Appendix E

The Modeling of Land Use Activities within the Delaware Segment of the Chesapeake Bay Watershed

Team

University of Delaware SCC Land Use Modeling Project

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Summary

The University of Delaware (UD) Sustainable Coastal Communities (SCC) Program in cooperation Delaware Department of Natural Resources and Environmental Control (DNREC) has worked to develop a land use model for the Delaware segment of the Chesapeake Bay Watershed. The model is built upon the *CommunityViz®* platform and will aid officials visualize land use issues and understand the consequences of their land use policies while working to provide necessary information to implement environmental improvements to in the Delaware portion of the Chesapeake Bay Watershed.

Project

The UD was tasked with performing the following in support of DNREC's requirements for Element 3 of its Watershed Implementation Plan: Mechanisms to Account for Future Loads:

- Use the UD Community Land Use Model and *CommunityViz®* GIS platform to apply its 100-Acre grid to the entire Delaware portion of the Chesapeake watershed. The project will utilize the UD's previous work on defining Existing Land Use in Sussex County to expand the study area to the Delaware watershed, showing current and projected land use and population changes through 2025
- Incorporate small area population projections from the Delaware Population Consortium (DPC)
- Apply statutorily required comprehensive plans from Delaware's three counties and the 14 incorporated municipalities within the watershed to growth consideration

- Assign the UD's model land use types to growth based on DPC projections for the 2005-2015[1] and 2015-2025 time frame
- Perform *CommunityViz*® Build-out and Impervious Cover analysis for each of the Delaware Chesapeake Bay subwatersheds
- Assign current and planned method of wastewater disposal by land use type to the 100A tiles in the subwatershed

This document provides a brief synopsis of the methodology, assumptions, and constraints applied to the UD Community Land Use Model for this project.

Background

The UD Community Land Use Model

The UD team evaluated *CommunityViz*®(1) to develop a cost-effective, yet powerful GIS mapping and analysis tool in order to 1) support the County's sub-regional planning efforts in working meetings between community stakeholders and 2) support future comprehensive growth planning. *CommunityViz®* met our goals in providing a visualization tool with set of "crayons" for "painting" a picture of a community's character in terms of what it has today (existing land use), what it might have (land use as per the Comprehensive Plan), and what it could have (a "what-if" vision) for the future.

Working with Sussex County's Land Use Planner, the UD Team created a representative 100-acre square geographical feature to represent land use at the community level and defined associated land use designations, ranging from low density (1 unit per 100A) to high density (8 units per acre) mixed use designations. The 100-acre tile size was selected based on the average size of Delaware State Preliminary Land Use Service (PLUS) projects in the 2007-2008 pipeline. Six of the land use designations were modeled after form-based code transects. The land use designations were backed by underlying demographic parameters at the unit level that the Team easily customized to reflect Sussex County and Delaware-based demographics for the associated summary land capacity (build-out), population, and economic projections.

[1] DNREC requested growth projections to 2017 and 2025. DPC small area projections are estimated in five year increments. It was agreed by all parties that the UD would provide growth data for years 2015 and 2025, and that DNREC would extrapolate to year 2017 if necessary. See DPC section below.

The build-out and demographic results were validated by spatial and numeric comparison to 2007 digital orthophotography, State demographic projections in transportation analysis zones, 2007 land cover, Sussex County address structures and building footprint GIS layers. Export of the 3D "painted" transect images to Google Earth finalized the analyses by providing a visualization of future land use across the County.

The Land Use Designer, associated land use "paint" capability, and demographic database presented the most likely of the *CommunityViz®* tools to meet our needs. We began by describing and defining twelve land use designations as assumptions that could be imported into the Land Use Designer database. The base mapping unit/feature for the land use was a map of 100-acre squares or tiles forming a grid across the County. The 100-acre area was chosen based on the average size of new major developments already in the Delaware State application process.

While each of the designations could be applied to the Sussex County zoning districts, the designations were defined to broadly support form-based growth principles for "what-if" visioning. The tile or "transect" represented neither zoning nor land cover, but a land use type with varying densities, residential-nonresidential ratios, and single-mixed use variations to emulate the character of the community.

Sussex County and State development standards and demographic parameters were identified and input at the unit level in the Land Use Designer models. Custom formulas for land-use-calculated dwelling units and commercial floor area were developed that substituted the County build-out results and applied them to summary demographics.

The County was "painted" in several scenarios: existing land use, existing with pipeline (PLUS[2] projects) and as defined by the Sussex County 2008 Comprehensive Plan's Future Land Use Map. Cross-County "what-if" scenarios also included agriculture preservation scenarios – land needed to maintain a viable agriculture economy while maintaining growth projections around town centers.

The numeric build-out and demographic results were "ground-truthed" using 2007 satellite orthophotography in conjunction with the County's 911 address structures GIS layer to count dwelling units; by comparing statistics between small sub-areas to known town areas; and by spatially comparing the *CommunityViz®* results with State demographic projections stored in map overlays such as transportation analysis zones, building structures and footprint files.

[2] Preliminary Land Use Service (PLUS), Office of State Planning Coordination, Delaware

Export of the "painted" transect images to Google Earth finalized the analyses by providing a 3D visualization of future land use densities.

Details of the cited model and analytical process can be found in Attachment #1) *UD-SCC Community Land Use Model.pdf* and Attachment #2) *UD-SCC Land Use Planning Matrix Chesapeake 15Aug10.xlsx.*

The Sussex County Land Use Model discussed above is being used to create two build-out scenarios for the Delaware Chesapeake Bay Watershed. Starting with the Existing Land Use the UD Team "painted" a future land use scenario for the year 2015 and a separate land use scenario for the year 2025. For this project, the UD LU Model was calibrated to the Delaware Population Consortium (DPC) 2000-2030 projections of occupied housing and became the base from which to build the Growth 2015 and Growth 2025 scenarios.

2005 Delaware Population Consortium Population Projection

The 2005 DPC Population Projection project was developed in part to support the efforts of the State to address the increasing population within the State and determine the possible location of future population centers based upon inward and outward migration of existing and future residents. The effort, now required by Delaware Code to support the school referendum process for new and existing school construction, is the most recent comprehensive study undertaken by the State to consider future population dynamics. The DPC population projection process uses a series of mathematical formulas that incorporate a variety of data sources to determine future population on 5 year increments. This process is often updated every two to three years to meet the demands of local school districts; however, the 2005 effort is consider to be a complete effort because it blended the both the art and science of predicting population growth. Thus, in order to assign growth based on the DPC Small Area Projections data, the Team will assign DPC-specified growth to UD Land Use Model for the years 2015 and 2025.

The following modification of the UD model's growth and land use statistics would provide the data to support the 2017 EPA identified timeline midpoint. This effort would use the existing model's formulas with supplemental data inputs from the US Census data to derive short term population adjustments within the normal 5 year time frame. With these existing tools in place, the determination of the 2017 EPA Chesapeake Bay TMDL effort could be developed; however, it would require the input of local jurisdictions to address the population shifts base upon possible future development projects, land use constraints, etc.

Project Methodology

The SCC Land Use Modeling Team was tasked with the land use evaluation and modeling for the over 20 river segments (e.g. subwatershed) of the Chesapeake Bay Watershed within Delaware. The Bay watershed impacts all three Counties within Delaware, with the bulk of watershed located within Sussex County. Based upon Federal requirements, DNREC requested that the model should account for all activities within the watershed statewide. As a result of this requirement, statewide parameters were applied to the model's assumptions and constraints. These parameters are described in this document.

Study Area

The Chesapeake Bay Watershed extends into each of the three Delaware counties, but not all of any. The study area boundary encompasses only the portions of Delaware within the watershed and assigns a value of "unused" to any surrounding tiles. Tiles from the 100-Acre grid were selected from the entire State of Delaware based on their location within the NCC, Kent, and Sussex Chesapeake Bay Watershed. Using GIS spatial selection, the tiles were selected if their "centroid" fell within the Chesapeake river segments layer provided by EPA. A review of the boundary was performed to synchronize the study area as closely as possible to the EPA river segment area.

Data and Assumptions

Certain model parameters were customized to meet the needs of DNREC's requirements as detailed below and under the *Process* section. These customizations were within the model's parameters and did not affect the integrity of the model. A list of the GIS data layers used for the project can be found in the Methodology Attachments.

The density parameter input into the build-out analysis (Attachment 2, Line 7, dwelling units per acre ,) was modified from the range maximum to the density mid-point for the rural land use tiles (T100, T20 and T5). The mid-point of the range was more appropriate for the base (Existing LU Scenario) due to the rural nature for most of the watershed. In addition, given that the ultimate use of the model in this instance deals with environmental issues, the Team did not want to overstate the amount of impervious area that would be developed through the various modeling scenarios.

To further ensure consistency of the impervious surface data will be consistent with the Federal TR-55 Water model, the TR 55 impervious values were added to the Matrix (lines 57,

58 and 59). All rural tiles are assigned 8,712 square feet of impervious surface (i.e. 20% of lot size). In addition, for the same reason, the Build Efficiency parameter for land use types T30-Employment and T200-Retail were revised to reflect impervious area as per TR-55 (line 22). Lastly, for mixed use land use types, a custom formula was created to accommodate impervious area of their nonresidential portions. The formula assigns TR-55 impervious area as appropriate for that tile.

For the purposes of this project, all rural areas and the T2 Suburban land uses were assumed to use septic systems. All other development is assumed to be connected to a central or community sewerage treatment system[3].

Timeframe

Near term timeframes were specified as requirements of the project. For that reason the starting point, i.e. the existing use of the land, needed to closely reflect known data. Therefore, the Team found that the Model's existing occupied dwelling unit count and total existing population counts needed to be calibrated to the controlling data, the DPC Small Area Projections for the year approximating 2005. This was accomplished by modifying the base density of the rural land use types from the maximum per tile to the midpoint per tile (see *Data* #1 above). As a result, the total number of existing occupied dwelling units in the Watershed was within three percent of the DPC estimate. Differences in geography should be kept in mind when comparing statistical differences derived from GIS spatial analysis. With this calibrated starting point, application of the added occupied dwelling units projected by the DPC for the years 2015 and 2025 should be accurately reflected in the Model.

Process

The process used to assign DPC's projected growth changes between 2005-2015 and 2015-2025 are outlined below.

Existing land use was assigned or "Painted" consistent with the most recent aerial photographs, structure data file and other available data for Kent and New Castle Counties. In Sussex County, changes in existing land use between the original "Paint" in 2008 and more current data resulted in an adjustment to the paint to reflect the new development. The data were then compared to the DPC modified grid data for the entire watershed in each County. Adjustments

[3] See Line 60: Wastewater Type in the UD Community Land Use Model Parameter Matrix

discussed above were then made to assure that the model reflected known data for the current situation. The steps for processing are outlined as follows:

- Attributes that reflected DPC projected growth 2005 to 2015 and 2015 to 2025 were added to the Small Area Population Projections database table.

- Two new scenarios were added to the Existing Land Use Scenario in the *CommunityViz*® analysis: 'Growth2015' and 'Growth2025'. Growth change was calculated and applied by time frame to each Chesapeake Bay river segment by summing the DPC projected change Land use types were assigned to the Existing Lu Scenario for all three counties using the following GIS data: 2009 NAIP orthophotography, 2007 Land Use Cover, County 911 Address structures (Kent and Sussex), and parcel data.

- Growth change in land use was assigned based on the following assumptions and criteria:
    1. PLUS projects in growth areas. If multiple PLUS projects exist in a watershed, the Team selects the projects most closely adhering to the remaining criteria to apply growth;
    2. Smart Growth criteria such as compact housing, mixed use types, "places", populated crossroads that had the potential to grow to urban villages ;
    3. County Comprehensive Plans, land use policies, or potential annexation areas;
    4. Central Sewer over on-site septic projects

- The Team first calculated the increase in the number of occupied housing units projected by the DPC in each watershed. Figures were calculated for the period 2005 to 2015 and for the period 2015 to 2025. The team then looked at the watershed and, applying the priorities discussed above, distributed the growth by tile across the watershed. Existing tiles are then replaced by the new tile selected by the team to reflect "growth" within the watershed during the appropriate period (to 2015 or to 2025). Team stops allocating growth and changing tiles within a watershed when the number of new occupied housing units exceeds the DPC projection for that area[4].
- Build-out was first run for all three scenarios using the calibrated rural density values and applying the model's net build efficiency factors that consider seasonal vacancy rates (i.e. occupied housing comparable to EPA "Households").

[4] The tile location is consistent with usual development practices. That is, the tile is not primarily out of play (wetlands, publicly held lands), avoids concentrations of agricultural easements, is near development or contains road frontage for access to development.

- Build-out was subsequently run for all three scenarios using the calibrated rural density values and applying the model's gross build efficiency factors (i.e. total dwelling units built; comparable to EPA's "Total Housing Units").
- Attributes were created to test the calculation of impervious surface based on the model's land use types. For residential impervious surface, the calculation is based on number of estimated dwelling units for the 100A tile and the model's land use type lot size. The resulting impervious surface estimate does not account for roads, sidewalks or other entities external to the residential lot. The algorithm for the calculation of nonresidential impervious surface is in progress and requires more input from DNREC. The results will be provided at a later date. Results were summarized statewide and by land use type for quality control; by EPA river segment for comparative purposes. Residential and nonresidential densities, floor area, and associated demographic summarizations were included. *(Note 23Aug10: Impervious surface calculation will be provided after discussion with DNREC re: floor area assumptions.)*
- All results were summarized statewide and by EPA river segment.
- Maps were created both statewide and countywide for each scenario: Existing Land Use, Growth 2015, and Growth 2025.

Conclusion

The land use modeling and build-out results (Methodology, Maps, and Results Tables) provided today should be considered preliminary land use and build-out findings as the first draft to the Phase I portion of the EPA Chesapeake Bay TMDL Project. The draft format was requested by DNREC in order for a review and refinement process to take place prior to delivery to EPA. The decisions regarding land use assignment to the Growth 2015 and Growth 2025 Scenarios were performed solely by the land use modeling team listed above based on their planning expertise, study area knowledge, and supporting GIS validation data. In order to refine the estimates based on jurisdictional growth specifics, future iterations of the modeling process are needed to finalize the results. Also, some jurisdictional GIS data were not available at the time of analysis and are needed to validate assumptions and land use assignments.

List of Deliverables

UD Build-Out Methodology

Chesapeake Bay Watershed Build-out Methodology_Draft1_22Aug10_UD.docx

Build-Out Results (22Aug10):: Total Housing Units[5]

1. **Indicators_ChesapeakeWS_THU_22Aug10.xlsx**

   Worksheet 1: *Growth Indicators THU Statewide*
   Worksheet 2: *THUs by River Segment*

2. **THU _Growth 2015-2025 Demographics_22Aug10.xlsx**

   Worksheet 1: *THU_ExistingLU_22Aug10_byRivSeg*
   Worksheet 2: *THU_Growth2015_22Aug10_byRivSeg*
   Worksheet 3: *THU_Growth2025_22Aug10_byRivSeg*

Build-Out Results (21Aug10): Households[6]

Indicators_ChesapeakeWS_Households_22Aug10.xlsx

Worksheet 1: *Indicators_ChesBayWS_Households*
Worksheet 2: *Households by River Segment 21Aug10*

Maps

Chesapeake_WS_Draft_Maps_21Aug10.pdf

Document Attachments

1. *UD-SCC Community Land Use Model.pdf*; presentation to DNREC on May 13, 2010
2. *UD-SCC Land Use Planning Matrix_Chesapeake_15Aug10.xlsx*
3. *List of GIS and CommunityViz® Data (File Dependency Report)*

References

1. "Sussex County Land Use Model - Crayons, *CommunityViz®* and the 100-Acre Grid" 12OCT09; University of Delaware Cooperative Extension; William McGowan, Ed.D, Carol Bason, and Richard Kautz, AICP *(unpublished)*
2. Delaware Population Consortium, Office of State Planning Coordination, State of Delaware, Small Area Population Projections, 15Jan08

[5] Total Housing Units: Full capacity of dwelling units available
[6] Households: Equivalent to 'Occupied Housing' accounting for seasonal vacancies

UD-SCC Community Land Use Model

May 13, 2010

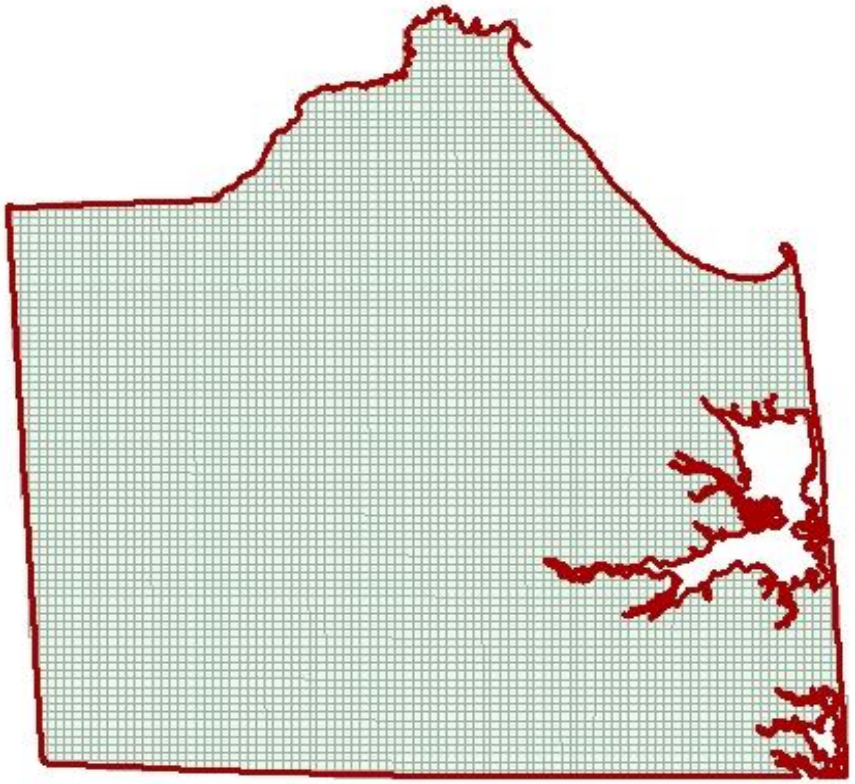
University of Delaware Team
Bill McGowan, Ed.D, County Agent, Community Development & Public Policy
Carol Bason, Program Manager, CommunityViz®
Richard Kautz, Land Use Planner

The UD-SCC Community Land Use Model

UD-SCC Community Land Use Model – What is it?

- **Geographical Feature**: 100-Acre tiles forming a cross-county grid
  - Impartial
  - Consistent
  - Reproducible
- **Land Use Designations :** Form-based and Sussex County Custom
  - "Crayons" (palette) for assigning land use types
  - Three-dimensional Google Earth representations of density
  - Associated unit-level residential & nonresidential densities
  - Associated validated custom SC demographics
- **Analysis**
  - Build-Out – Numeric, Spatial (2D), Visual (3D)
  - Associated demographic impacts
- **Assumptions**
- **Constraints**

UD-SCC Community Land Use Model
100-Acre Cross-County Grid



Model Land Use Designations

Legend

- Unused
- T1 - Rural Village
- T100A - Rural
- T2 - SubUrban
- T200K - Retail
- T20A - Rural
- T30K - Employment
- T4 - SubUrban
- T4 - SubUrban Mixed
- T5A - Rural
- T6 - Urban Mixed
- T8 - Town Center
- TM - Strip Mixed Use
- T16 - High Density Mixed

Land Use: Rural

- T100A-Rural: 1 DU
- T20A-Rural: 5 DU
- T5A-Rural: 20 DU
- T1-Village: 100 DU; Mixed

Land Use: SubUrban and Urban Mixed

- T2- SubUrban: 200 DU
- T4- SubUrban: 400 DU
- T4-Mixed SubUrban: 400 DU/Mixed Use
- T6-Urban Mixed: 600 DU/Mixed Use
- T8-Town Center: 800 DU/Mixed Use
- T16-High Density Mixed: 1600 DU/Mixed

Land Use: Non-Residential

- TM: Highway Commercial/Mixed Use
- T30: Employment Centers/ Institutional
- T200: Retail/Shopping Centers

The Model’s Toolset

Land Use Model Parameters

- Residential Dwelling Units
- Nonresidential Floor Area (and Employees)
- Demographics
  - Residents & Children Projections
  - Residential & Nonresidential Taxes
  - Commercial Employee Statistics
  - Water and Wastewater Usage
  - Vehicle Trips
- “Out-of-Play” from State Policies; Runways (Constraints)
- Land Use Efficiency: (ROW, easements, vacancy rate, etc.)

Demographic Coefficients

Land-Use Models Table

Land-Use Layer: SC_LU_Grid

Attribute Name	T2 - SubUrban	Unused	TM - Strip Mixed	T1 - Rural Village	T100A - Rural	T200K - Retail	T20A - Rural	T4 - SubUrban	T4 - SubUrban Mi	T
LU Children per DU	0.7	0	0.6	0.6	0.7	0	0.7	0.4	0.6	0.
LU Com Tax Rate	0	0	20	15	0	25	0	0	20	0
LU EE VTD	0	0	20	20	0	40	0	0	20	0
LU EE Waste Water	0	0	20	20	0	20	0	0	20	0
LU EE Water Use	0	0	25	25	0	25	0	0	25	0
LU LBCS Activity	1100	1100	9990	9990	1100	2100	1100	1100	9990	7(
LU LBCS Function	1100	1100	9990	9990	1100	2100	1100	1100	9990	5!
LU Residents per DU	2.41	0	2.41	2.41	2.45	0	2.45	2.63	2.41	2.
LU Tax Rate per DU	100	0	85	85	85	0	85	100	100	8!
LU VTD per DU	10	0	10	10	10	0	10	10	10	1(
LU Waste Water per DU	300	0	300	300	300	0	300	300	300	3(
LU Water Use per DU	300	0	300	300	300	0	300	300	300	3(

Land Use Model Palette

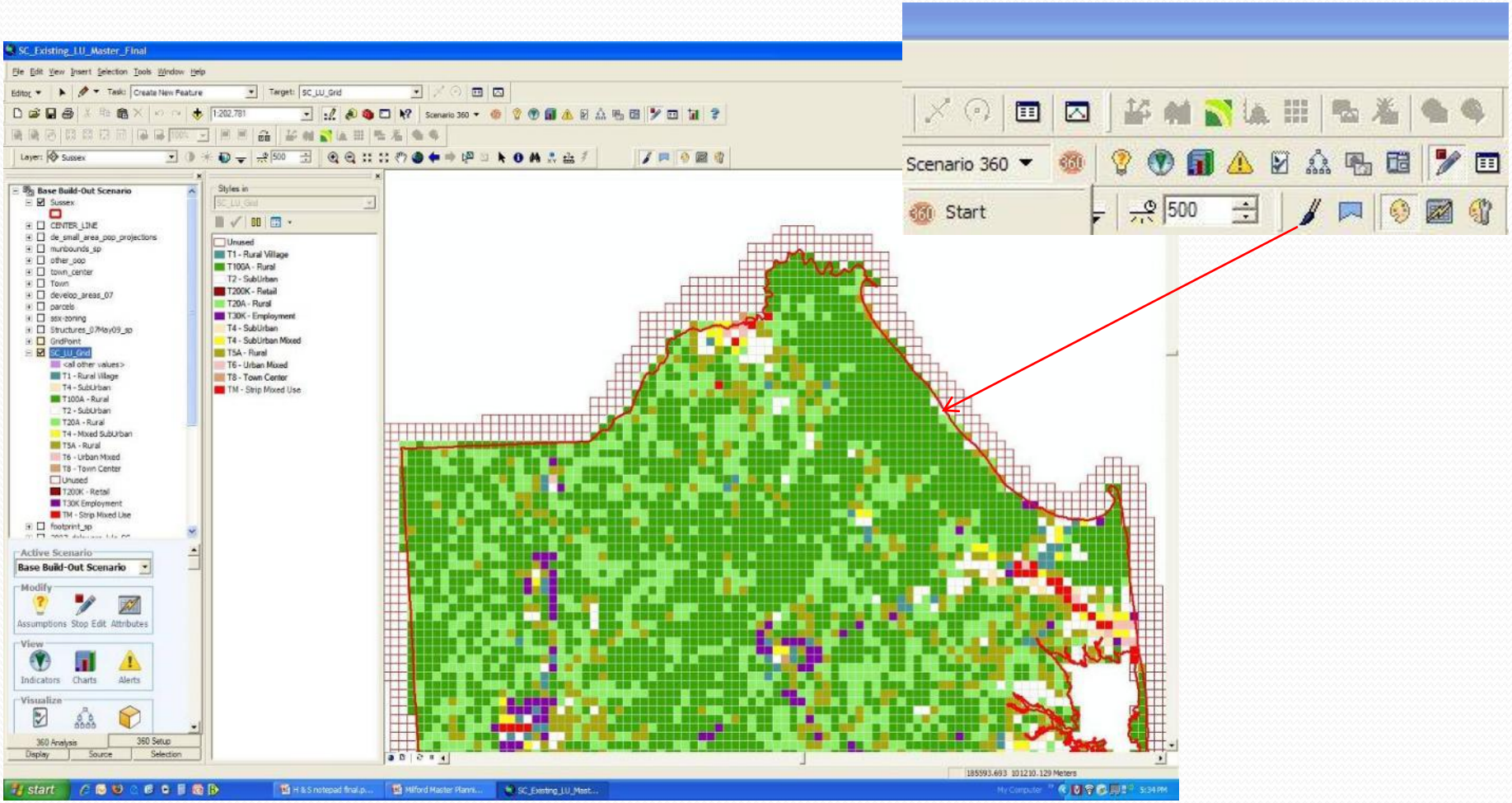
Community Land Use Type	Legend	Residential Density (Dwelling Units)	Non-residential Square Footage (per 100A)	Build Efficiency (Full Occupancy)
T100A Rural		1-4 DU / 100 A	None	100%
T20 Rural		5-20 DU / 100A	None	100%
T5 Rural		21- 50 DU / 100A	None	60%
T2 Suburban		2 DU / A	None	70%
T4 Suburban		4 DU / A	None	80%
T1 Rural		1 DU / A	9000 SQ FT	75%
T4 Suburban Mixed		4 DU / A	150,000 SQ FT	75%
T6 Urban Mixed		6 DU / A	300, 000 SQ FT	75%
T8 Town Center		8 DU / A	500, 000 SQ FT	90%
TM Strip Mixed Use		4 DU / A	700, 000 SQ FT	80%
T16 HDM		16 DU / A	50, 000 SQ FT	90%
T30 Employment		None	200, 000 SQ FT	80%
T200 Retail		None	800, 000 SQ FT	80%

The Land Use Modeling Process

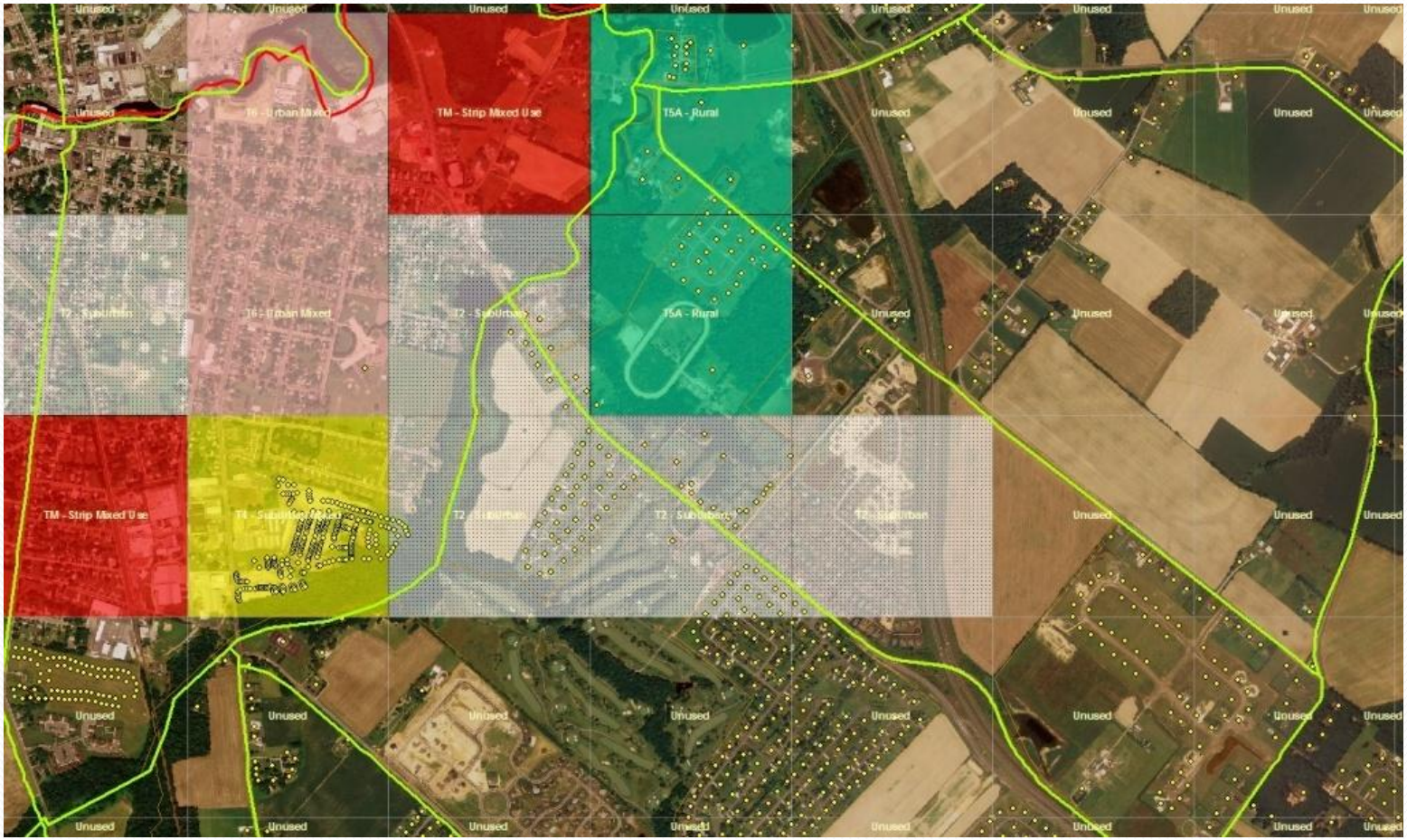
Modeling Process *in a Nutshell*

1. Define Boundary of Sub-Region/Master Plan area
2. Extract Sub-Region Grid from Sussex County Master Grid
3. Research/Compare/”Paint” Sub-Region Comprehensive Plan
4. Hold Stakeholder Workshop(s)
5. ”Paint”/Analyze/Compare Stakeholder Scenarios
6. Hold Public Workshops
7. ”Paint”/Analyze/Compare Public Scenarios
8. Define/Analyze consensus-built Composite Scenario
9. Write/Deliver Sub-Region Report & associated land use data

“Painting” the Land Use Model



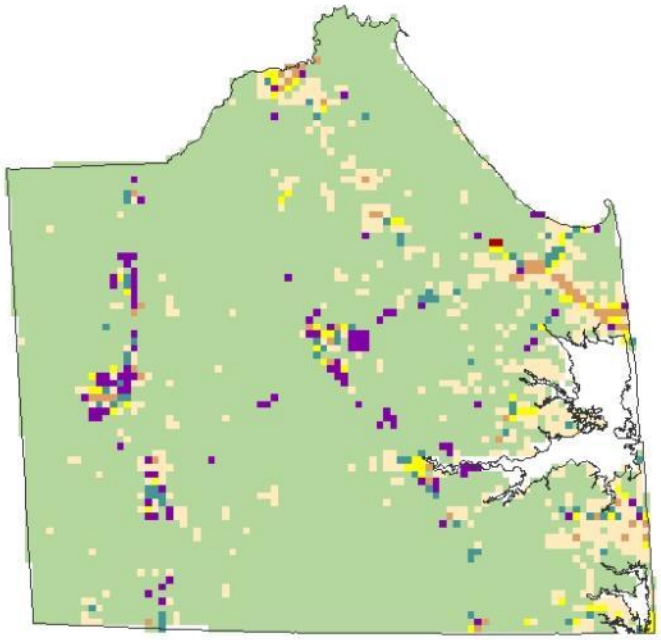
Validating the Land Use Model



GIS / Land Cover / Structures / Building Footprints / 2007/2009 Aerials / TAZ's

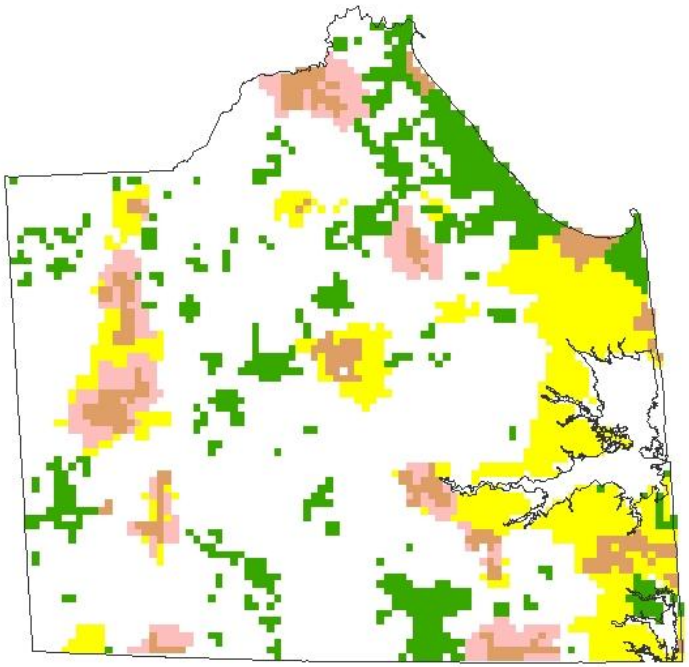
Cross-County
Existing & Comprehensive Plan Scenarios

Sussex County Land Use Comparison



Existing Land Use with Pipeline
(Rural Combined)

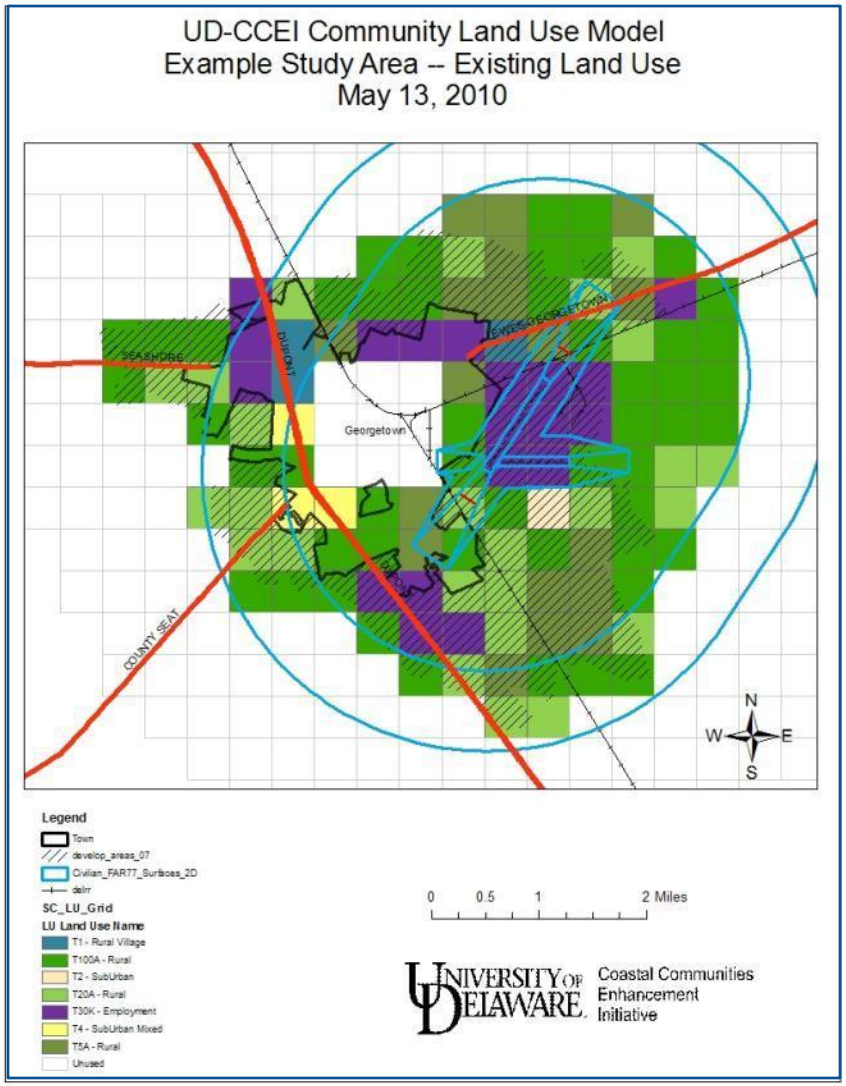
SC Growth Plan Land Use

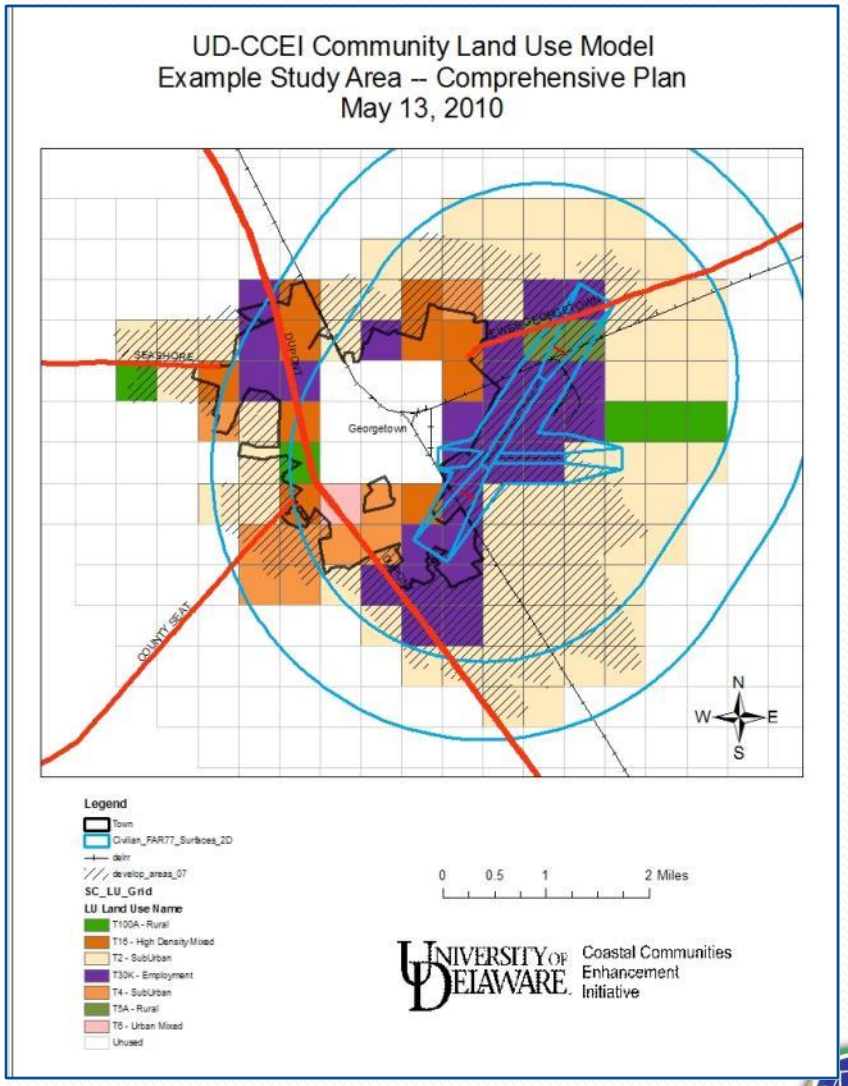


Example Study Area
Existing & Comprehensive Plan Scenarios

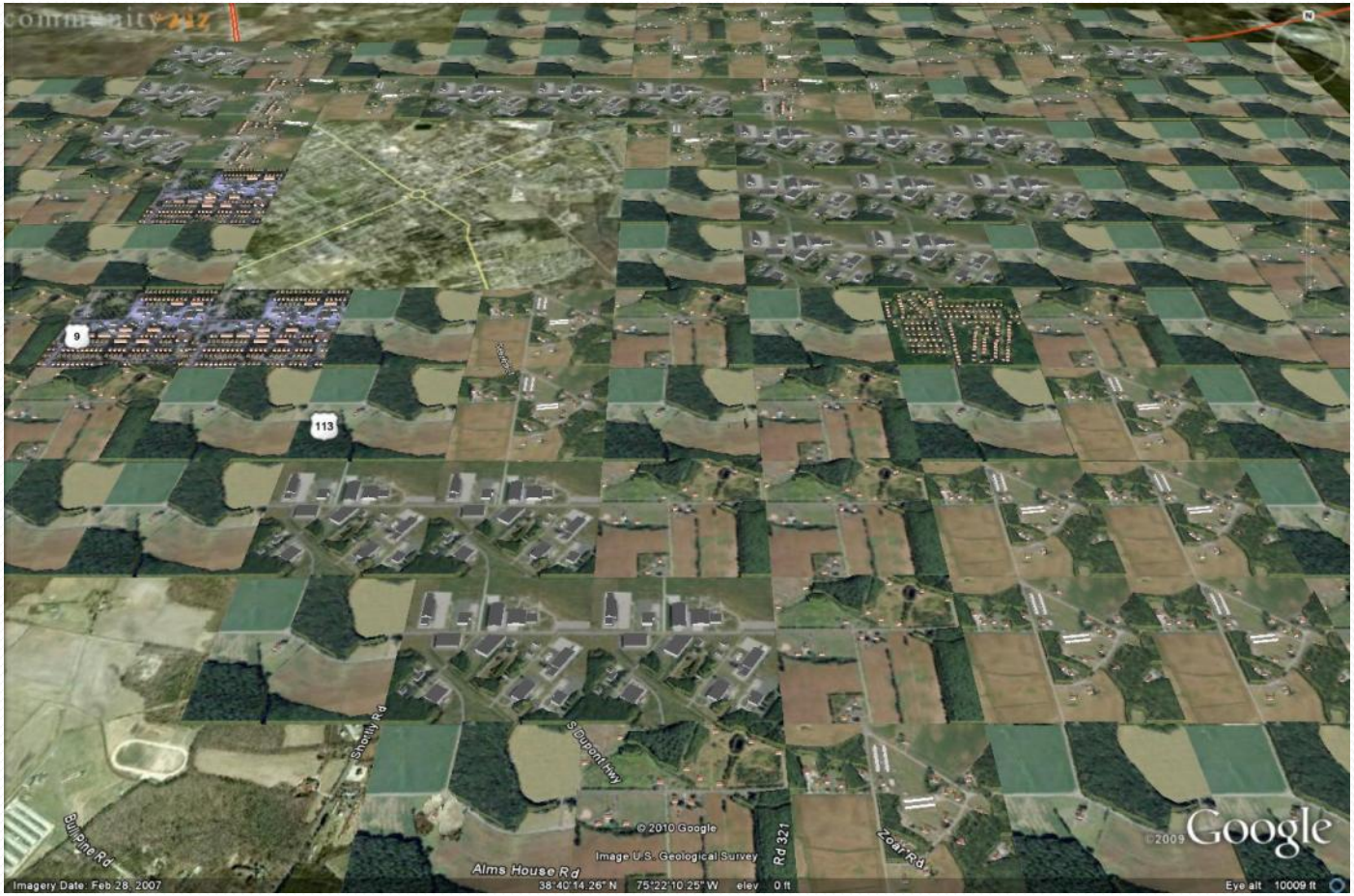
Stakeholder Workshops

Land Use Scenarios





“Existing” Land Use Density*



** Google Earth 3D representation of land use: residential and non-residential density*

Comprehensive Plan Land Use Density*

** Google Earth 3D representation of land use: residential and non-residential density*

Build-Out Analysis Example

Georgetown "Inner Circle"	Existing Land Use Scenario	Comprehensive Plan Scenario
Residential		
Dwelling Units	2,149	24,491
Residents	5,224	62,499
Children	1,416	9,874
Res Taxes	194,830	2,258,105
Res VTD	21,490	219,574
Res Waste Water	644,700	7,347,300
Res Water Use	644,700	7,347,300
Non-Residential		
NumComFloorArea	3,397,750	4,835,000
Employees	8,319	12,559
Com Taxes	168,964	236,242
Com VTD	86,835	119,625
Com Waste Water	162,835	223,625
Com Water Use	203,543	279,531

Data above are for demonstration purposes only

Benefits of the UD-SCC Land Use Model

- Stakeholder interests visualized and analyzed
- Public deliberates and makes land use choices
- “On-the-fly” instant impact analysis identifies consequences
- “What-if” process provides implementation options
- Iterative tradeoff & consensus-building visualization process leads to consensus
- Regional, State and Local-level scalable model

Visioning – *Your Turn!*

SE Neighborhood Public Workshops
Source: David Ross, Milford Beacon, October 22, 2009

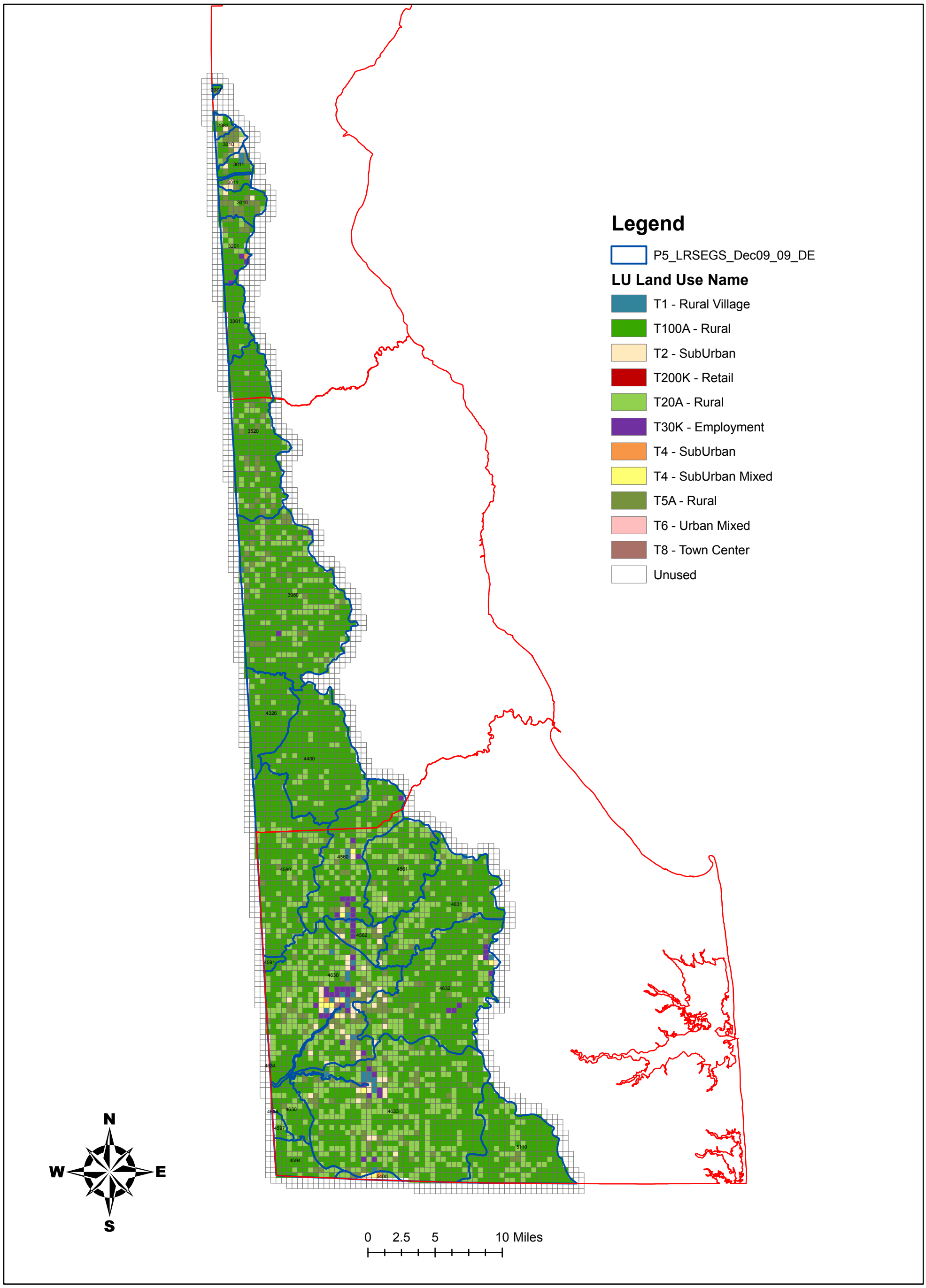
Milford, Del. – "Southeast residents speak out on planning"

After hours of hearing professional planners talk about the options for development in their neighborhood, residents of southeast Milford got a chance to draw their own vision of the future on Oct. 15. "We're having our vote now," neighborhood resident Wesley Barrows said.

After state planner David Edgell and Milford City Planner Gary Norris spoke on the options they'd come up with for zoning and development southeast of town, almost 50 local residents, farmers and businesspeople took their turn as planners, laying out their own maps of the southeast neighborhood in 100-acre blocks. Each group of five got a set of tiles, color-coded from green for the lowest density to red for the highest, to arrange however they liked.

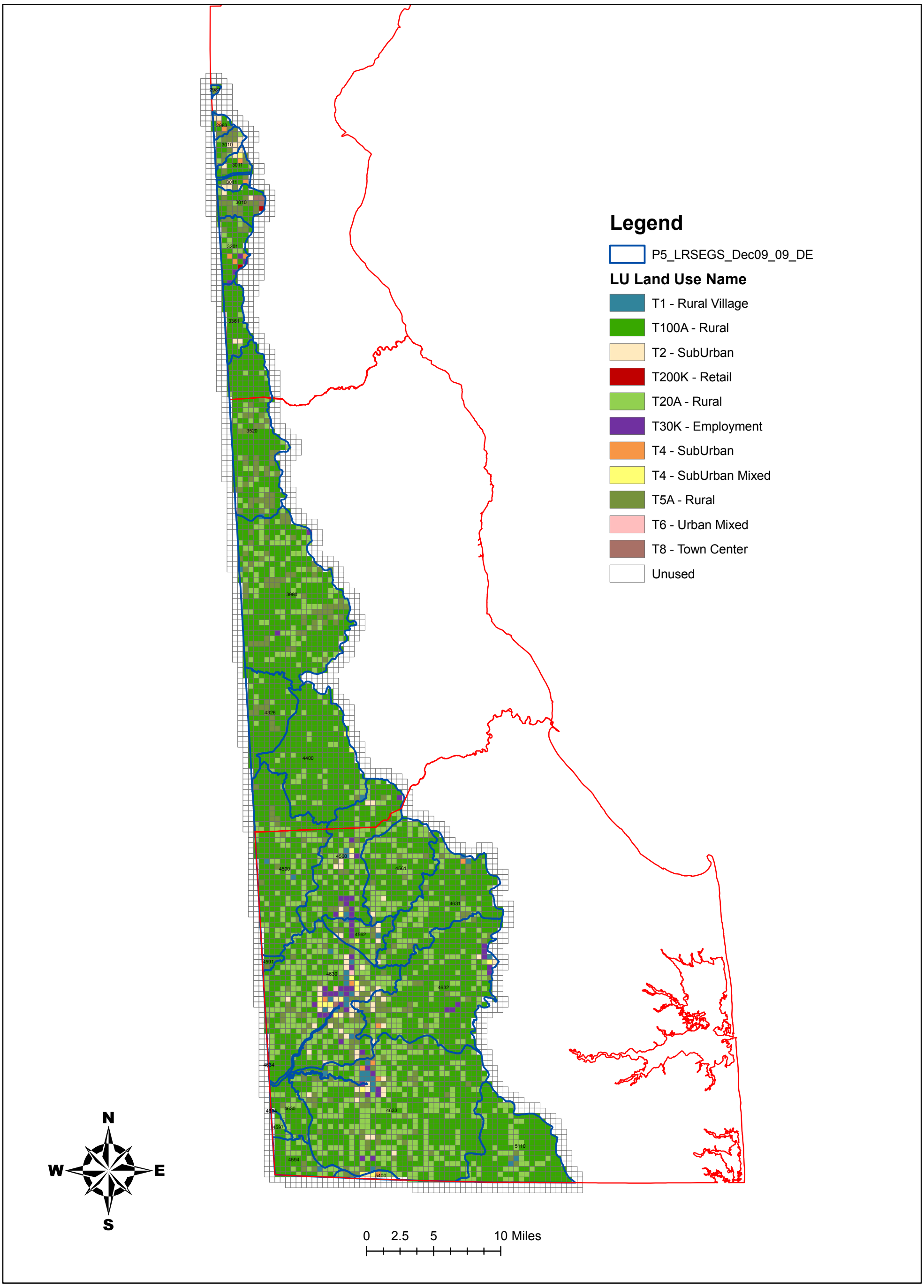
Bill Pfaffenhauser said he'd like to see more areas like the mix of stores and housing in downtown Milford, rather than blocks designated for nothing but housing or nothing but commercial. . "I like the idea of small business with apartments upstairs," he said. Apartments, to me, provide not low-income housing but more reasonable housing."

Chesapeake Bay Watershed - Delaware Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



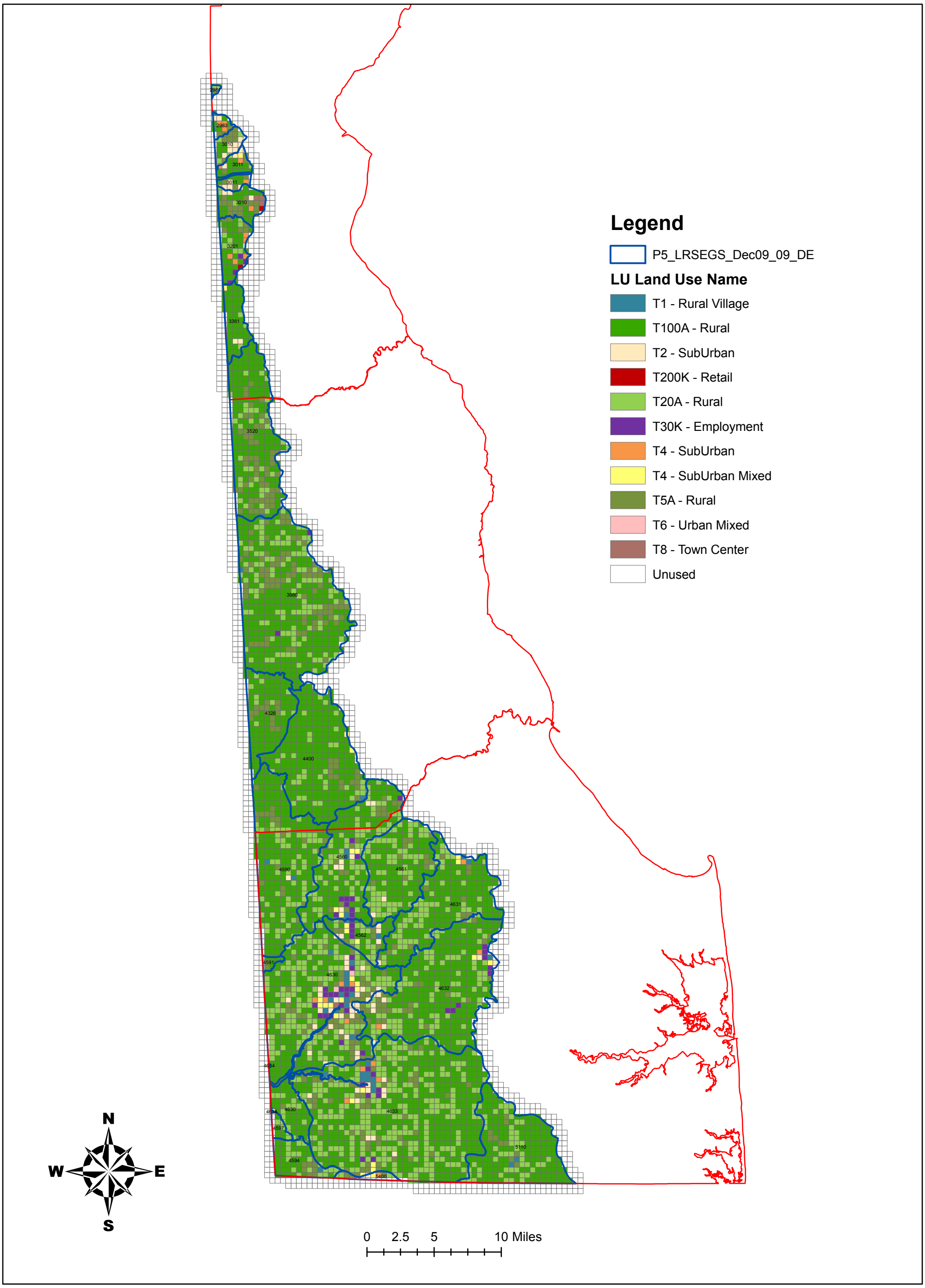
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - Delaware
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



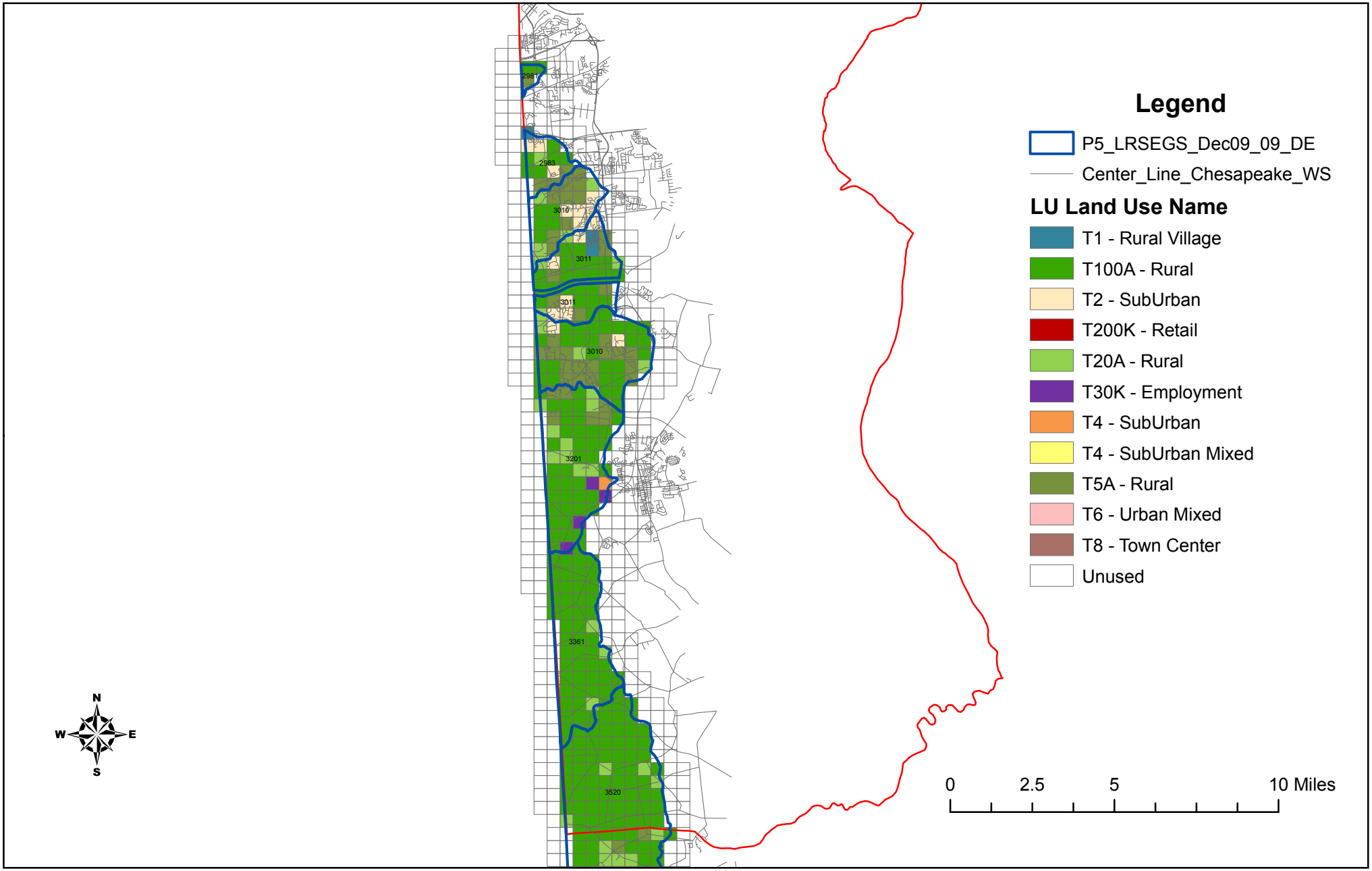
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - Delaware
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



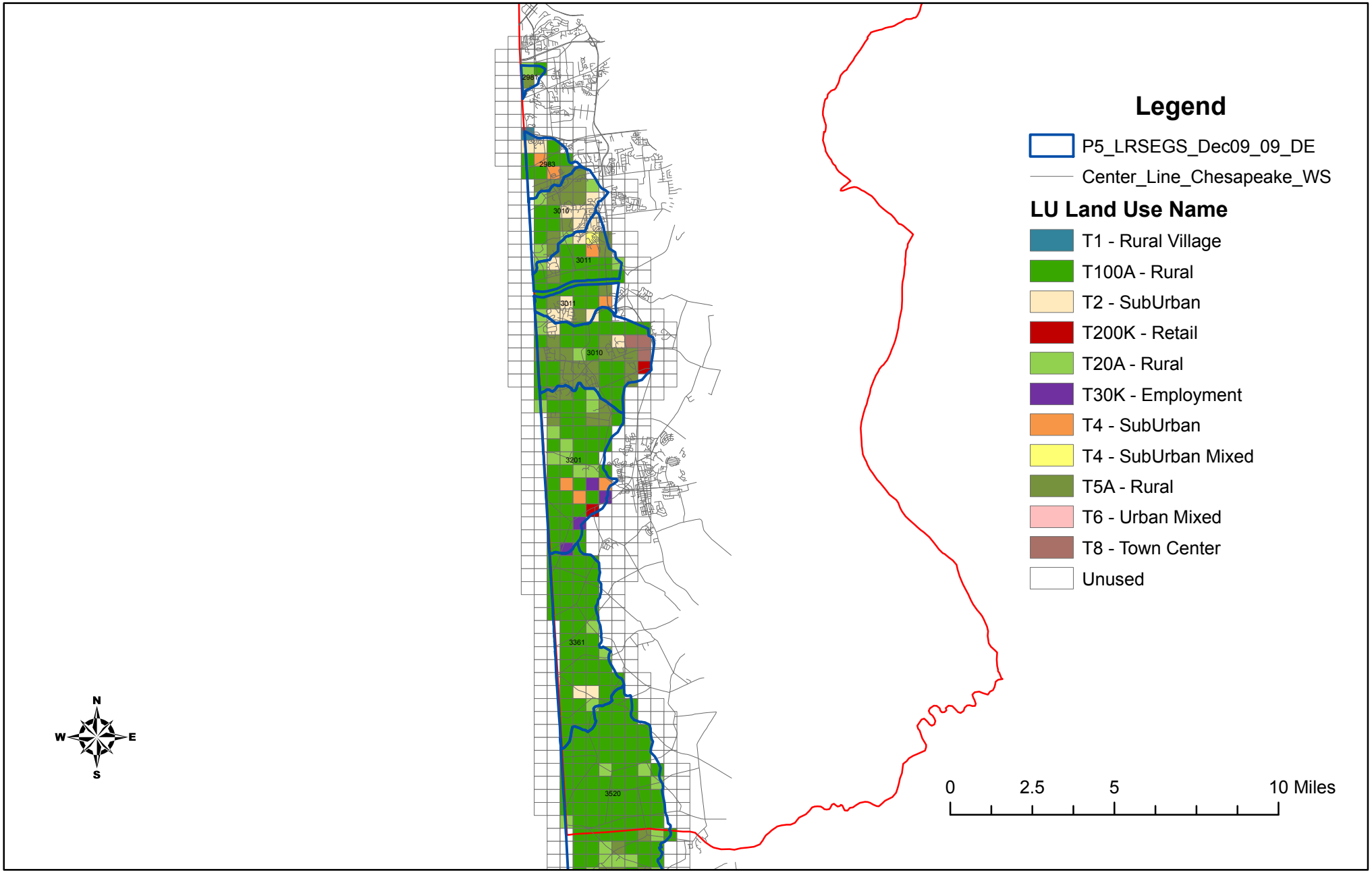
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



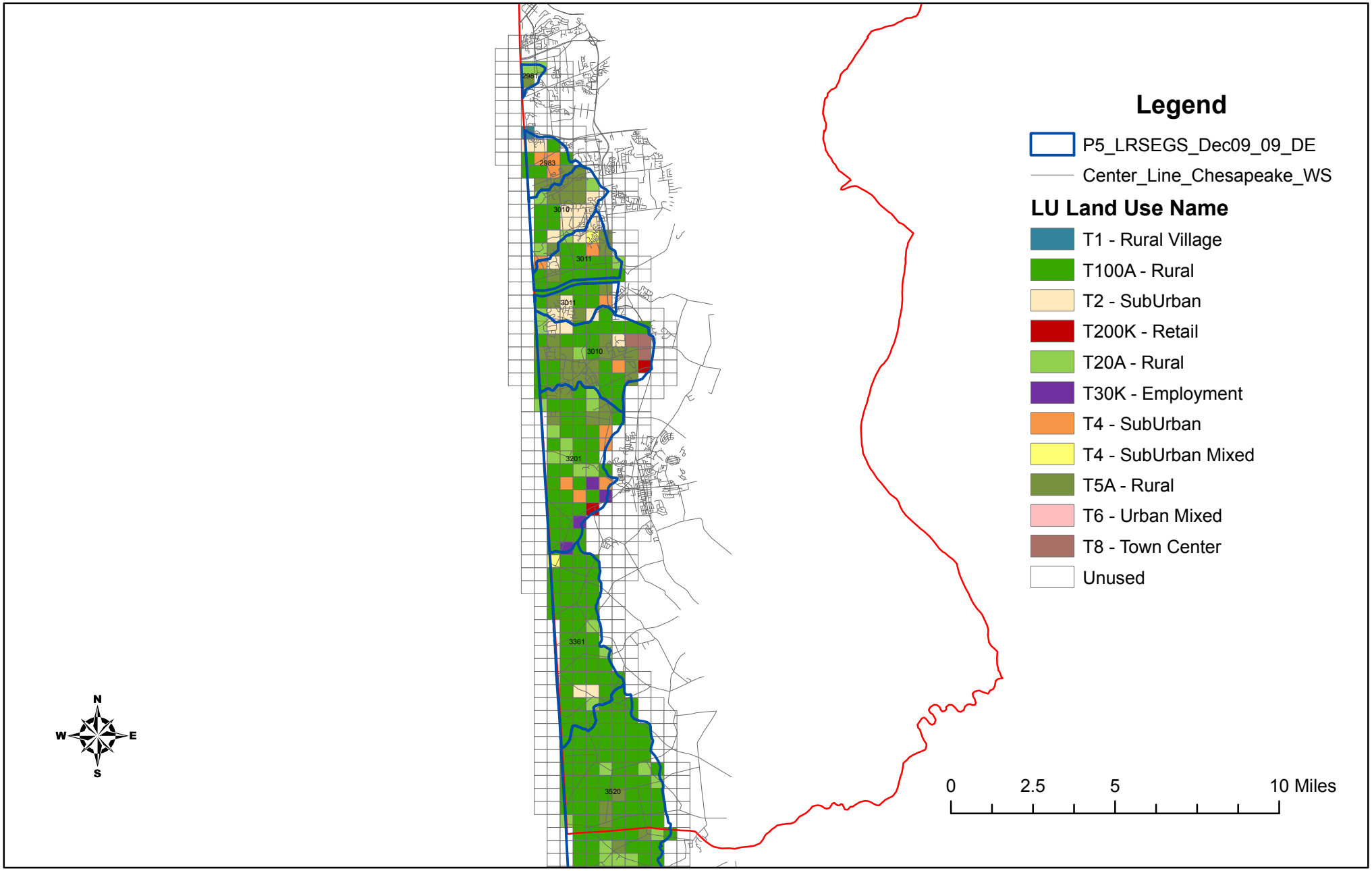
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



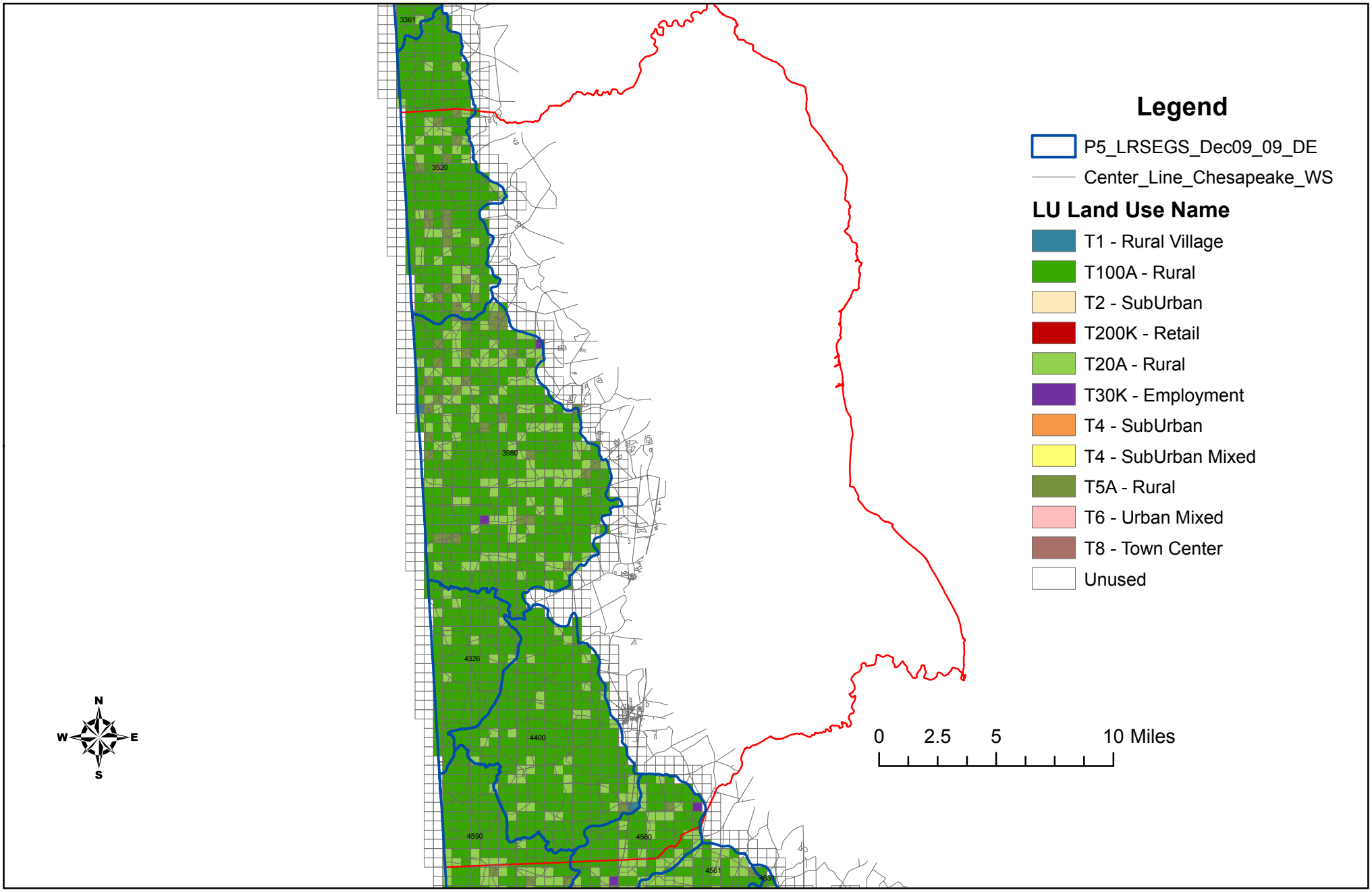
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



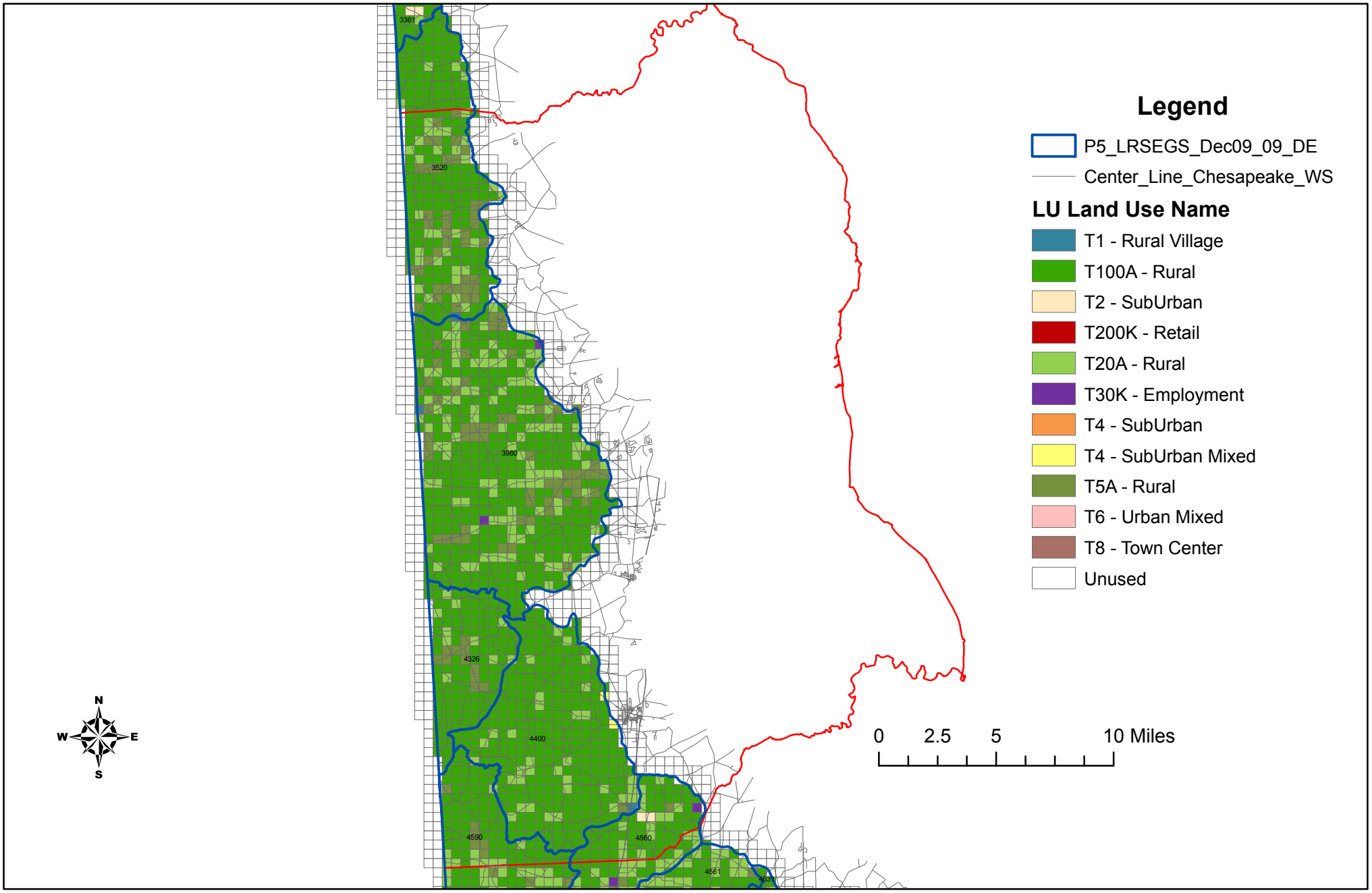
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



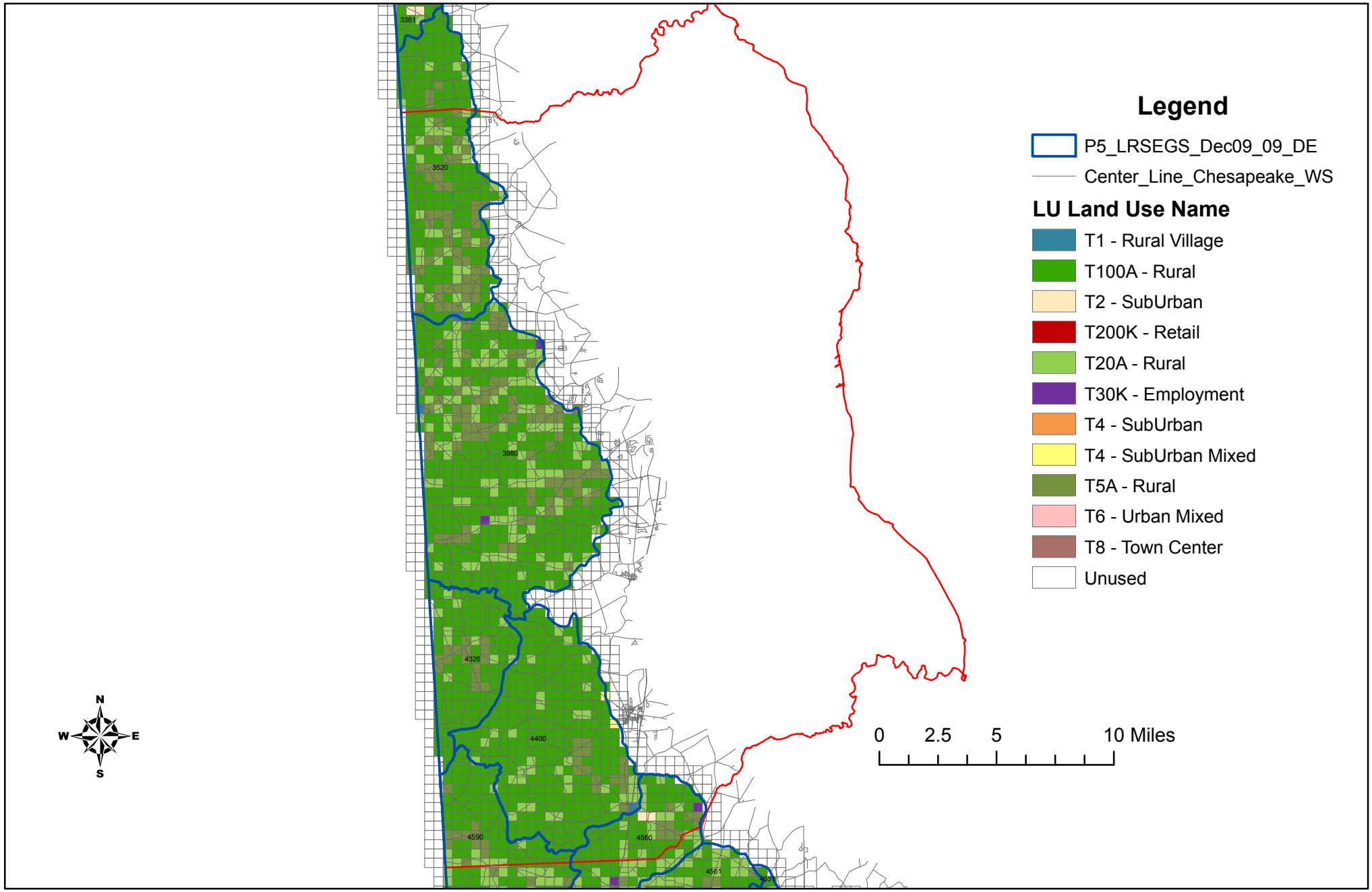
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



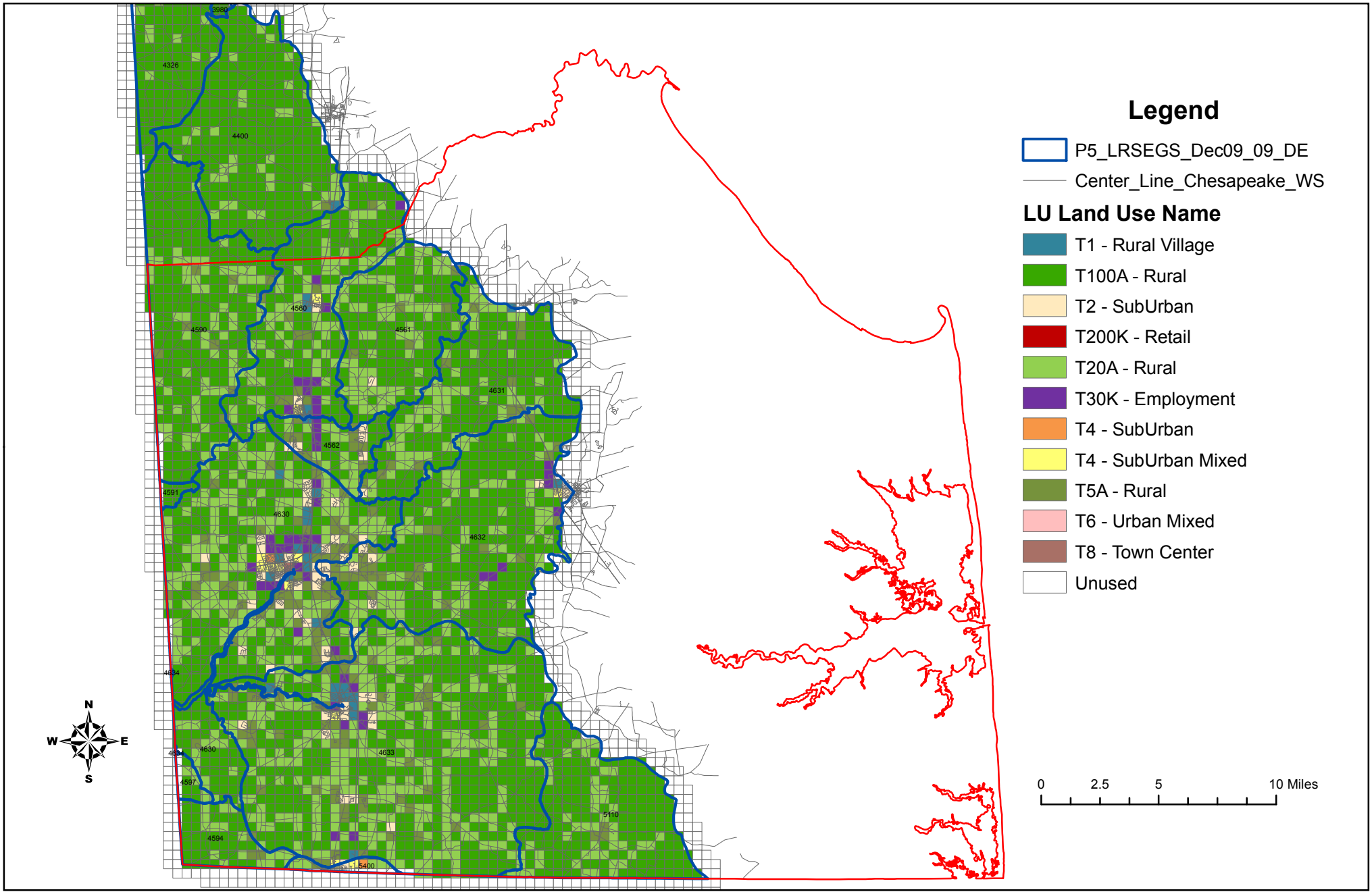
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



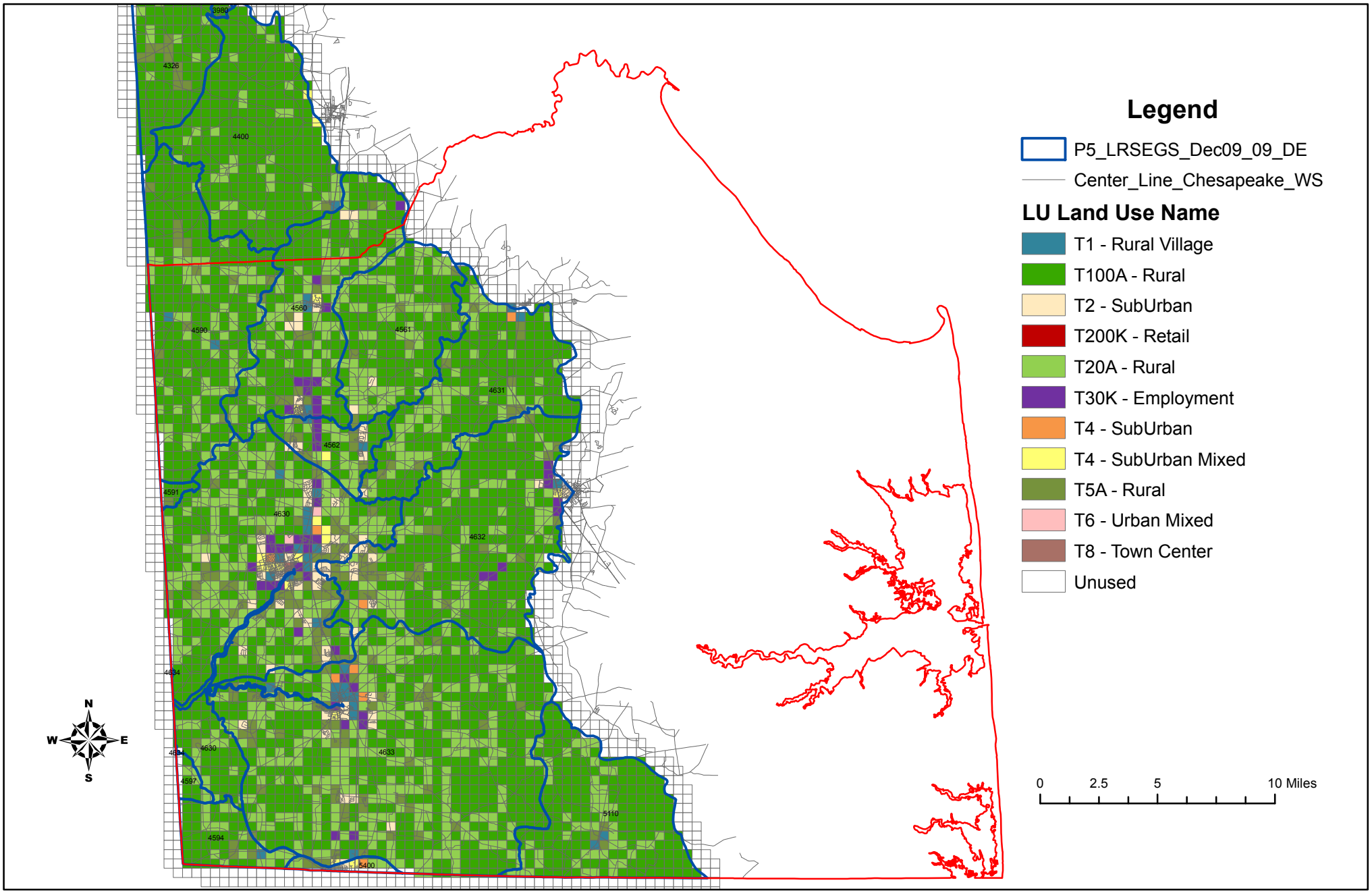
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



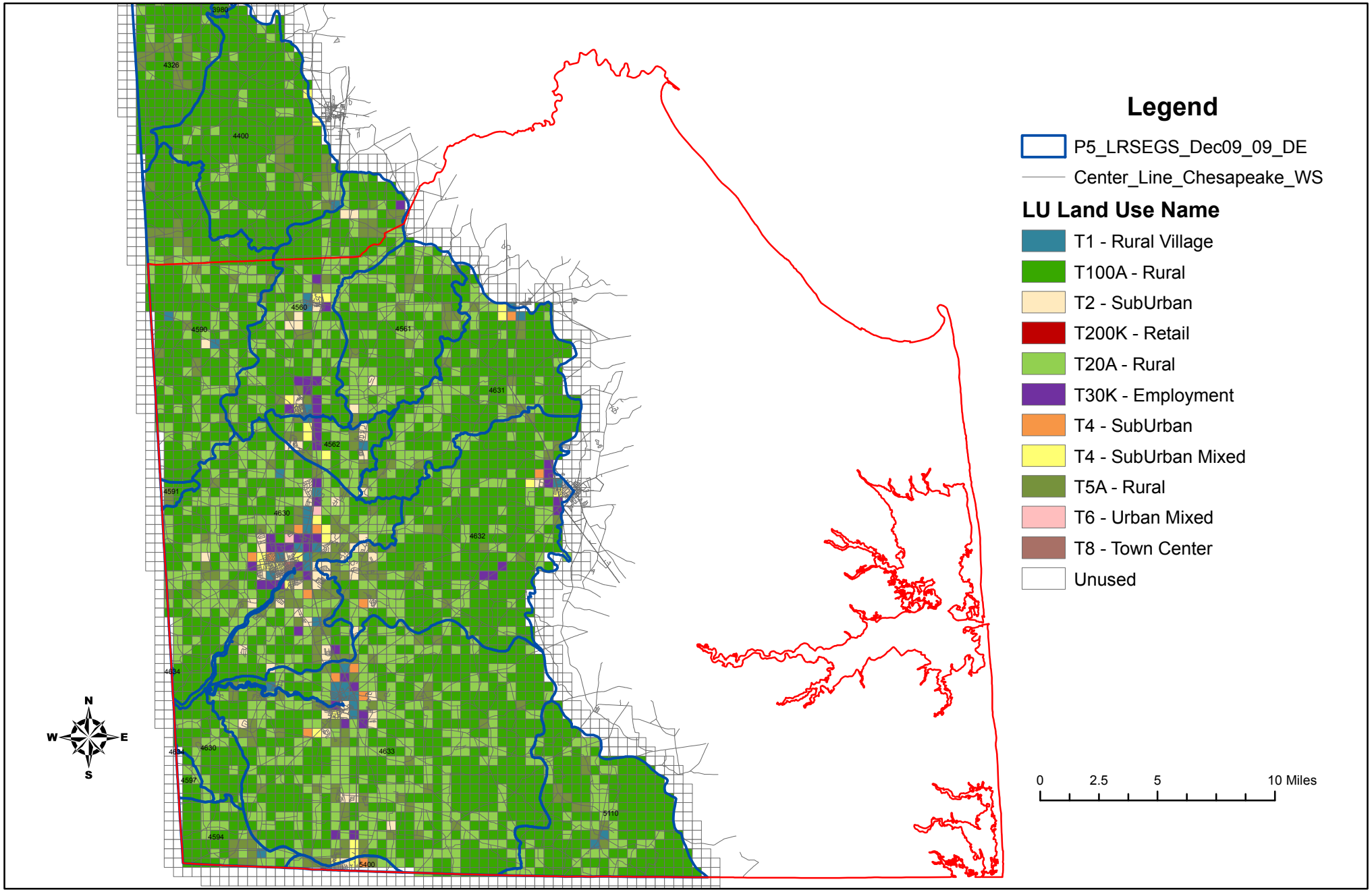
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



Source: University of Delaware Land Use Model

Chesapeake Bay Watershed -- Delaware
Total Housing Units - Statewide
UD Land Use Model Build-Out - August 22, 2010

PARAMETER		Chesapeake Bay Watershed Build-Out in Total Housing Units (THU)		
CommunityViz Build-Out - Numeric Results		**Existing Land Use**	**Growth 2005-2015***	**Growth 2015-2025***
Build-Out Numeric Dwelling Units		36,227	46,149	54,040
Build-Out Numeric Floor Area		9,792,000	13,636,000	15,024,250
RESIDENTIAL				
Total Housing Units	Dwelling Units	36,227	46,149	54,040
Residents	#	88,412	113,490	133,326
Children	#	24,411	29,407	33,635
Residential VTD	trips/day	361,566	459,108	537,542
Residential Waste Water	gal/day	10,868,100	13,844,700	16,212,000
Residential Water Use	gal/day	10,868,100	13,844,700	16,212,000
Residential Impervious Area	Square Feet	TBD	TBD	TBD
NONRESIDENTIAL				
Non-residentialFloorArea	Square Feet	9,792,000	13,636,000	15,024,250
Employees	#	29,081	34,019	36,786
Non-residential VTD	trips/day	250,738	351,404	391,613
Non-residential Waste Water	gal/day	445,138	527,671	567,879
Non-residential Water Use	gal/day	556,423	659,588	709,849
Nonresidential Impervious Area	Square Feet	TBD	TBD	TBD
** Source of Build-Out: UD Community Land Use Model*		** Source of Growth Change: Delaware Population Consortium "Small Area Population Projections"*		
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Growth Projection Comparison by EPA River Segment
Total Housing Units

EPA_River Segment	Tile Count	Area - Acres		DU's - Existing LU	DU's - Growth 2015	DU's - Growth 2025
2981	3	300		23	33	43
2983	13	1,300		548	1,036	1,354
3010	73	7,300		1,618	2,501	3,375
3011	39	3,900		1,062	1,834	2,126
3201	57	5,700		586	1,194	1,830
3361	52	5,200		89	354	586
3520	256	25,600		930	1,313	1,736
3980	504	50,400		2,387	3,000	3,380
4326	123	12,300		230	417	493
4400	304	30,400		760	1,248	1,481
4560	263	26,300		2,116	2,821	3,376
4561	192	19,200		1,146	1,303	1,417
4562	61	6,100		954	1,259	1,709
4590	308	30,800		1,062	1,294	1,523
4591	8	800		12	31	50
4594	58	5,800		278	369	455
4597	11	1,100		65	65	65
4630	540	54,000		9,411	11,125	12,025
4631	241	24,100		1,258	1,606	2,059
4632	408	40,800		3,121	3,718	4,250
4633	771	77,100		7,007	7,895	8,847
5110	223	22,300		814	959	1,092
5400	9	900		750	774	768
Total Housing Units				36,227	46,149	54,040
Growth Change - Total Housing Units					9,922	7,891
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Source of Build-Out: UD Community Land Use Model						

Chesapeake Bay Watershed
Households - Statewide
UD Land Use Model Build-Out - August 22, 2010

PARAMETER	Chesapeake Watershed Build-Out in Households (Occupied Housing)			
CommunityViz Build-Out - Numeric Results		**Existing Land Use**	**Growth 2005-2015***	**Growth 2015-2025***
Build-Out Numeric Dwelling Units		28,701	36,031	42,113
Build-Out Numeric Floor Area		9,023,200	11,862,500	12,599,150
RESIDENTIAL				
NumDwellingUnits	Dwelling Units	28,701	36,031	42,113
Residents	#	70,089	88,689	104,014
Children	#	19,394	23,033	26,307
Res VTD	trips/day	286,618	358,724	419,544
ResWasteWater	gal/day	8,610,300	10,809,300	12,633,900
ResWaterUse	gal/day	8,610,300	10,809,300	12,633,900
Impervious_Area - Residential	Square Feet	TBD	TBD	TBD
NONRESIDENTIAL				
NumComFloorArea	Square Feet	9,023,200	11,862,500	12,599,150
Employees	#	27,996	31,589	33,481
Com_VTD	#	229,039	302,800	325,517
ComWasteWater	gal/day	423,439	479,067	501,783
ComWaterUse	gal/day	529,298	598,834	627,229
Impervious_Area - Nonresidential	Square Feet	TBD	TBD	TBD
** Source of Growth Change => Delaware Population Consortium "Small Area Population Projections"*				
Source of Build-Out => University of Delaware Community Land Use Model				
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Chesapeake Bay Watershed
Households - By River Segment
Growth 2015-2025 Comparison

Chesapeake Bay Watershed -- # Households -- Change 2015-2025

			UD Land Use Model Build-Out			Change in Households: Existing -> 2015			Change in Households 2015 -> 2025		
EPA_River Segment	**Tile Count**	**Area - Acres**	**DU's - Existing LU**	**DU's - Growth 2015**	**DU's - Growth 2025**	**Change 2005 to 2015**	**Expected Change**	**UD-DPC* Difference**	**Change 2015 to 2025**	**Expected Change**	**UD-DPC* Difference**
2981	3	300	19	28	37	9	8	1	9	5	4
2983	13	1,300	408	858	1136	450	505	-55	278	248	30
3010	73	7,300	1,235	1819	2360	584	581	3	541	531	10
3011	39	3,900	794	1368	1638	574	500	74	270	262	8
3201	57	5,700	508	1040	1596	532	518	14	556	539	17
3361	52	5,200	77	265	404	188	130	58	139	135	4
3520	256	25,600	809	1127	1465	318	364	-46	338	281	57
3980	504	50,400	2,000	2510	2830	510	563	-53	320	302	18
4326	123	12,300	194	349	413	155	88	67	64	66	-2
4400	304	30,400	651	918	1140	267	268	-1	222	222	0
4560	263	26,300	1,648	2126	2509	478	414	64	383	388	-5
4561	192	19,200	957	1071	1167	114	110	4	96	95	1
4562	61	6,100	742	931	1208	190	174	16	277	203	74
4590	308	30,800	908	1107	1283	199	121	78	176	191	-15
4591	8	800	8	24	40	16	17	-1	16	14	2
4594	58	5,800	227	306	379	79	81	-2	73	71	2
4597	11	1,100	56	56	56	0	2	-2	0	0	0
4630	540	54,000	7,086	8080	8934	994	994	0	854	856	-2
4631	241	24,100	1,050	1354	1621	304	325	-21	267	277	-10
4632	408	40,800	2,451	2916	3328	465	464	1	412	399	13
4633	771	77,100	5,618	6390	7062	772	776	-4	672	699	-27
4634		0	0	0	0	0	0	0	0	0	0
5110	223	22,300	681	807	919	126	128	-2	112	109	3
5400	9	900	574	581	588	7	10	-3	7	9	-2
Statewide	4,517		28,701	36,031	42,113	7,331	7,141	190	6,082	5,902	180
2015-2025 Change in Dwelling Units (DU)				7,330	6,082						

** Source of Growth Change => Delaware Population Consortium "Small Area Population Projections"*

Source of Build-Out => University of Delaware Community Land Use Model

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