

Phase 7: Land Use Time Series (1985-2022) – Development Trends

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Urban Stormwater Work Group

March 17, 2026

Agenda

- Land Use Time Series Overview
- Developed Classification: Phase 6 vs Phase 7
- Observed Development Trends and Validation
- Data Access, Timeline, and Review

Land Use Time Series Overview

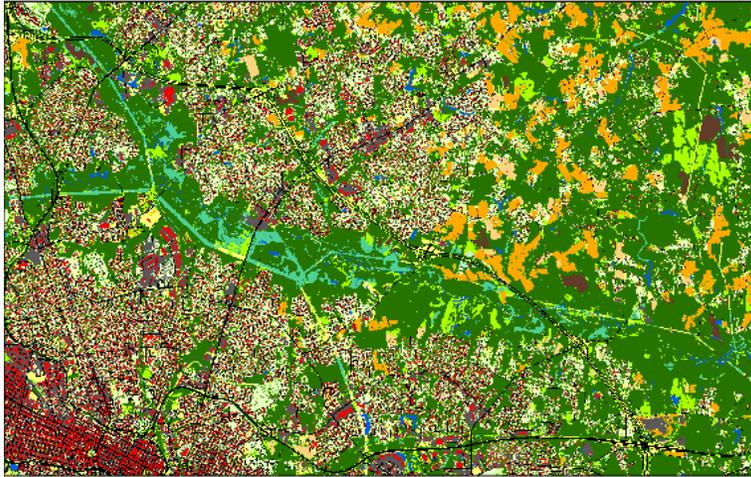
Project Goals

This project utilizes the spatial and categorical accuracy of 1-meter resolution Land Use/Land Cover (LULC) to represent the present (2013-2022) and the temporal accuracy of Landsat derived products to deconstruct the landscape back through time (1985-2013).

What Does “Land Use” Mean?

High-resolution LULC

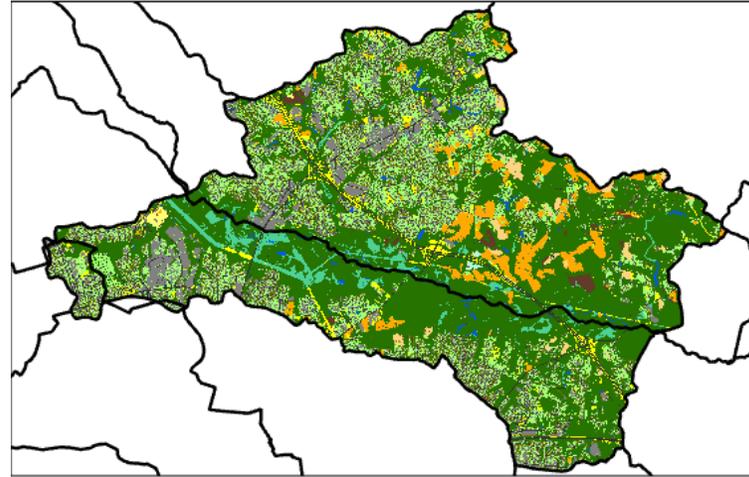
56 classes



Mapped from aerial imagery, Light Detecting and Ranging (LiDAR), and ancillary data sources.

Phase 7 Land Use

17 classes



Reclassifies mapped LULC and summarizes as acres per class per Land River Segment to form the base land use for CAST.

CAST Land Use

51 classes (or load sources)

County	LRSEG	Land Use	Acres
ABC	1	Grass	100
ABC	2	CSS Roads	200
ABC	3	Pasture	50
DEF	4	Septic	35
DEF	5	True Forest	500

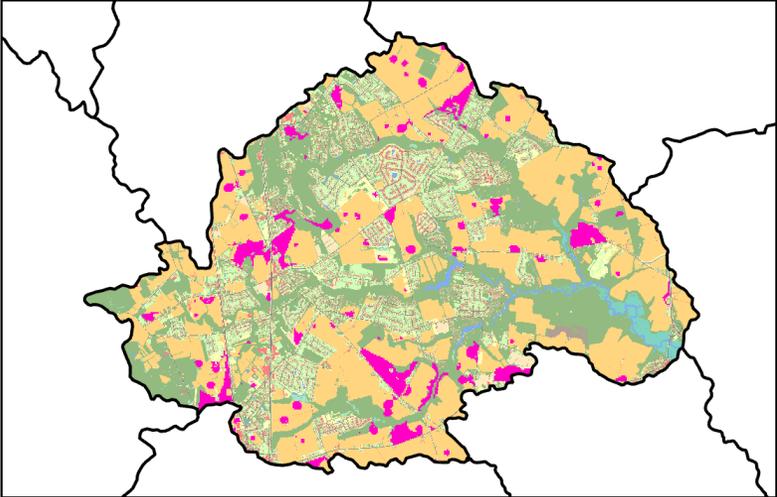
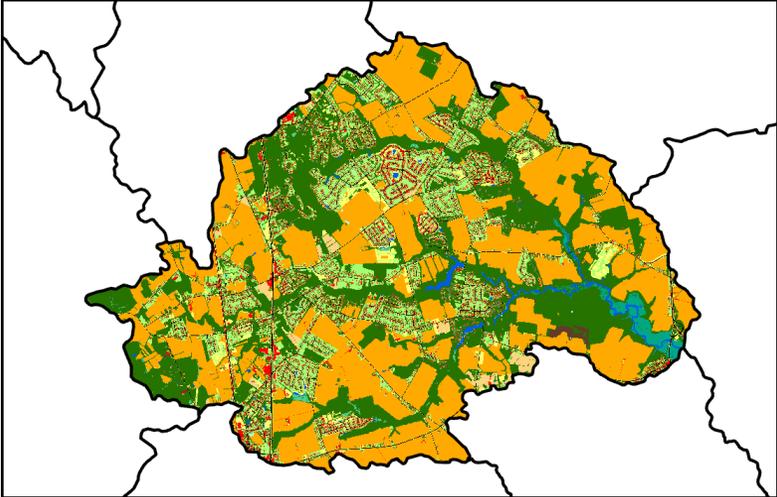
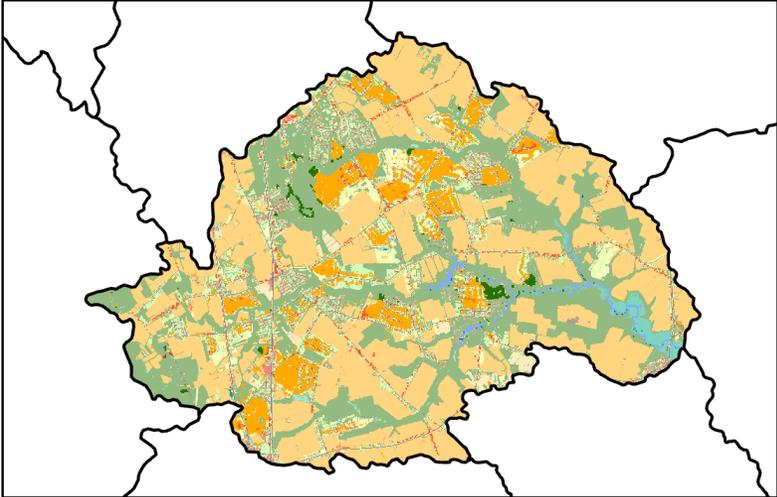
Incorporates reported data (census of agriculture, state annually-reported forest harvest and construction acres, CSO separations) with the base land use acres. Produces acres of land use by Land River Segment in which BMPs are applied and loads are calculated.

How do we assess land use over time?

Past Land Use (30m)
1985-2012

Present Land Use (1m)
2013-2022

Future Land Use (30m)
2023-2100



Annual historic land use condition and trends by summary unit. NLCD detects and classifies change back through time with historical satellite imagery from Landsat at 30-meter resolution. The present is deconstructed where change is detected and summarized by LRSEG.

The land use conditions in the present, derived from the LULC at 1-meter resolution and by LRSEG. Annualized from the mapped dates 2013/14, 2017/18, and 2021/22. Serves as the starting point for the back-cast and forecasts.

Future land use trends modeled with the Chesapeake Bay Land Change Model (CBLCM). Urban growth model that converts forest and farmland to development to allocate for population growth. Usually predicted in 5- or 10-year increments. Modeled at 30-meter resolution and summarizes land use by LRSEG for modeled years.

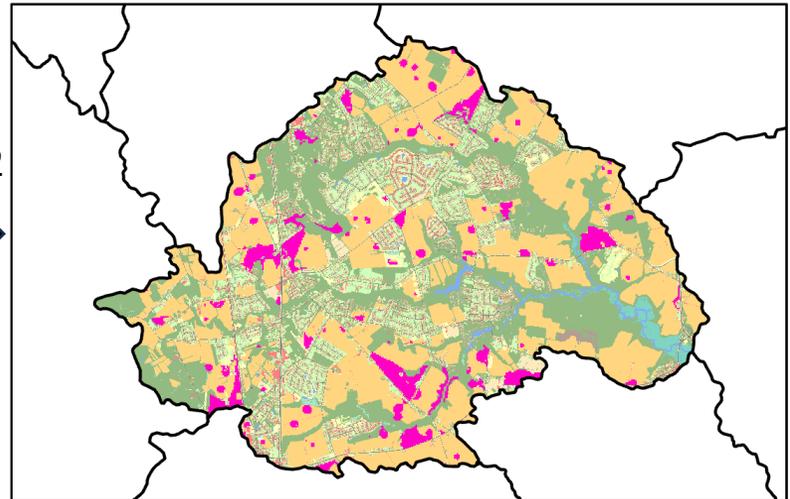
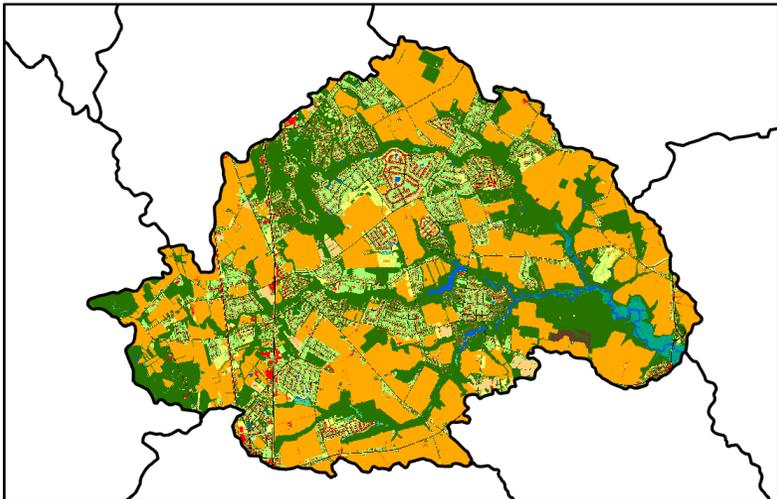
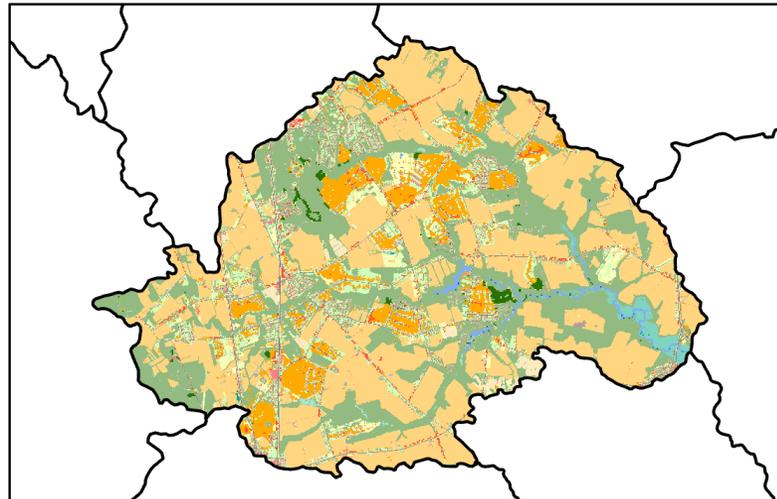
LULC = Land Use/Land Cover
LRSEG = Land River Segment
NLCD = National Land Cover Database

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2013-2022

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2023-2100



Annual historic land use condition and trends by summary unit and classifies change with historical satellite data. Landsat at 30-meter resolution present is decomposed into 30m summary units. is detected and summarized by summary unit.

The land use conditions in the

Future land use trends modeled with the Chesapeake Bay Land Change

Three distinct land use products that work together to provide a consistent classification of land use trends for the past, present and future

in growth forest and ment to allocate . Usually year

for the back-cast and forecasts.

increments. Modeled at 30-meter resolution and summarizes land use by summary unit for modeled years.

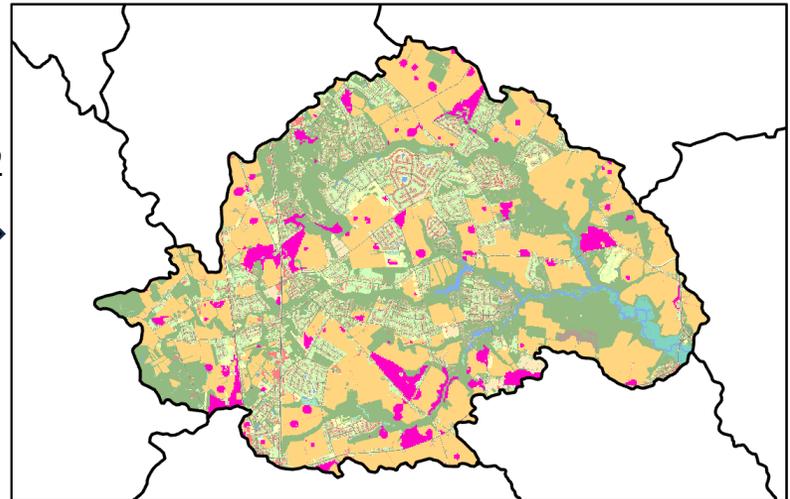
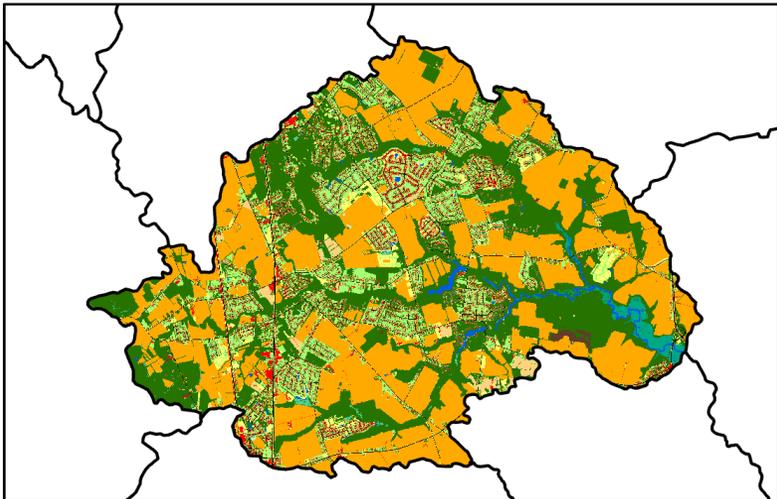
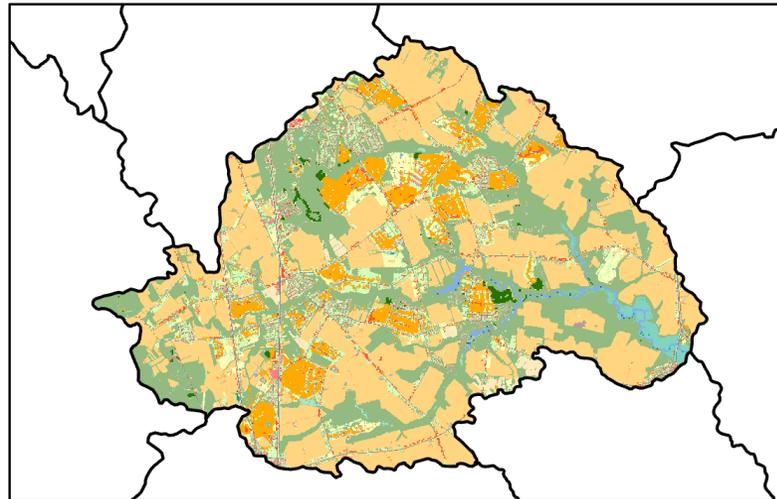
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Present Land Use (1m)
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Future Land Use (30m)
2023-2100



2013
←

2022
→

Observed Period
1985-2022

Future land use trends modeled with the Chesapeake Bay Land Change Model (CBLCM). Urban growth model that converts forest and farmland to development to allocate for population growth. Usually predicted in 5- or 10-year increments. Modeled at 30-meter resolution and summarizes land use by summary unit for modeled years.

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How is the Land Use Time Series Used?

1. To estimate spatially explicit loading rates from monitored loads.
 - a) An accurate land use status and trend is important for producing a model that best matches observed data.
2. To set appropriate planning targets and Total Maximum Daily Load (TMDL) allocations
3. The historical land use is used as inputs to scenarios run in CAST and the Dynamic Watershed Model representing those land use years. The scenarios are evaluated against monitored loads to evaluate model performance and load reduction progress in the [TMDL](#) indicator and [Monitored and Expected Total Reduction Indicator for the Chesapeake \(METRIC\)](#).

Developed Classification

Phase 6 versus Phase 7

Mapped Developed Classes in Chesapeake Bay Watershed Model

Phase 6

- Impervious Roads
- Impervious Non-Roads
- Tree Canopy over Impervious
- Tree Canopy over Turf
- Turf Grass

Phase 7

- Impervious Roads
- Impervious Non-Roads
- Tree Canopy over Impervious
- Tree Canopy over Turf
- Turf Grass
- Solar Infrastructure*
- Solar Pervious**
- Compacted Pervious**
- Construction**, ***

* Mapped as Impervious Non-Roads in P6

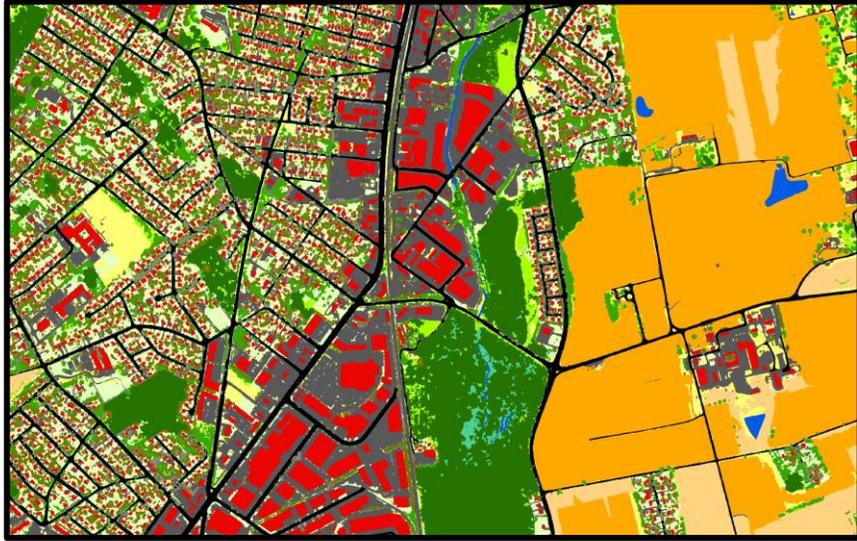
** Mapped as Mixed Open in P6

*** Reconciled with reported data

Data

High-Resolution Land Use/Land Cover

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

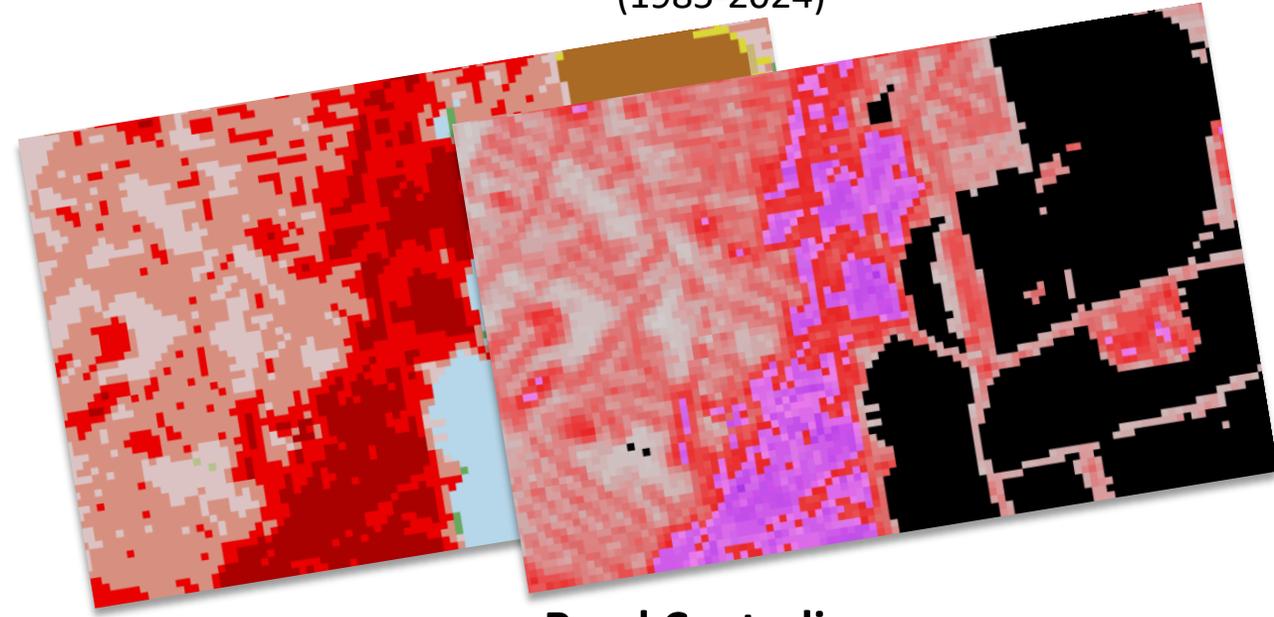


Parcel Boundaries



National Land Cover Database (NLCD)

Annual Land Cover and % Impervious
(1985-2024)



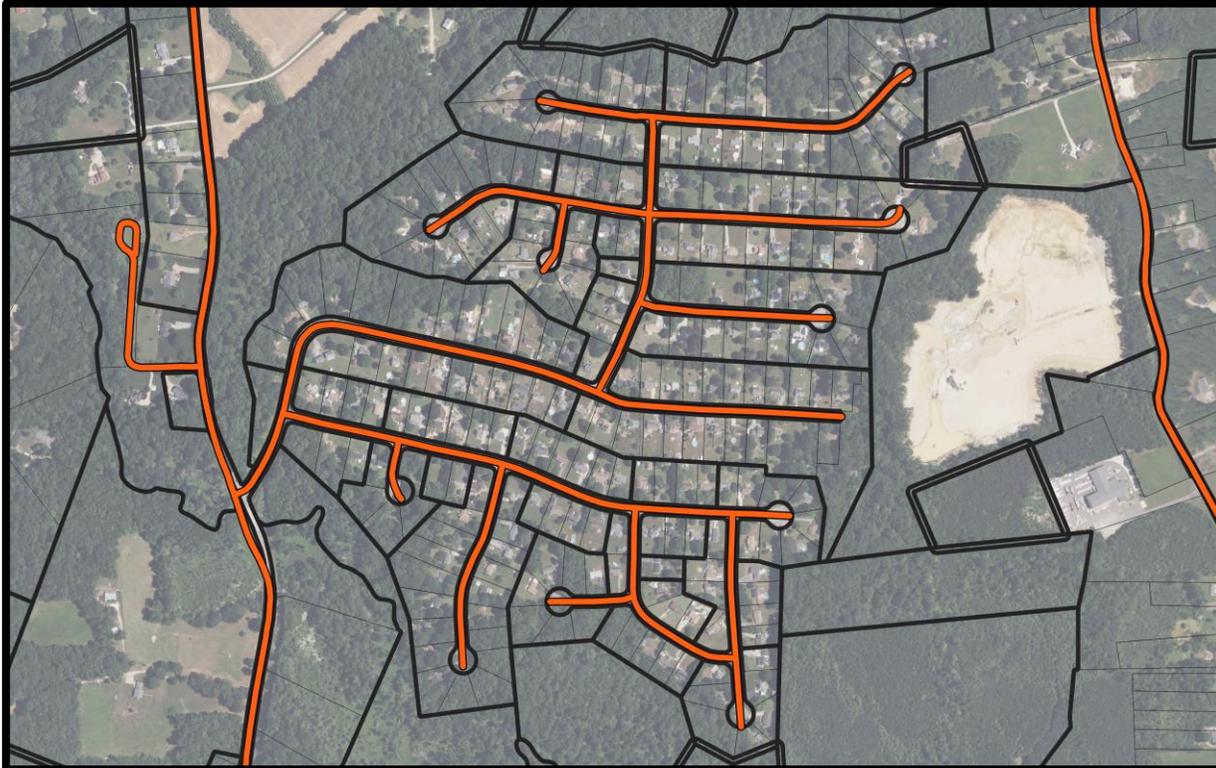
Road Centerlines



“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



Development Over Time

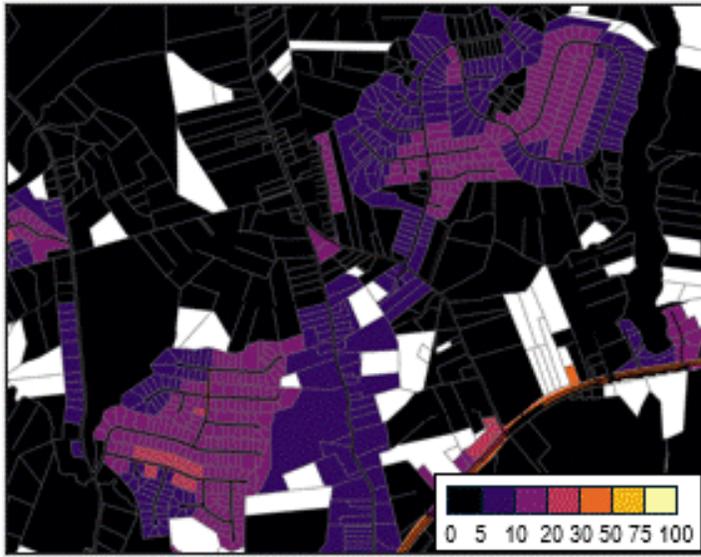
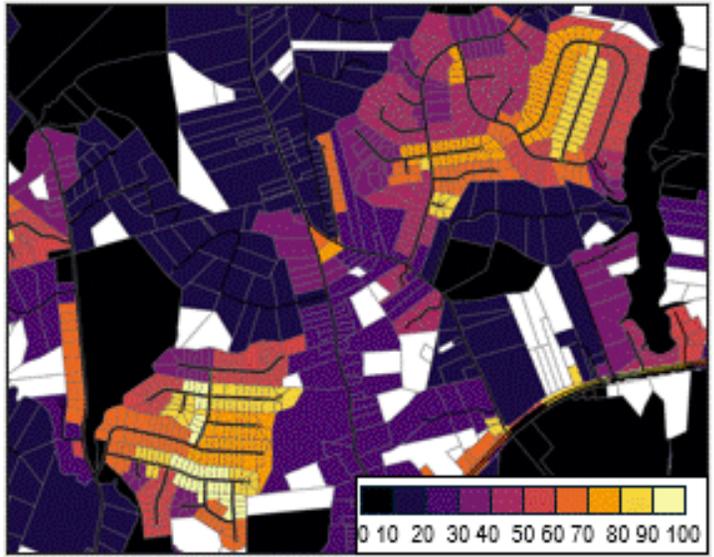
2014

% Developed

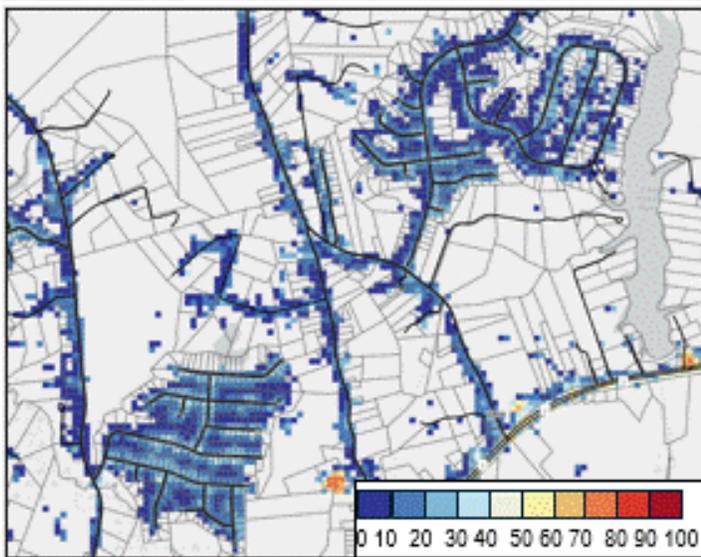
% Impervious

Gloucester, VA: 2014

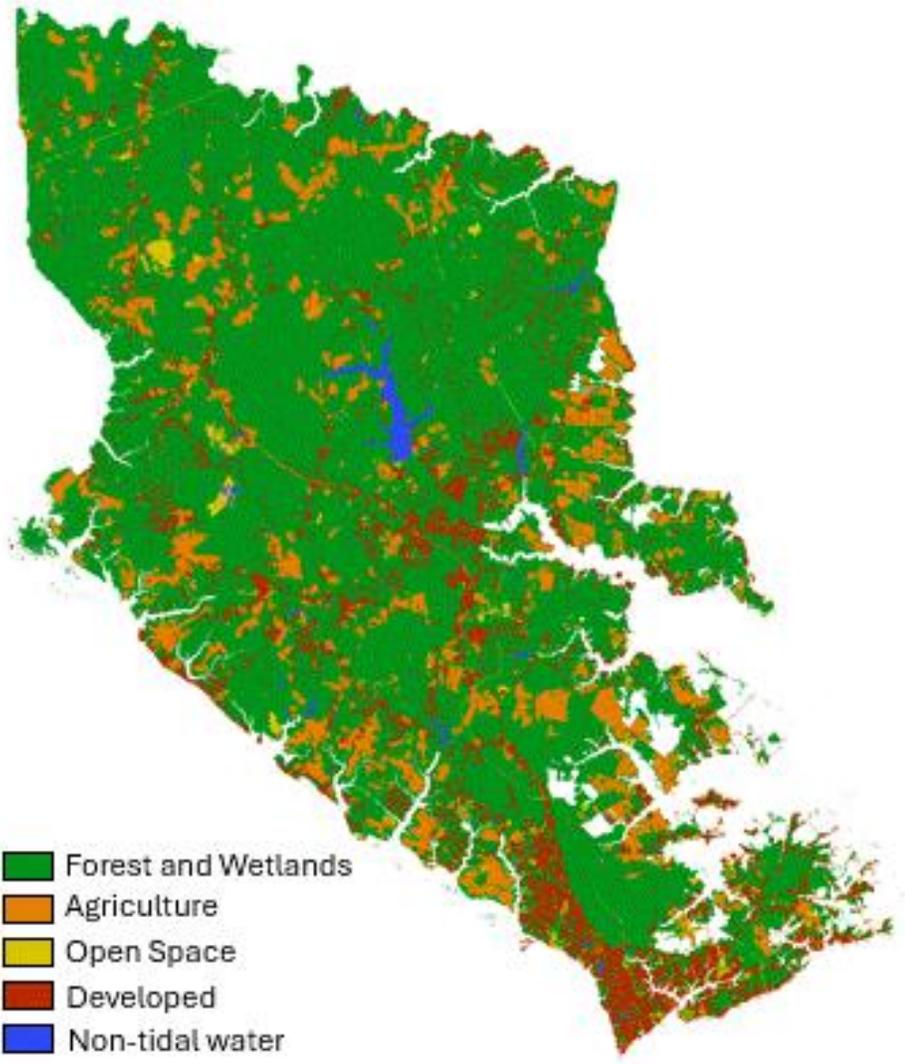
Parcel Patches



Raster (10-m Cells)



- Forest and Wetlands
- Agriculture
- Open Space
- Developed
- Non-tidal water



Expand Developed to Phase 7 Classes

- **Open Space**

- Construction for year is calculated as $1.127 * \text{area of development change (year to year+1)}$
- Compacted Pervious is ratio of compacted pervious to development in T1 * remaining open space area

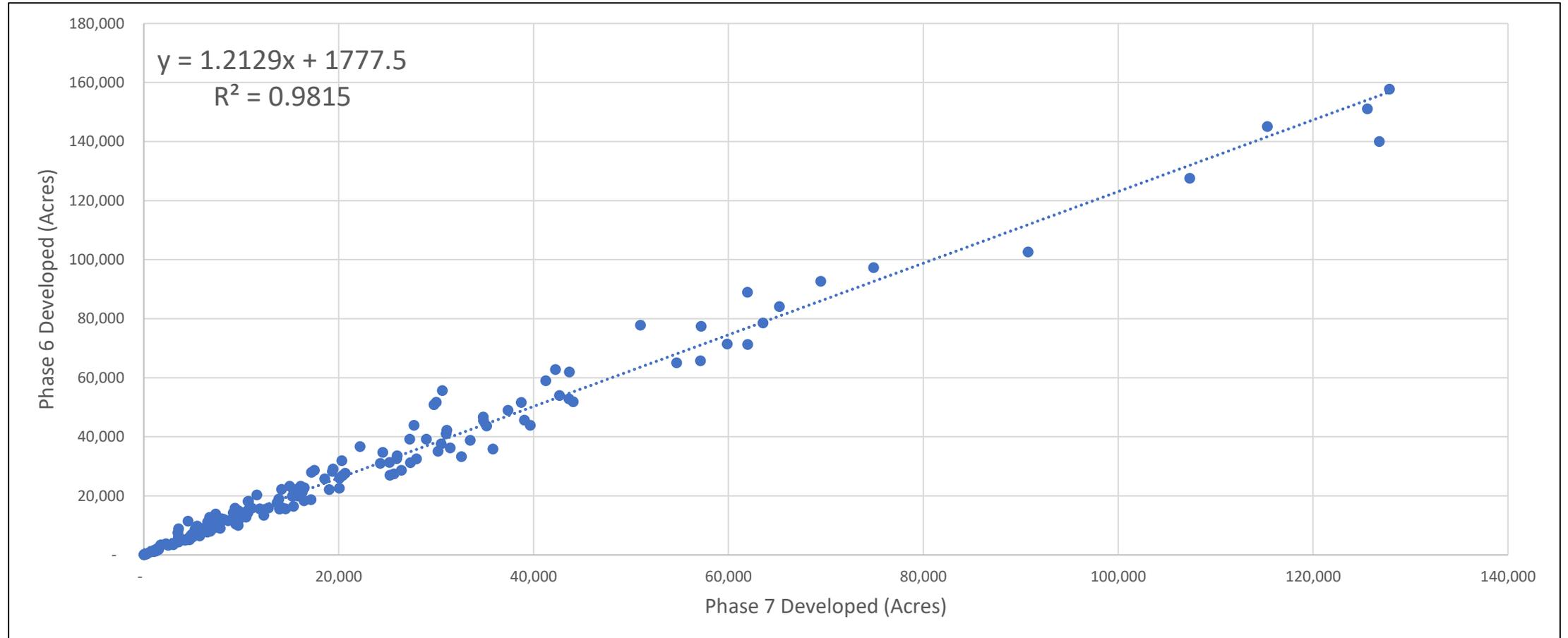
- **Development**

- 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

Observed Development Trends and Validation

Phase 6 vs Phase 7: Development in 2013/14

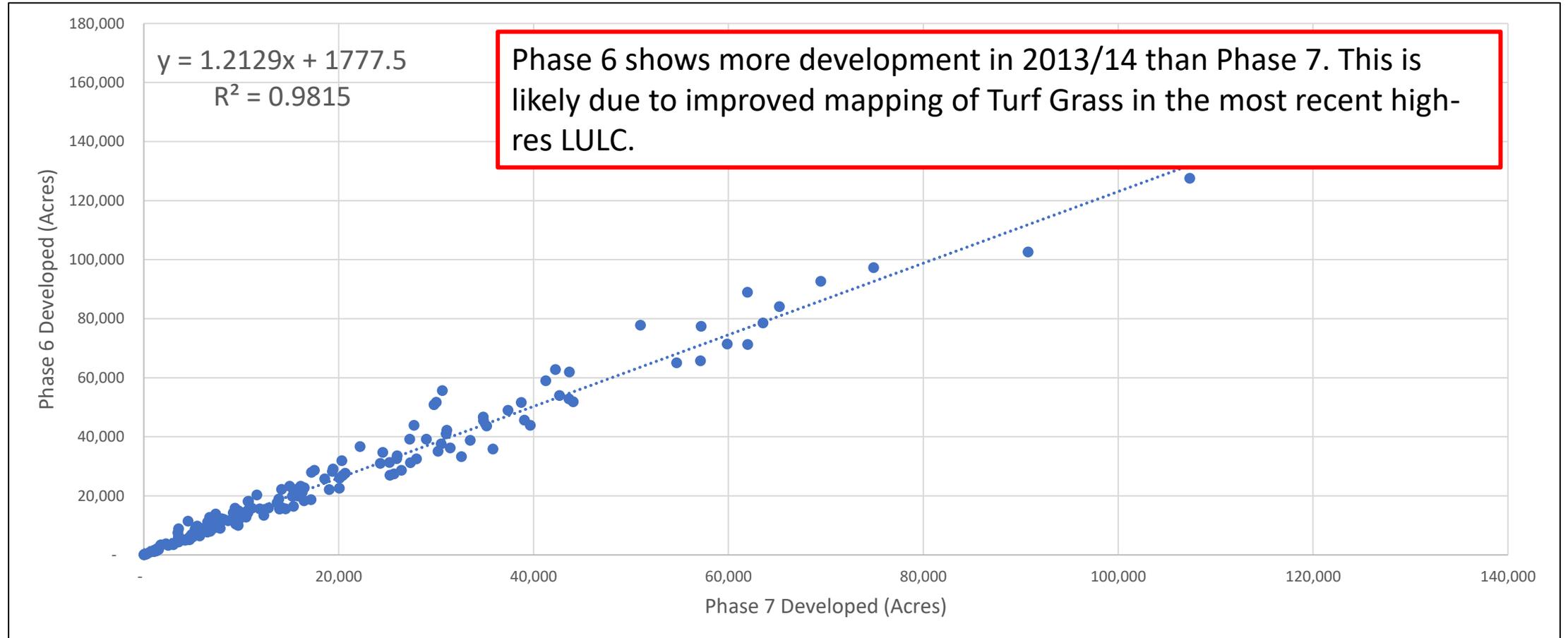
The 2013/14 year served as the starting point for both the Phase 6 and Phase 7 back-casts. Phase 6 used the first iteration of the high-resolution Land Use/Land Cover (LULC), where Phase 7 is using the third attempt of mapping the same year. Compacted Pervious and Construction are not included in Phase 7 development for this comparison.



* Data shown are 170 of 197 counties used in the model

Phase 6 vs Phase 7: Development in 2013/14

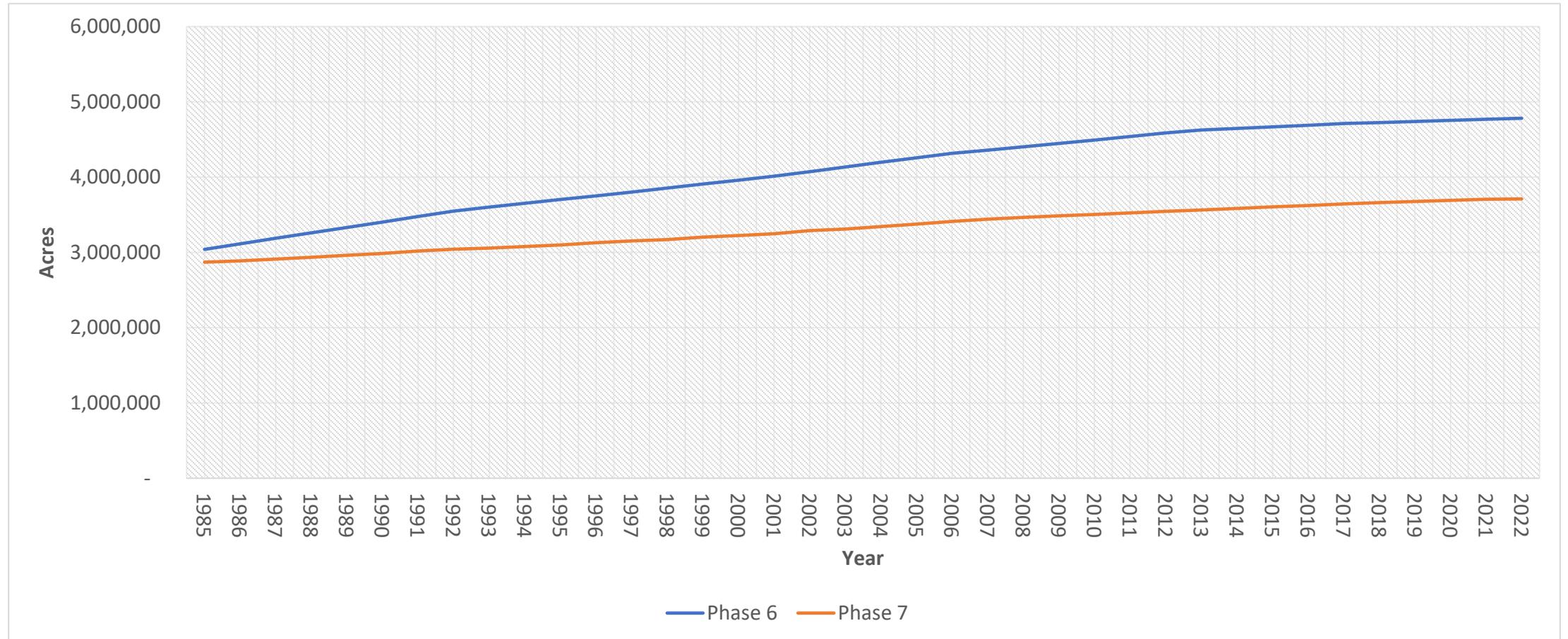
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Phase 6 vs Phase 7: Development over Time

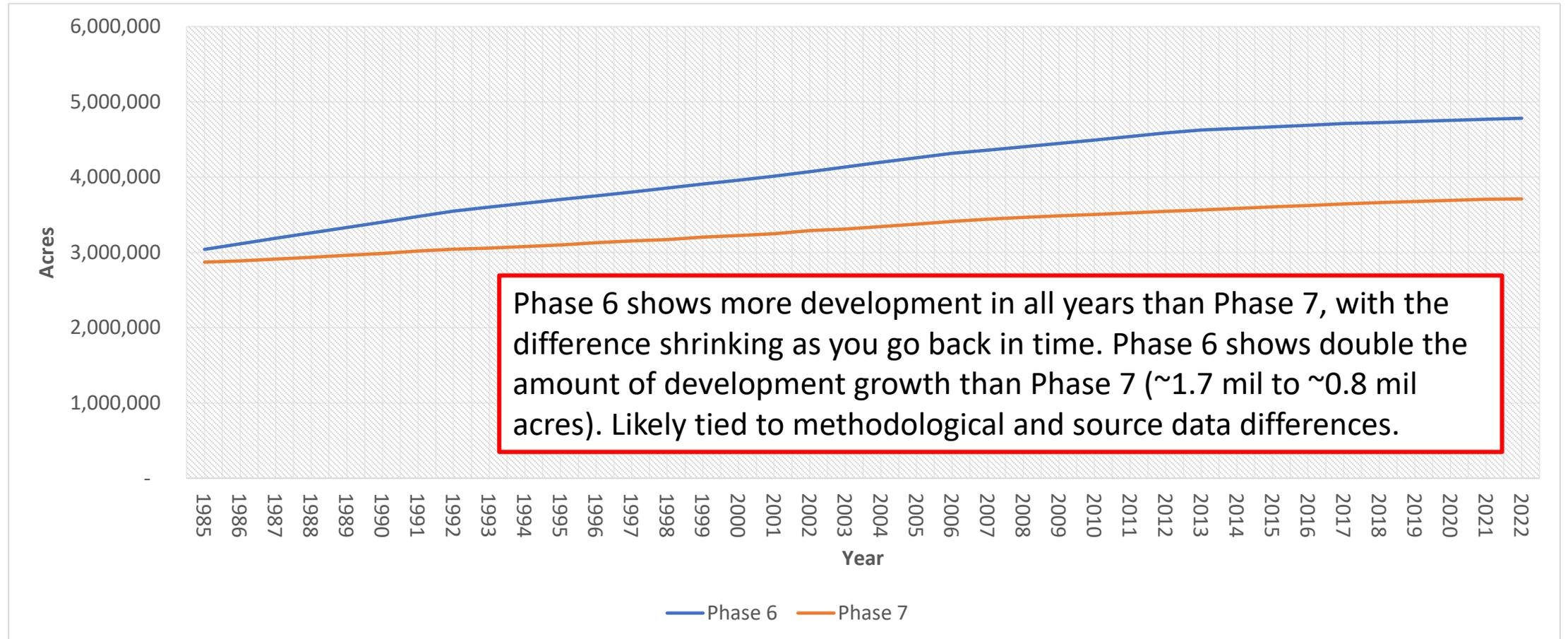
Total Developed acres over time are shown. Compacted Pervious and Construction are not included in Phase 7 development for this comparison.



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Phase 6 vs Phase 7: Development over Time

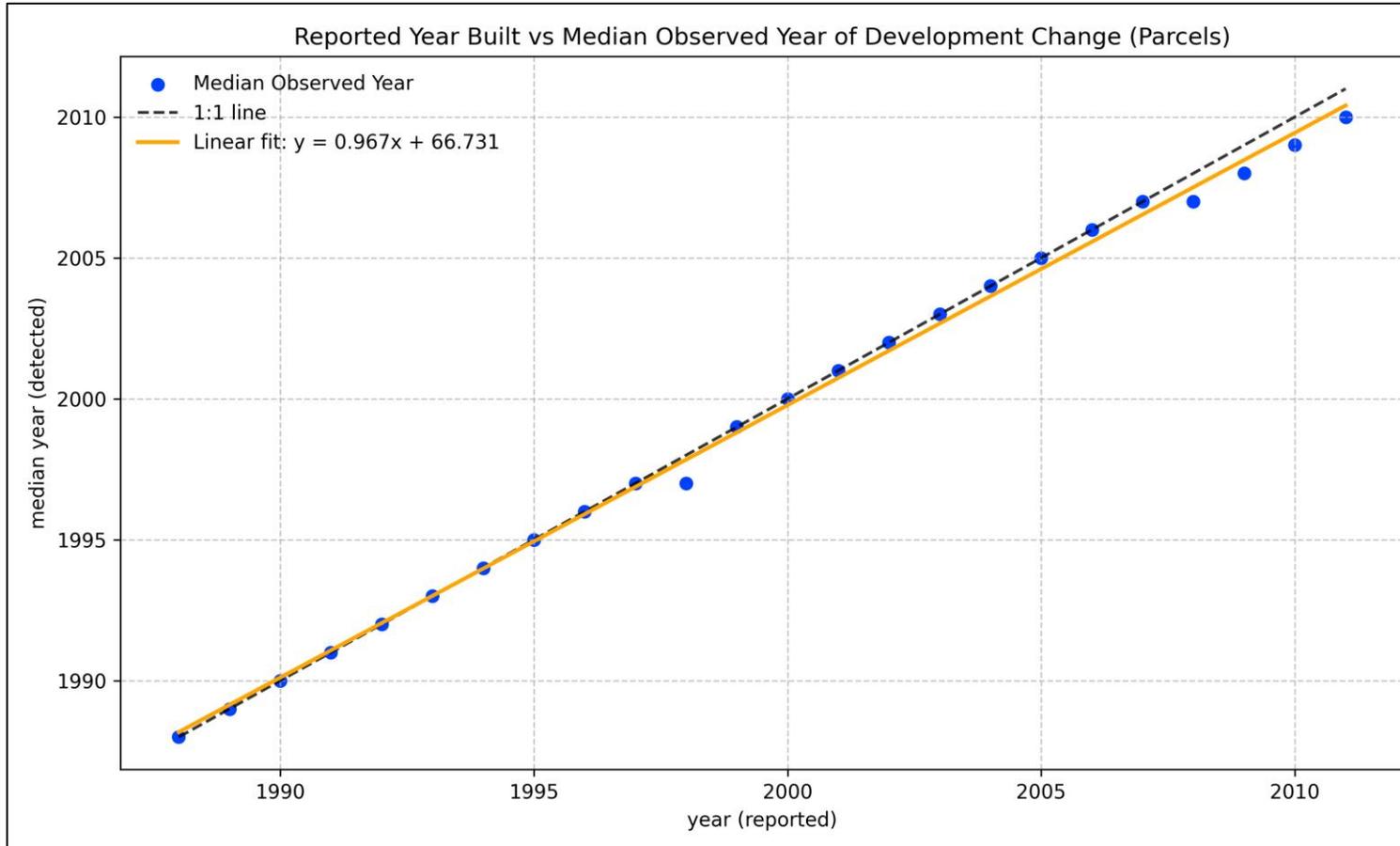
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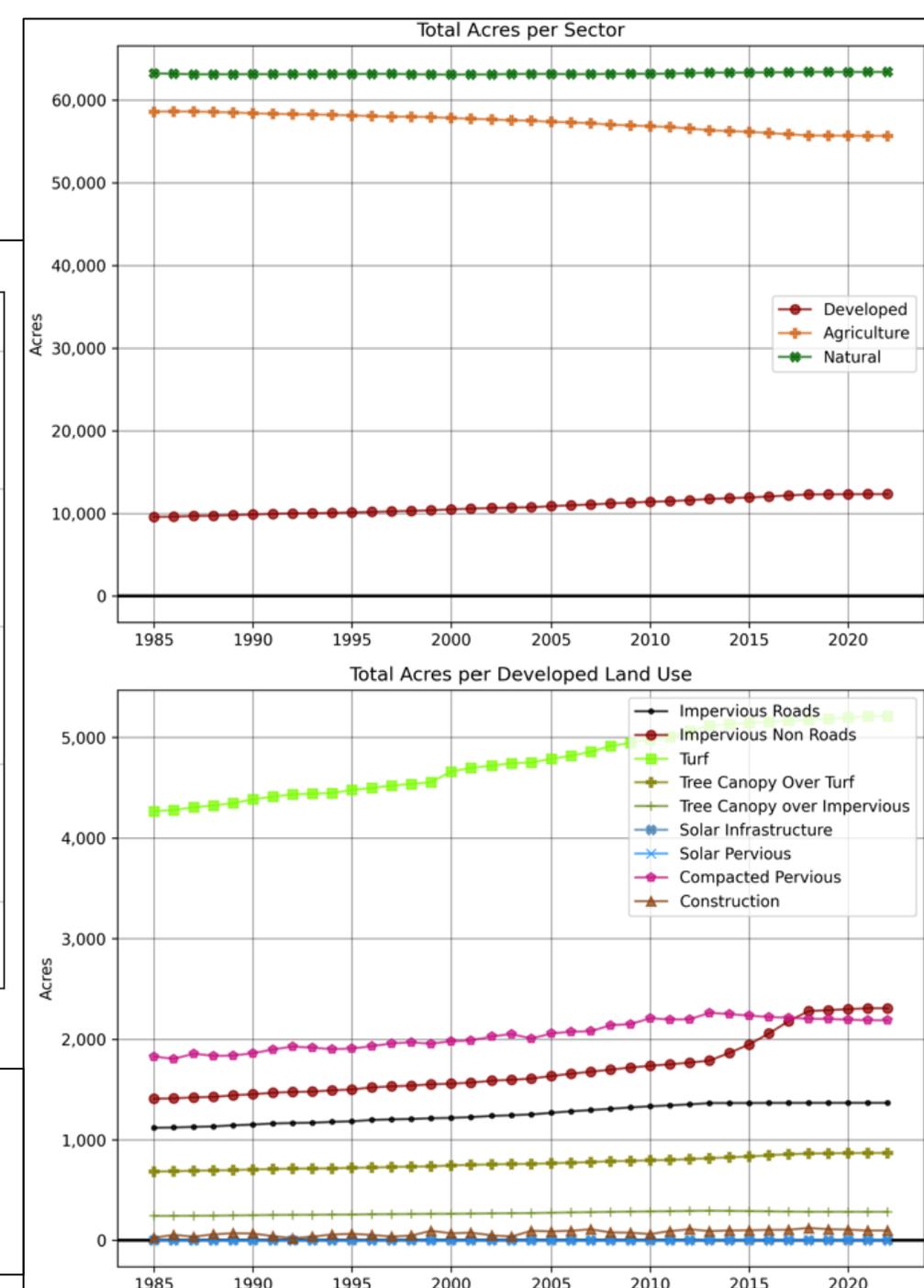
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Phase 7 Development Trends

Kent County, DE



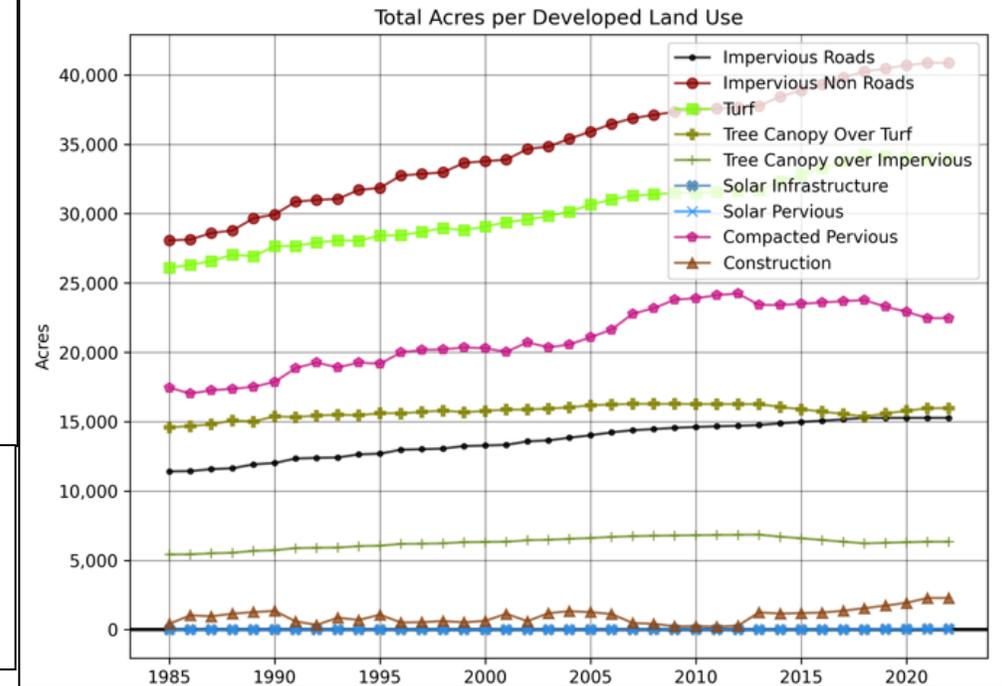
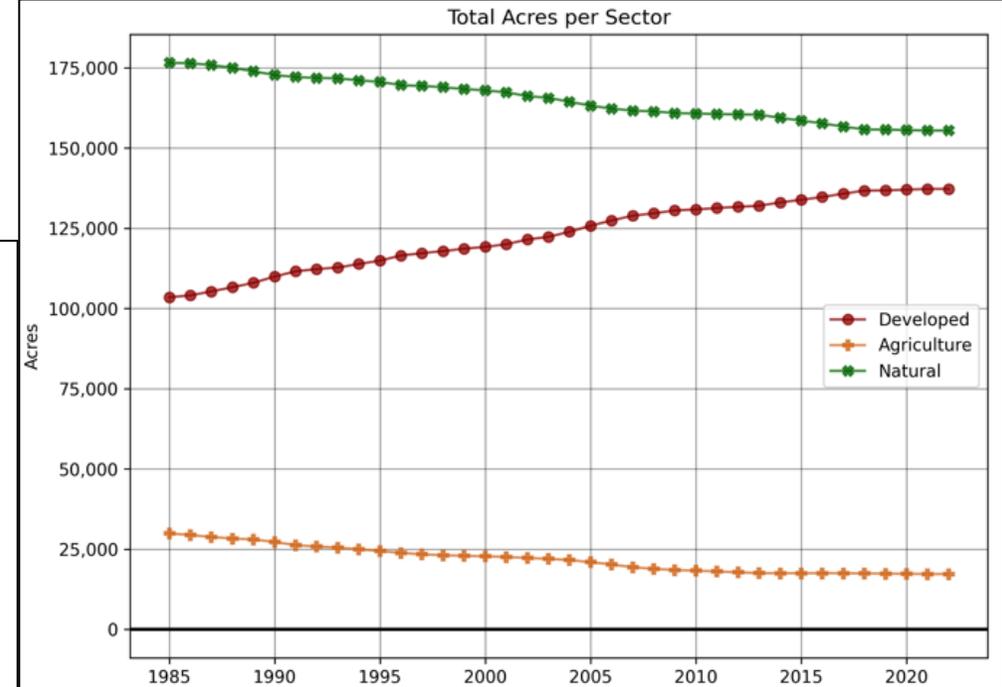
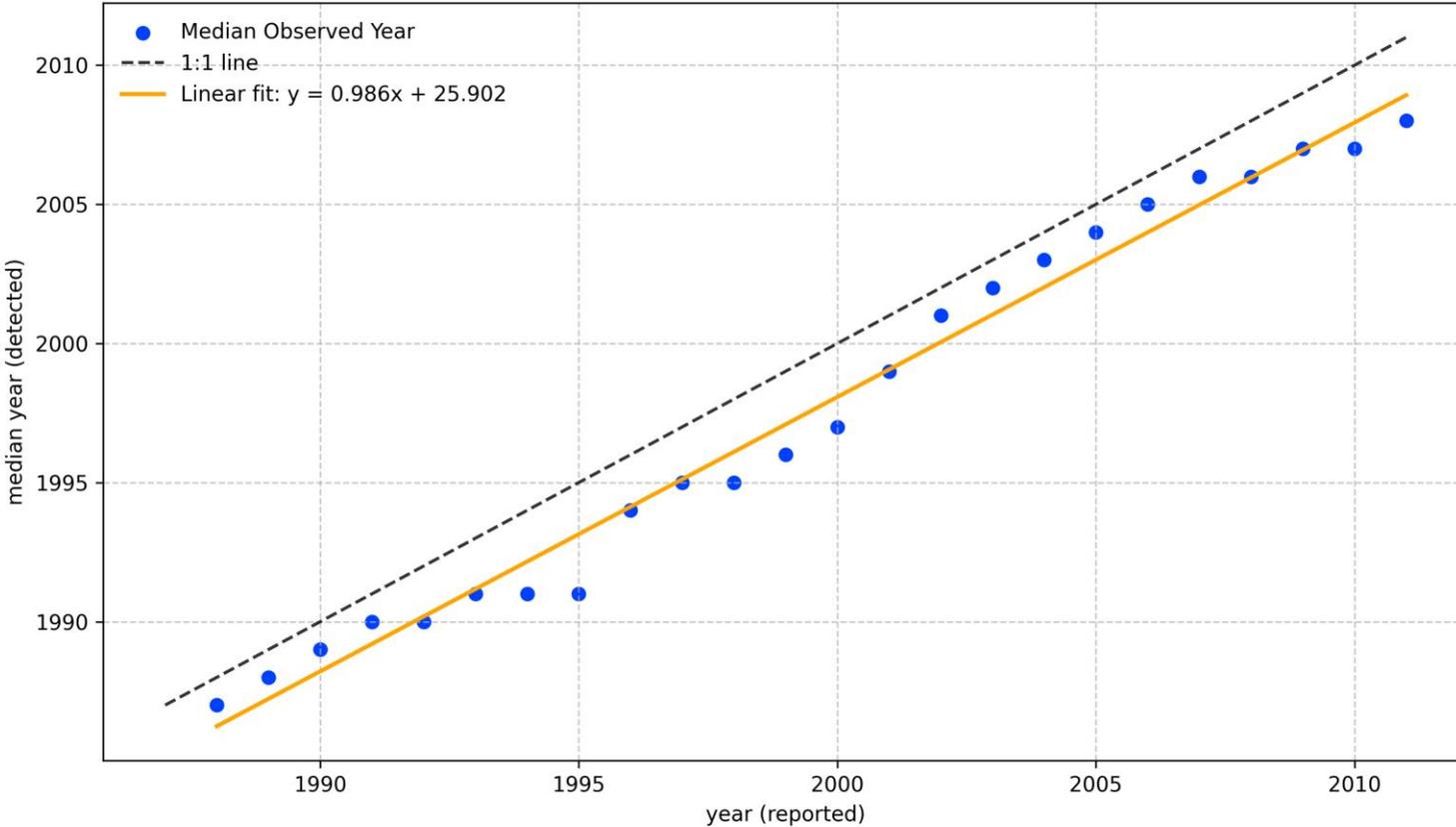
For counties with enough parcel data attributed with “year built” during the observed period, plots comparing the median year of mapped development change per reported year is produced. **Validation is at a much finer scale than the model. If this comparison is reasonable, we can assume the model-scale trends will be too.**



Phase 7 Development Trends

Prince George's County, MD

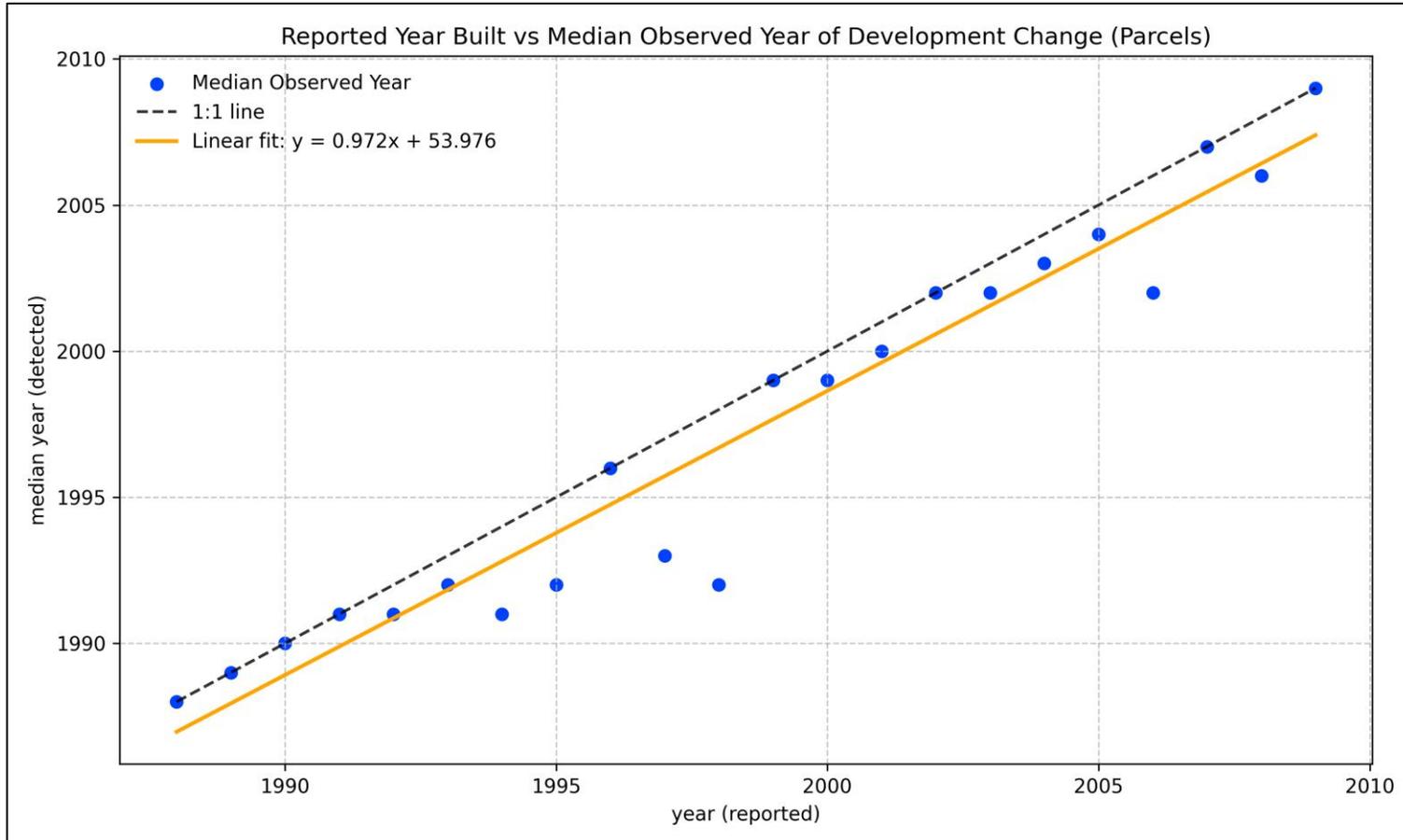
Reported Year Built vs Median Observed Year of Development Change (Parcels)



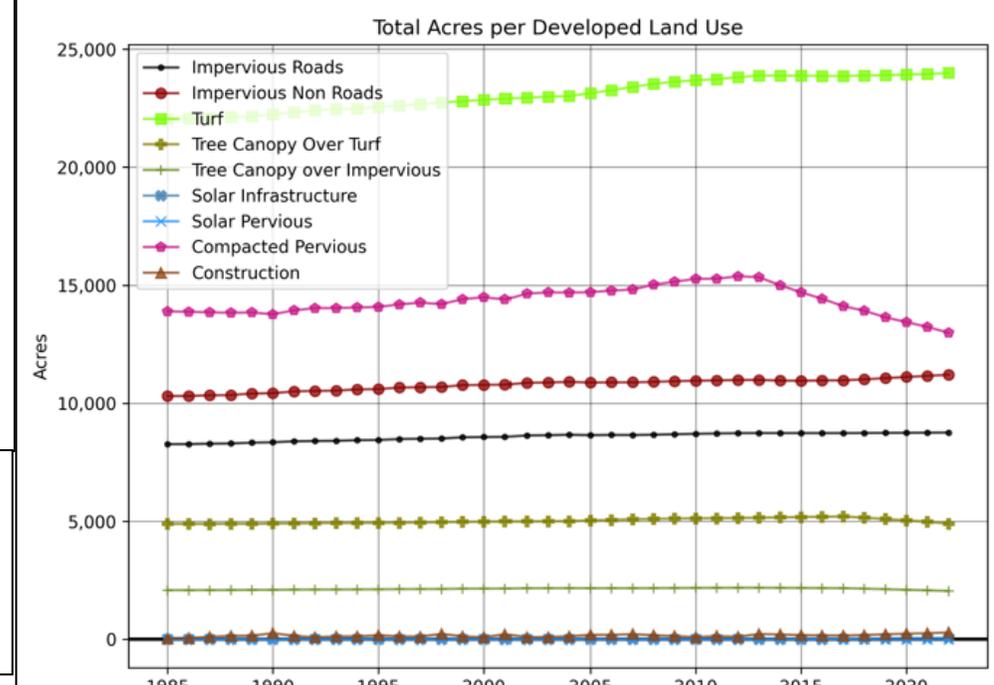
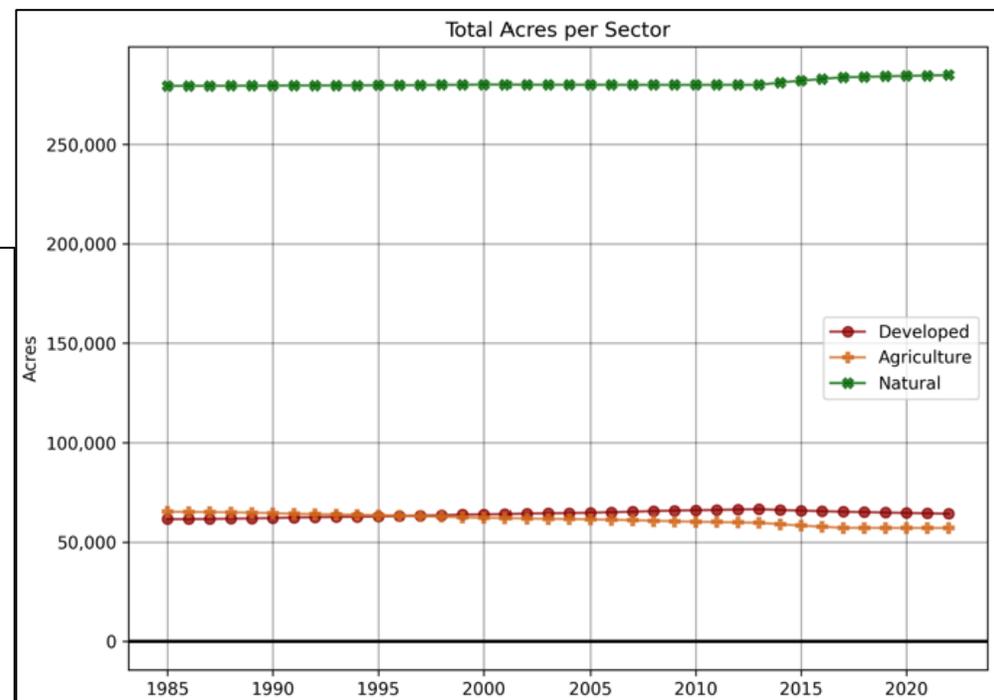
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Phase 7 Development Trends

Broome County, NY

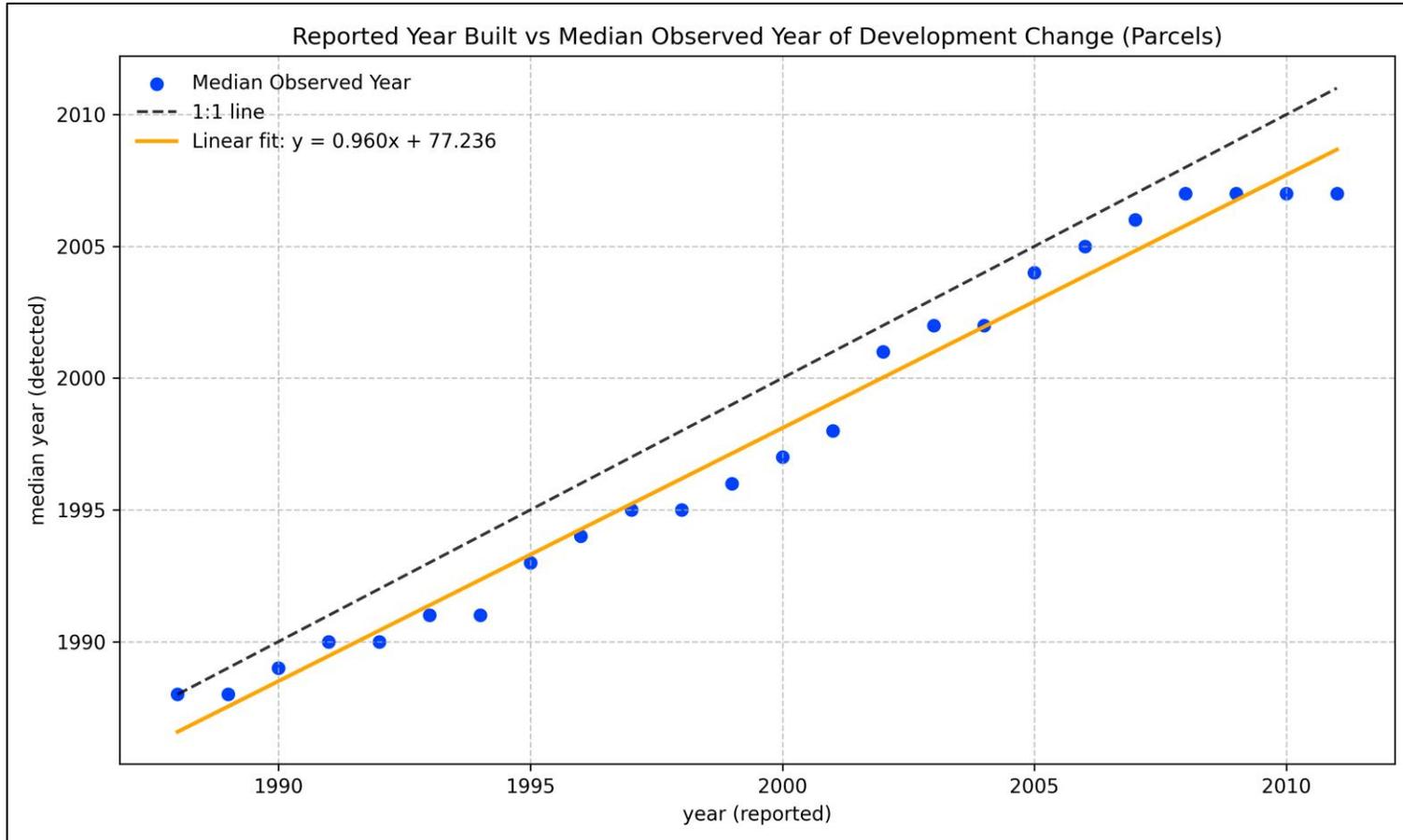


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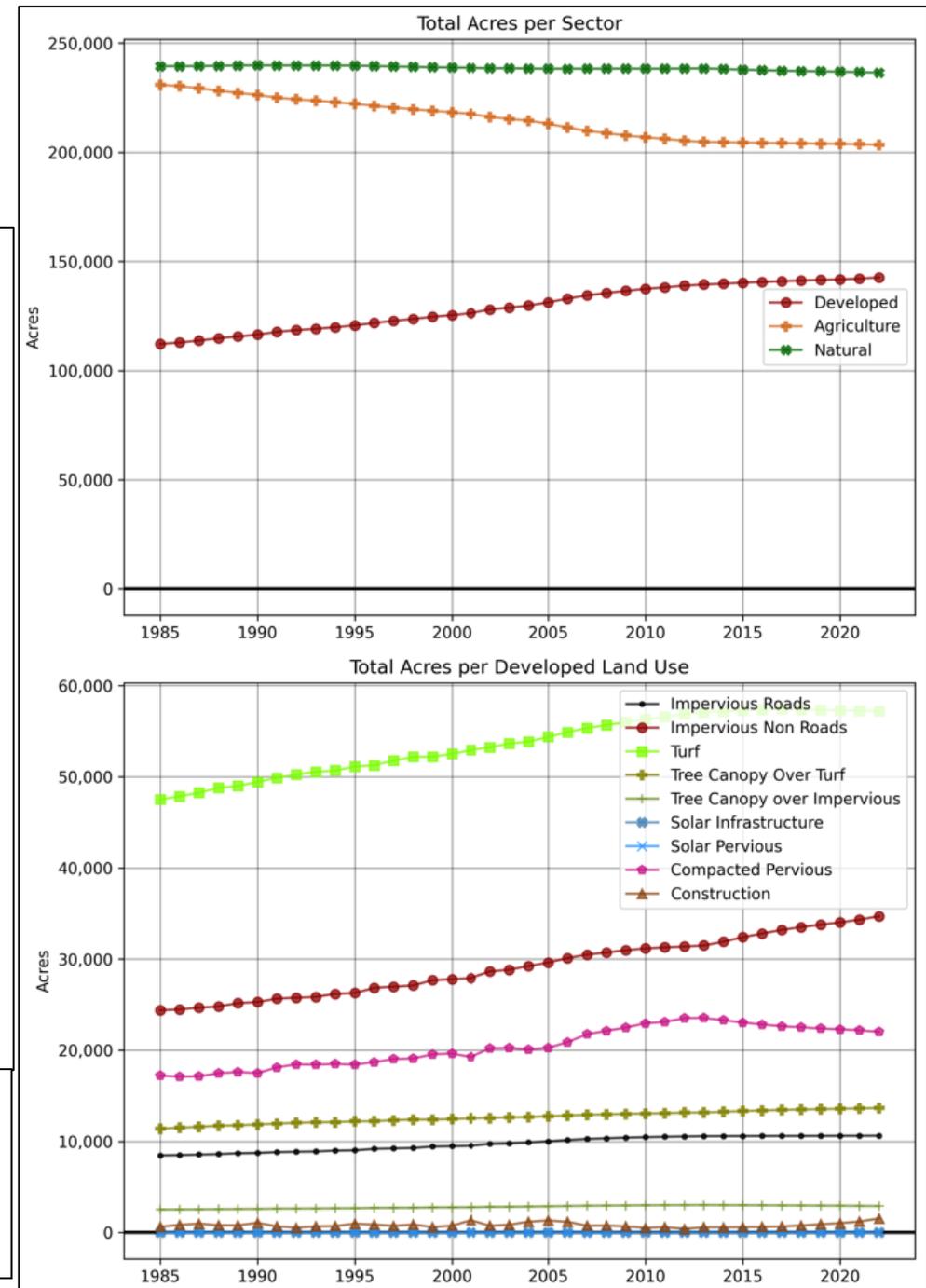


Phase 7 Development Trends

York County, PA



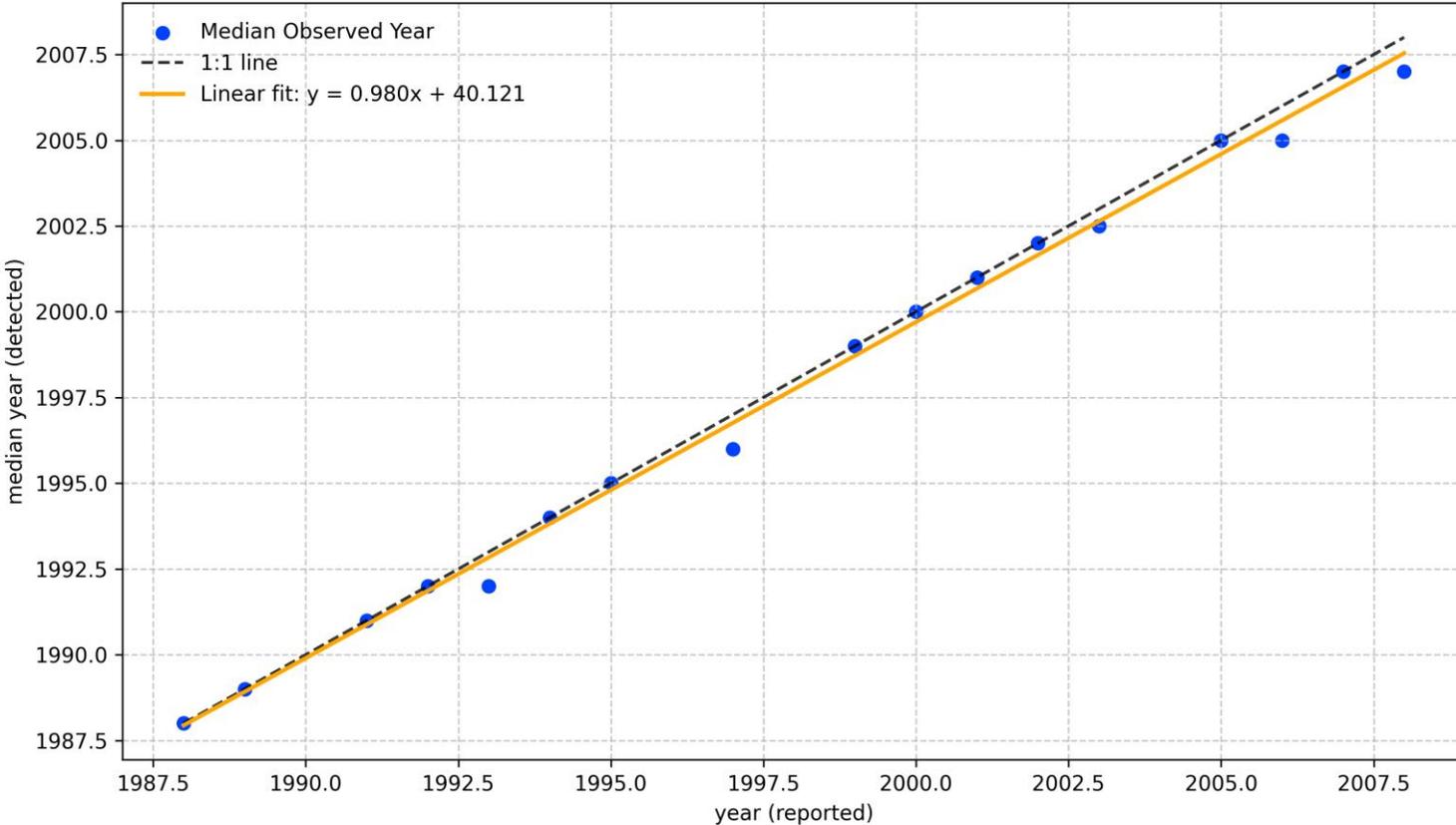
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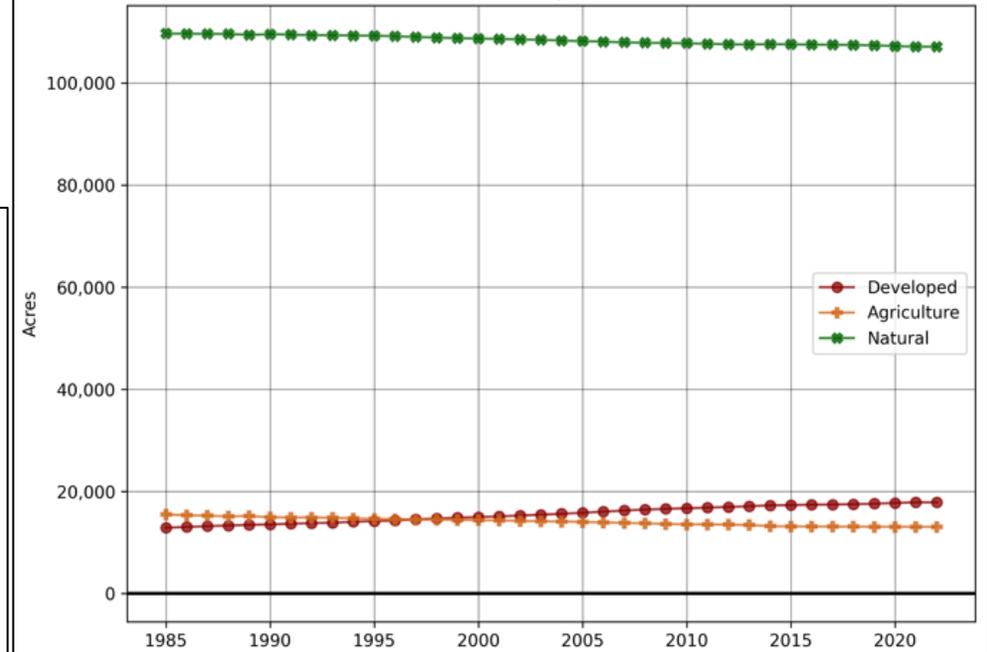
Gloucester County, VA

Reported Year Built vs Median Observed Year of Development Change (Parcels)

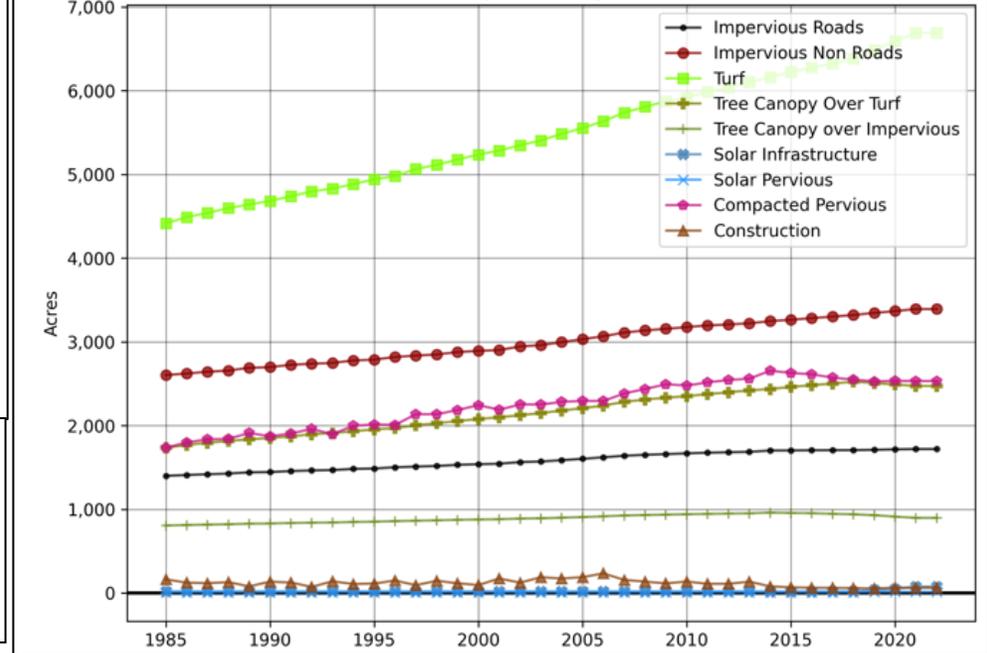


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Total Acres per Sector

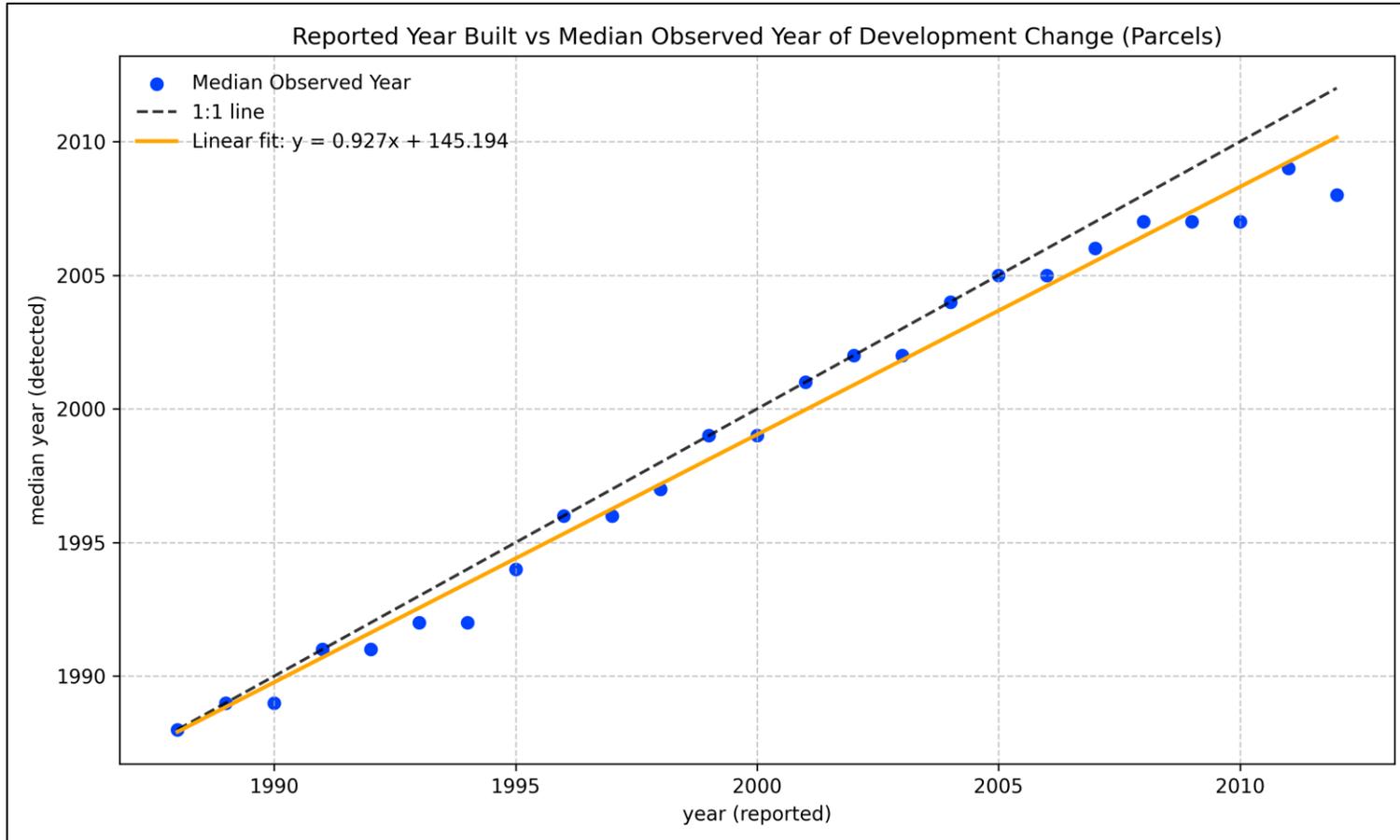


Total Acres per Developed Land Use

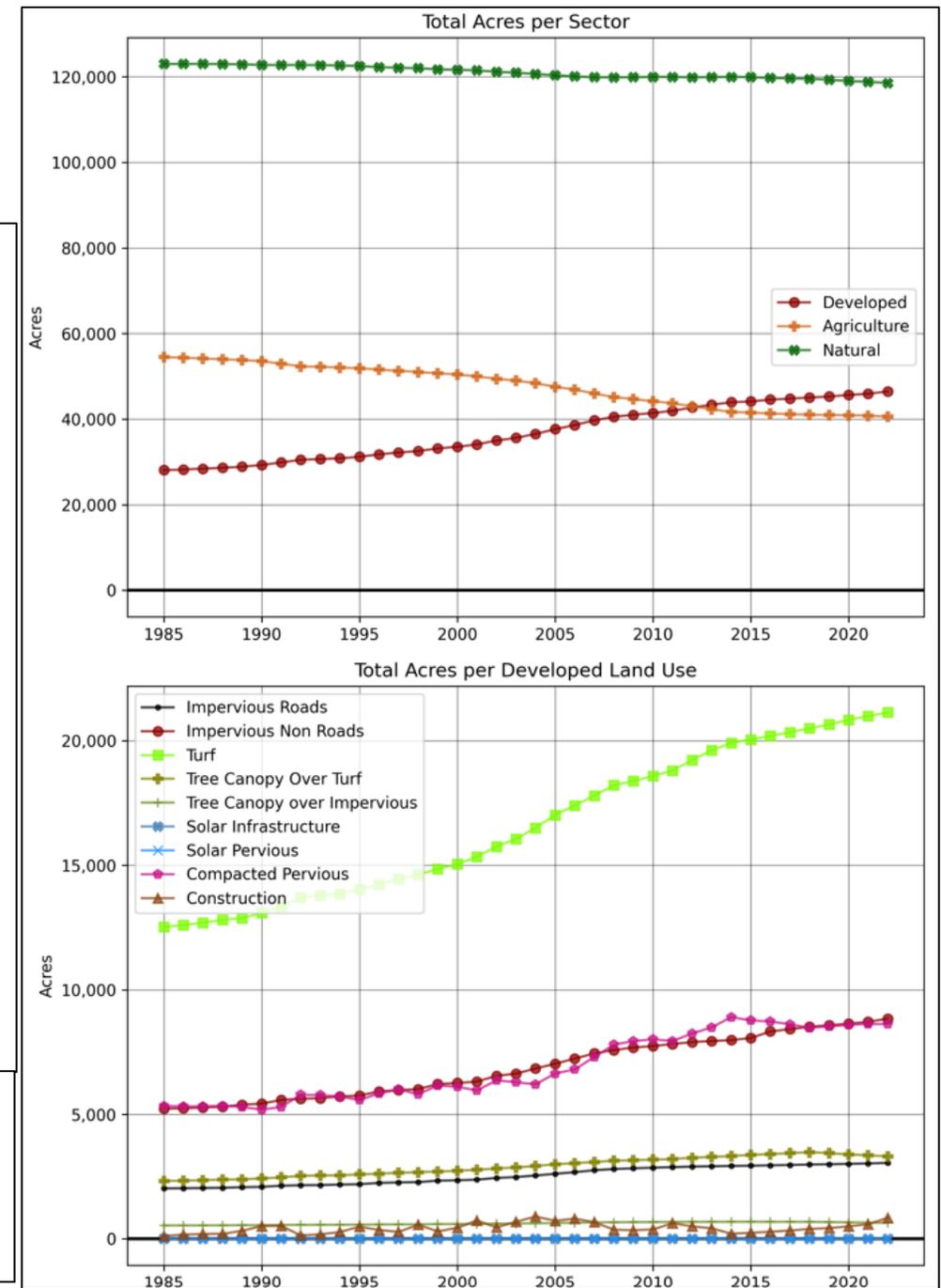


Phase 7 Development Trends

Berkeley County, WV



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Data Access, Timeline, and Review

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
- Walk-through of web-app:
 - https://www.chesapeakebay.net/files/documents/LandUseTimeSeries_LUWG-Office-Hours_20260303.pdf
 - <https://youtu.be/yBxhEYmmnYQ>

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?

- 70 of 197 counties are available now
- 170 of 197 counties will be available today
- Remaining 27 counties will be uploaded as they are completed

Questions or Feedback?

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