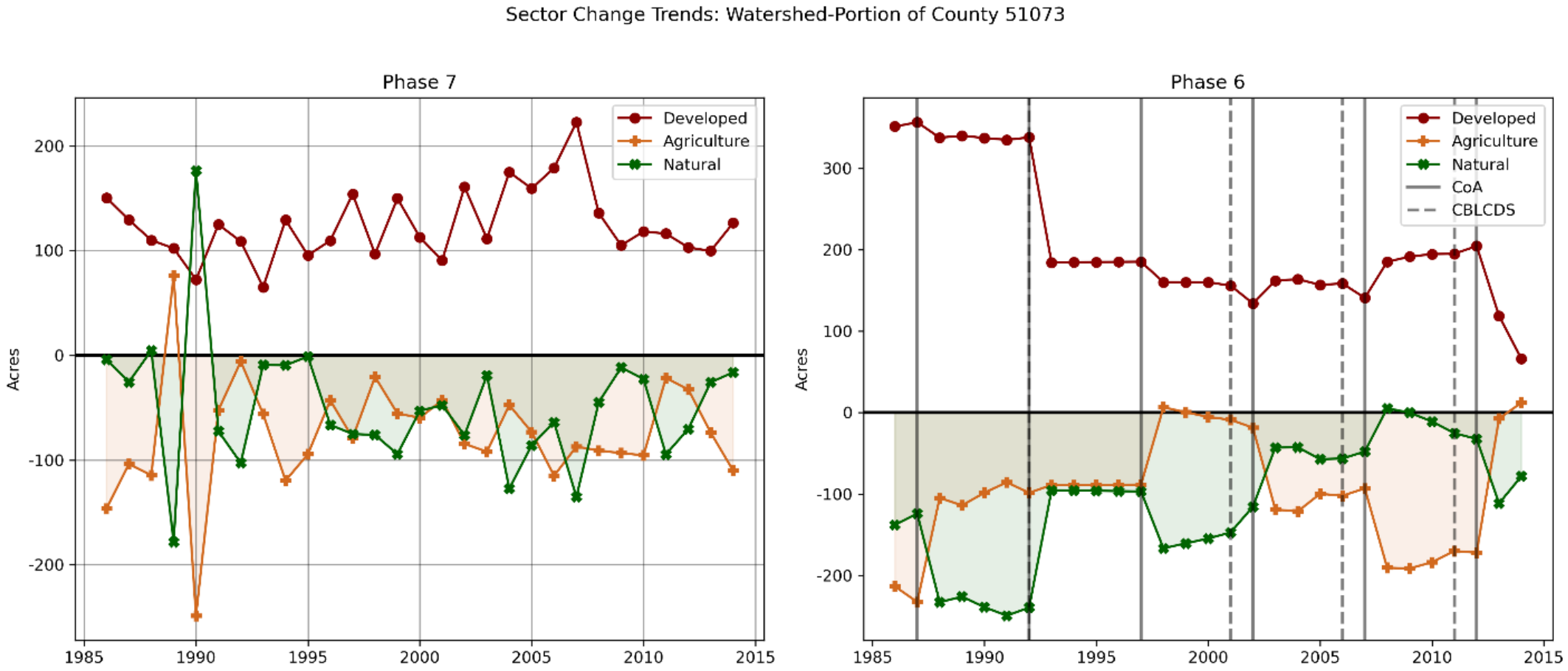
Results

Example Charts of what to Expect in the Reports

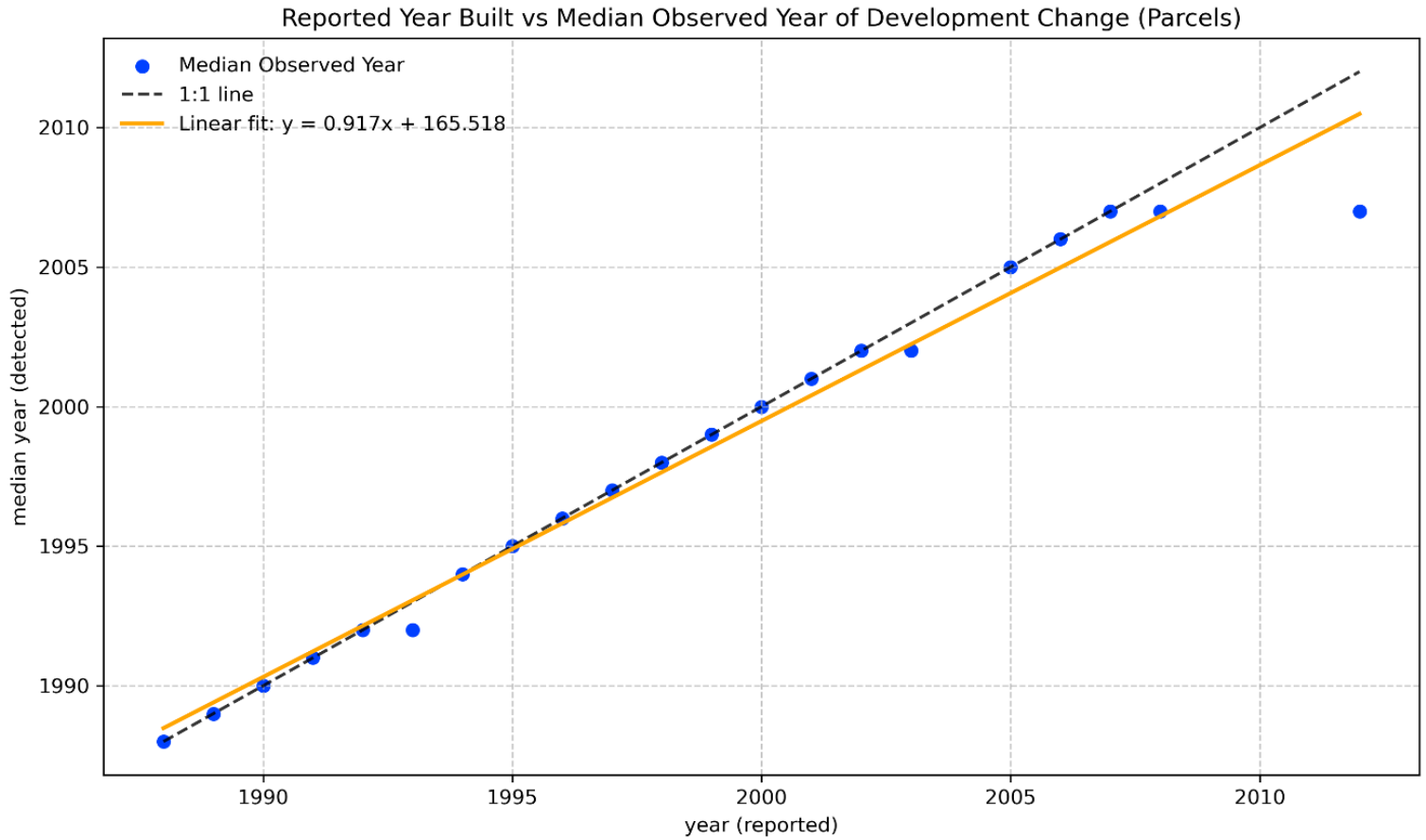
Comparison of 2013/14 Sector Area Between Phase 6 and Phase 7



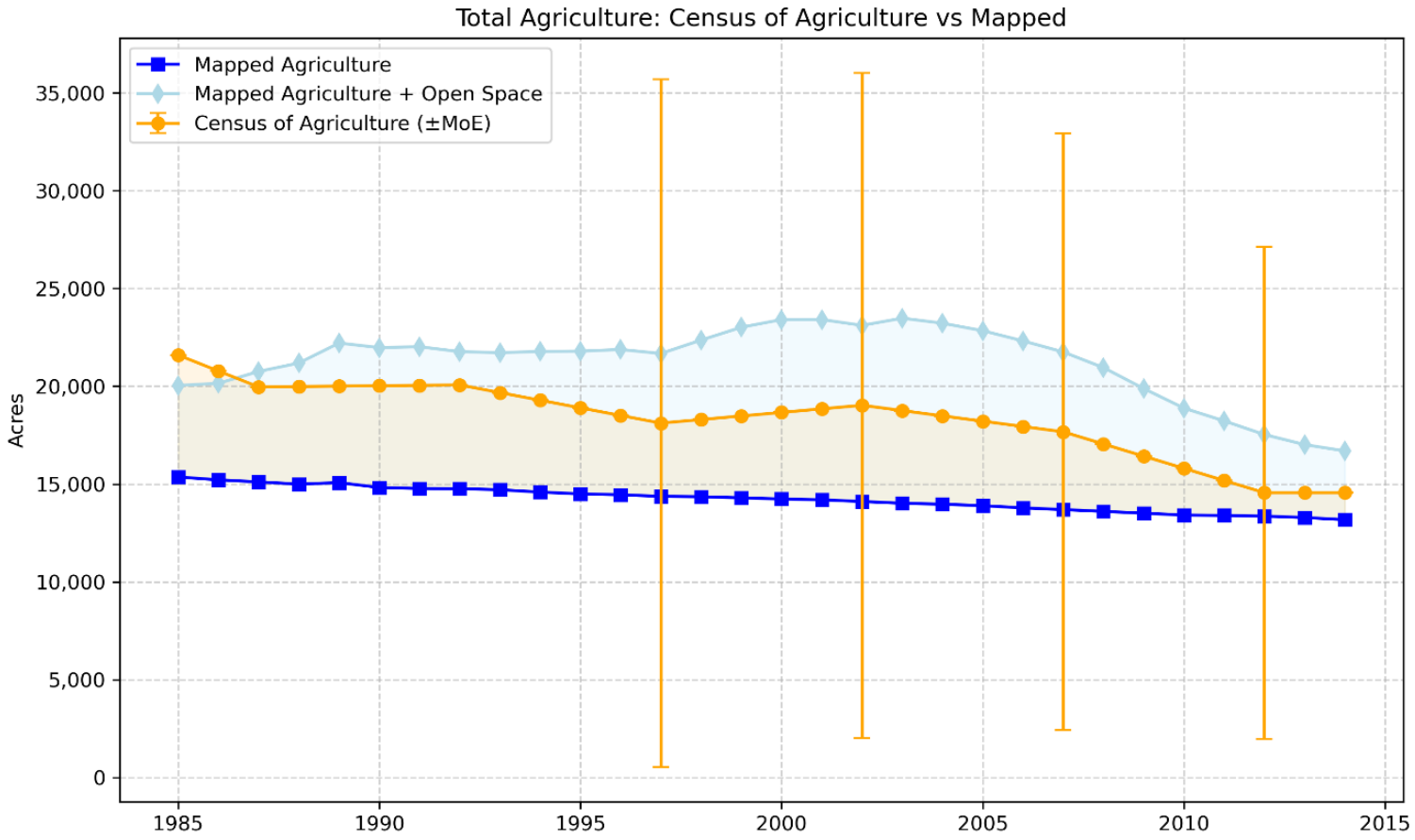
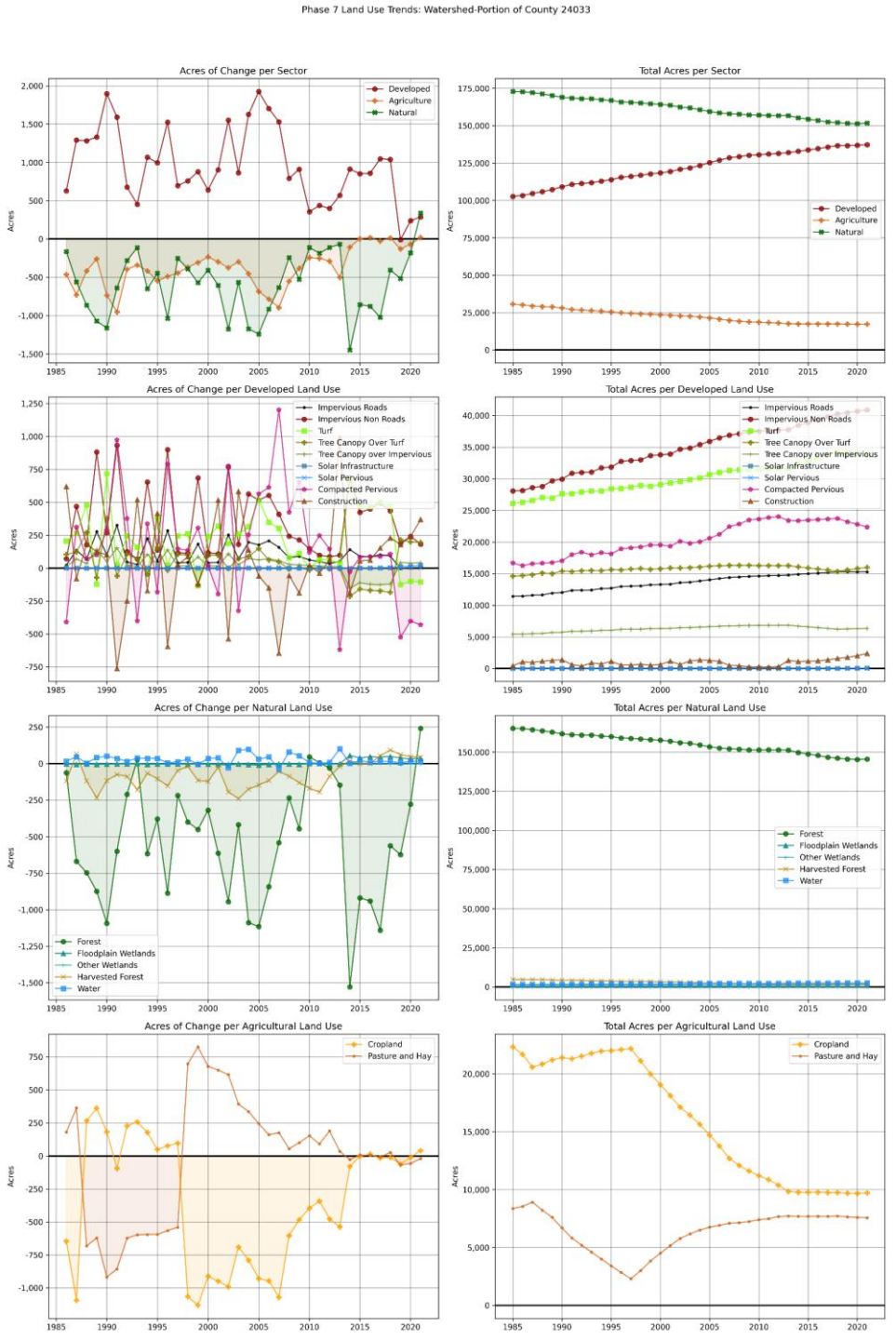
Comparison of Area of Change Over Time By Sector Between Phase 6 and 7



Development Validation



Agriculture Validation



Phase 7 Trends