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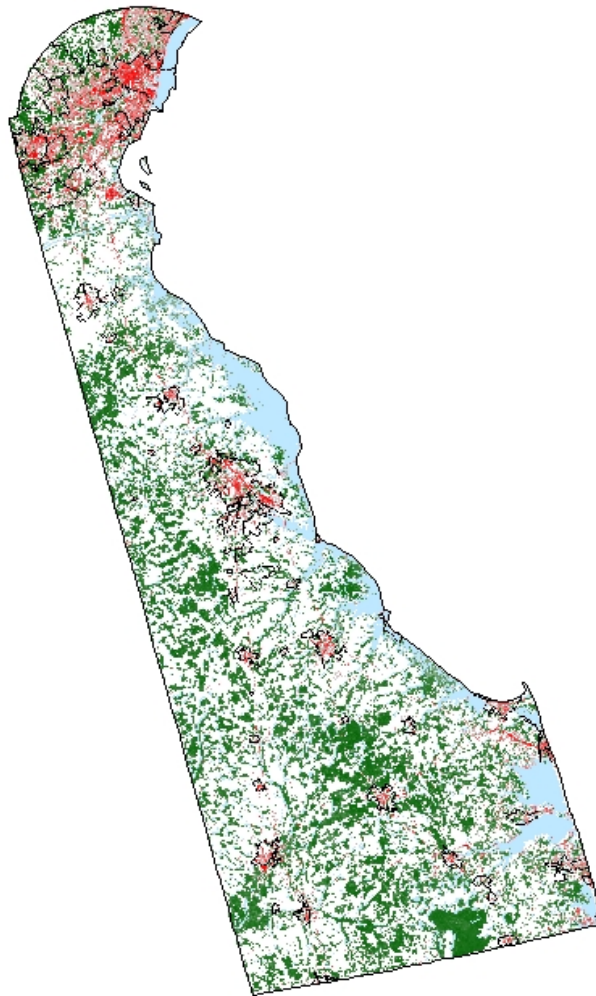
**Northern
Research Station**

General Technical
Report –



Delaware's Urban and Community Forests

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Abstract

Urban or community lands in Delaware currently comprise about 17.8 percent of the state land area, an increase from 14.0 percent in 1990. Although statewide tree cover averages 23.1 percent, tree cover in urban or community lands is about 16.4 percent, with 15.5 percent impervious cover and 19.4 percent of potential growing space filled with tree canopies. Statewide, urban or community land in Delaware has an estimated 7.1 million trees, which store about 1.3 million metric tons of carbon (\$29,600,000) and annually remove about 44,000 metric tons of carbon (\$1,003,000) and 1,431 metric tons of air pollution (\$10,400,000). This report details how cover characteristics vary within the state by community, county, and county subdivision. Individual communities are graded on their cover characteristics and priority areas for planting are detailed. Report information can be used to improve the understanding and management of the urban forest resource in Delaware.

Executive Summary

The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 was designed to provide assessments of the Nation's forest and grassland resources, which includes urban and community forests. The urban and community forest resource can significantly affect human well-being and environmental quality in and around urban and urbanizing areas. This report summarizes population trends and land cover characteristics for urban and community areas at the state to local levels based on National Land Cover Database (c. 2001) and United States Census data (1990 and 2000). It provides urban forest information at the state, county, county subdivision, and incorporated and census designated place ("communities") levels to help improve the understanding, management, and planning of the urban and community forestry resource.

Urban or community lands in Delaware currently comprise about 17.8 percent of the state land area, an increase from 14.0 percent in 1990. Although statewide tree cover averages 23.1 percent, tree cover in urban or community lands is about 16.4 percent, with 15.5 percent impervious cover and 19.4 percent of total potential growing space filled with trees. Statewide, urban or community land in Delaware has an estimated 7.1 million trees, which store about 1.3 million metric tons of carbon (\$29,600,000) and annually remove about 44,000 metric tons of carbon (\$1,003,000) and 1,430 metric tons of air pollution (\$10,400,000).

Information in this report can be used to improve urban and community forest management by helping users to:

- Understand general land cover characteristics at the specific community level
- Determine how various communities relate in terms of tree canopy, impervious surface, available growing space, environment and tree canopy stocking characteristics
- Establish statewide or local standards related to urban and community forestry
- Determine areas of greatest growth, and areas of highest tree planting priority

- Justify urban and community forestry programs and budgets
- Improve urban and community forest management

Table 1. Summary of population, area, tree canopy and impervious surface cover, and urban tree benefits in urban, community, and urban or community areas.

| Delaware | | Statewide | Urban ^A | Communities ^B | Urban or Communities ^C | |
|--|---|-------------|--------------------|--------------------------|-----------------------------------|--|
| Population | 2000 | 783,600 | 627,758 | 344,549 | NA | |
| | 1990 | 666,168 | 486,501 | 255,939 | NA | |
| | % Change (1990-2000) | 17.6 | 29.0 | 34.6 | NA | |
| | % Total State Population | | 80.1 | 44.0 | NA | |
| Total Area | Km ² (2000) | 6,447.2 | 786.5 | 464.9 | 925.4 | |
| | Km ² (1990) | | 599.9 | 339.3 | 728.4 | |
| | % Change (1990-2000) | | 31.1 | 37.0 | 27.0 | |
| Land Area | Km ² (2000) | 5,059.5 | 780.2 | 445.3 | 902.5 | |
| | % State Land Area (2000) | | 15.4% | 8.8% | 17.8% | |
| | Km ² (1990) | | 596.6 | 320.5 | 708.4 | |
| | % State Land Area (1990) | | 11.8% | 6.3% | 14.0% | |
| Population Density (people/land area Km ²) | 2000 | 154.9 | 804.6 | 773.8 | NA | |
| | 1990 | 131.7 | 815.4 | 798.5 | NA | |
| | % Change (1990-2000) | 17.6 | -1.3 | -3.1 | NA | |
| Tree Canopy Cover (2000) | Km ² | 1,166.6 | 129.5 | 65.9 | 147.9 | |
| | % of Land Area | 23.1 | 16.6 | 14.8 | 16.4 | |
| | Per capita (m ² /person) | 1,488.8 | 206.3 | 191.2 | NA | |
| | Potential Growing Space (Km ²) ^D | 4,884.0 | 651.0 | 368.6 | 762.6 | |
| | Potential Growing Space % of State Land Area | 96.5% | 83.4% | 82.8% | 84.5% | |
| | % Stocking ^E | 23.9 | 19.9 | 17.9 | 19.4 | |
| | Available Growing Space (Km ²) ^F | 3,717.4 | 521.4 | 302.7 | 614.7 | |
| Impervious Surface Cover (2000) | Available Growing Space % of State Land Area | 73.5% | 66.8% | 68.0% | 68.1% | |
| | Km ² | 175.4 | 129.3 | 76.7 | 139.8 | |
| | % of Land Area | 3.5 | 16.6 | 17.2 | 15.5 | |
| Urban Tree Benefits (2000) | Per capita (m ² /person) | 223.9 | 206.0 | 222.6 | NA | |
| | Estimated Number of Trees | NA | 6,200,000 | 3,100,000 | 7,100,000 | |
| | Carbon | | | | | |
| | Carbon Stored (metric tons) | NA | 1,200,000 | 600,000 | 1,300,000 | |
| | Carbon Stored (\$) | NA | \$27,400,000 | \$13,700,000 | \$29,600,000 | |
| | Carbon Sequestered (metric tons/year) | NA | 39,000 | 20,000 | 44,000 | |
| | Carbon Sequestered (\$/year) | NA | \$889,000 | \$456,000 | \$1,003,000 | |
| | Pollution | | | | | |
| | CO Removed (metric tons/year) | NA | 23 | 12 | 26 | |
| | CO Removed (\$/year) | NA | \$30,100 | \$15,300 | \$34,400 | |
| | NO2 Removed (metric tons/year) | NA | 42 | 21 | 47 | |
| | NO2 Removed (\$/year) | NA | \$381,900 | \$194,200 | \$436,000 | |
| | O3 Removed (metric tons/year) | NA | 635 | 323 | 725 | |
| | O3 Removed (\$/year) | NA | \$5,833,000 | \$2,966,000 | \$6,661,000 | |
| | SO2 Removed (metric tons/year) | NA | 133 | 68 | 152 | |
| SO2 Removed (\$/year) | NA | \$298,700 | \$151,900 | \$341,000 | | |
| PM10 Removed (metric tons/year) | NA | 421 | 214 | 480 | | |
| PM10 Removed (\$/year) | NA | \$2,578,300 | \$1,311,200 | \$2,944,000 | | |
| Total Pollution Removal (metric tons/year) | NA | 1,253 | 637 | 1,431 | | |
| Total Pollution Removal (\$/year) | NA | \$9,100,000 | \$4,600,000 | \$10,400,000 | | |

^A Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters.

^B Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places.

^C Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries.

^D Potential Growing Space (PGS) is total area - impervious surface cover - water.

^E Stocking is the tree canopy cover divided by potential growing space.

^F Available Growing Space (AGS) is potential growing space - tree canopy cover (if the calculated value is less than 0, then value set at 0).

Introduction

The first urban forest assessment as part of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) was published in 2000 (Dwyer et al., 2000; Nowak et al 2001b). This national assessment used 1-km resolution Advanced Very-High Resolution Radiometer (AVHRR) data (Zhu, 1994) and 1990 U.S. census data to assess the extent of urban tree cover. That study concluded that urban areas (cities, towns, and villages) in the conterminous United States have doubled in size between 1969 and 1994, and covered 3.5 percent of the total land area. Urban areas were estimated to contain approximately 3.8 billion trees with an average tree canopy cover of 27 percent.

To update this first report, newer higher resolution tree and impervious cover maps were used along with census data to assess current urban forest attributes. These new reports are being produced for each of the lower 48 United States to provide information on urban change and state-specific urban and community forestry data to aid in local to regional planning and management of urban natural resources. Data are reported for the state, county, county subdivision, and community jurisdictions. The jurisdictional units used in this report are derived from U.S. Census defined legal or statistical divisions. "County" refers to county and equivalent areas that are the primary subdivision within states. "County subdivisions" are divisions of county and minor civil divisions. "Communities" are incorporated and census designated places (CDP) that have legally established boundaries or boundaries cooperatively delineated by local and state officials and the U.S. Bureau of Census (2007).

Urban and Community Definitions

At the state reporting level, two geographic definitions exist that overlap: "community" and "urban". These two entities are presented as they represent different aspects of urban or community management. The community definition is based on jurisdictional or political boundaries delimited by census definitions of incorporated or census designated places. The communities may include all, some, or no urban land within their boundaries.

Urban land definitions are based on population density and was delimited using the 2000 U.S. Census Bureau's urban definition of all territory, population, and housing units located within either urbanized areas or urban clusters (U.S. Bureau of Census, 2007). Urbanized area and urban cluster boundaries encompass densely settled territories, which generally consist of:

- A cluster of one or more block groups or census blocks with a population density of at least 386.1 people per square kilometer (1,000 people per square mile),
- Surrounding block groups and census blocks with a population density of 193.1 people per square kilometer (500 people per square mile), and
- Less densely settled blocks that form enclaves or indentations, or are used to connect discontinuous areas (U.S. Bureau of Census, 2007).

Urbanized areas consist of densely settled territory that contains 50,000 or more people; urban clusters consist of densely settled territory that has at least 2,500 people but fewer than 50,000 people. This new definition tends to be more restrictive than the 1990 census urban definition. The 2000 census definition of urban was applied to 1990 census data to analyze change in urban land between 1990 and 2000 (Nowak et al, 2005). The urban land definition encompasses many areas typically considered to be suburban.

As urban land reveals the more heavily populated areas (population density-based definition) and community boundaries indicate both urban and rural (i.e., non-urban) communities that are recognized by their geopolitical boundaries (political definition), both definitions provide information related to urban and community areas and forestry. As some urban land exists beyond community boundaries and not all community land is urban (i.e., communities are often a mix of urban and rural land), a category of “urban or community” was created to understand urban and community forestry attributes of the union of these two definitions. The “urban or community” definition encompasses both urban land and land in rural parts of communities.

Report Overview

This report is designed to be an urban and community forestry resource reference by providing tree and forest data from the state to local community level. The report provides information on the following attributes related to the urban and community forestry resource:

- Human population
- Urban and community land
- Tree canopy cover
- Tree canopy cover per capita
- Tree canopy stocking
- Impervious surface cover
- Impervious surface cover per capita
- Classified land cover types
- Grading of environmental and tree stocking characteristics
- Locations of highest priority for new tree establishment
- Urban tree benefits

The following sections summarize the maximum and minimum values within individual attributes detailed in the figures and tables. Percentages and densities are calculated out of the total land area of the geopolitical unit.

Population Characteristics and Trends (Figure 1)

Populations have been increasing throughout most areas in Delaware between 1990 and 2000, with total population in Delaware increasing from 666,168 in 1990 to 783,600 in 2000, a 17.6 percent increase (Table 1).

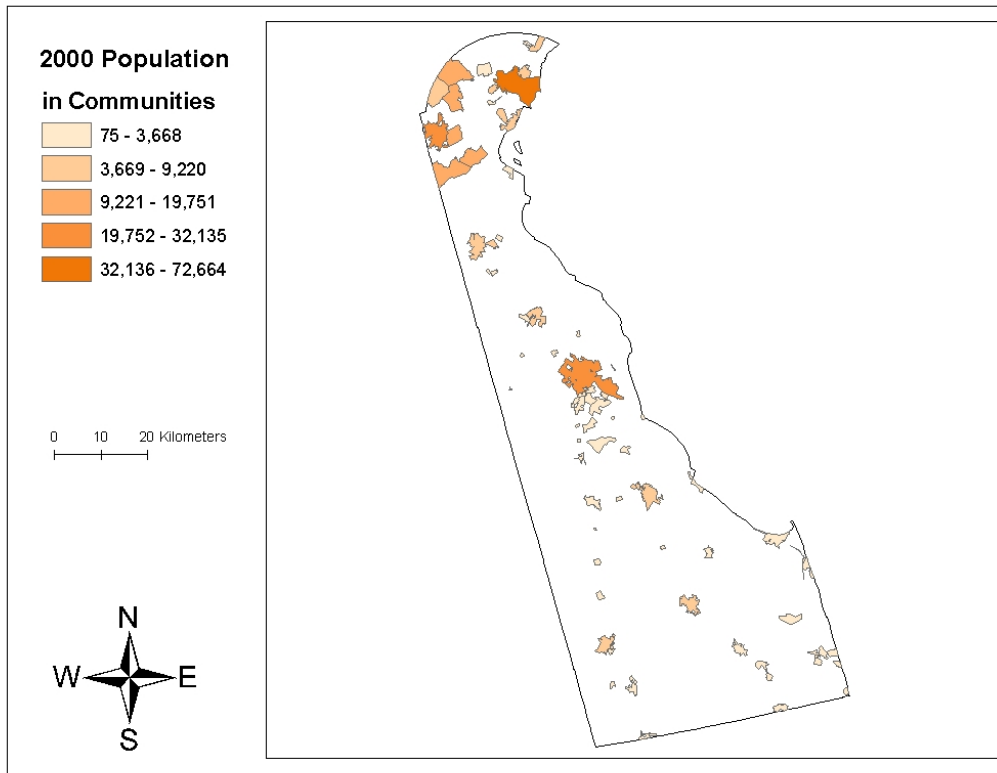


Figure 1. Total population within community boundaries.

Communities (Table 2; Figure 1)

- maximum percent population change (1990-2000): South Bethany town (232.4%)
- minimum percent population change (1990-2000): Farmington town (-38.5%)
- maximum population density: Bellefonte town (2,742.5 people/km²)
- minimum population density: Slaughter Beach town (57.1 people/km²)

Table 2. 2000 Population characteristics, population change (1990 – 2000), and percent of land classified as urban within communities.

| Name | Population | | | Urban Area | |
|------------------------|------------|--------------------|-----------------------------------|------------|--------------------|
| | 2000 | % change from 1990 | Density (people/Km ²) | % | % change from 1990 |
| Arden village | 474 | -0.6% | 667.4 | 100.0% | 0.0% |
| Ardencroft village | 267 | -5.3% | 931.1 | 100.0% | 0.0% |
| Ardentown village | 300 | -7.7% | 506.9 | 100.0% | 0.0% |
| Bear CDP | 17,593 | NA | 1,182.8 | 100.0% | 36.6% |
| Bellefonte town | 1,249 | 0.5% | 2,742.5 | 100.0% | 0.0% |
| Bethany Beach town | 903 | 177.0% | 302.1 | 97.3% | NA |
| Bethel town | 184 | 3.4% | 159.5 | 0.0% | NA |
| Blades town | 956 | 14.6% | 850.0 | 99.8% | 44.2% |
| Bowers town | 305 | 70.4% | 410.6 | 0.0% | NA |
| Bridgeville town | 1,436 | 18.7% | 662.8 | 0.0% | NA |
| Brookside CDP | 14,806 | -3.3% | 1,462.4 | 100.0% | 0.0% |
| Camden town | 2,100 | 10.6% | 436.6 | 51.0% | -18.9% |
| Cheswold town | 313 | -2.5% | 281.8 | 39.1% | -56.9% |
| Claymont CDP | 9,220 | -5.9% | 1,687.8 | 100.0% | 0.0% |
| Clayton town | 1,273 | 9.5% | 479.7 | 47.2% | 1.0% |
| Dagsboro town | 519 | 30.4% | 158.1 | 14.3% | -12.7% |
| Delaware City city | 1,453 | -13.6% | 446.5 | 0.0% | NA |
| Delmar town | 1,407 | 46.3% | 578.7 | 51.1% | 62.4% |
| Dewey Beach town | 301 | 47.5% | 338.5 | 95.5% | 8.2% |
| Dover Base Housing CDP | 3,394 | NA | 1,954.3 | 99.1% | 3.7% |
| Dover city | 32,135 | NA | 554.1 | 62.3% | -5.5% |
| Edgemoor CDP | 5,992 | 2.4% | 1,269.6 | 99.6% | -0.1% |
| Ellendale town | 327 | 4.5% | 497.9 | 0.0% | NA |
| Elsmere town | 5,800 | -2.3% | 2,274.6 | 100.0% | 0.0% |
| Farmington town | 75 | -38.5% | 415.3 | 0.0% | NA |
| Falton town | 784 | 14.8% | 489.6 | 0.0% | NA |
| Fenwick Island town | 342 | 83.9% | 384.0 | 63.0% | 49.6% |
| Frankford town | 714 | 20.8% | 391.0 | 0.0% | NA |
| Frederica town | 648 | -14.8% | 296.9 | 0.0% | NA |
| Georgetown town | 4,643 | 24.4% | 433.9 | 49.0% | 31.9% |
| Glasgow CDP | 12,840 | NA | 501.0 | 92.4% | 113.8% |
| Greenville CDP | 2,332 | NA | 329.1 | 54.0% | -0.1% |
| Greenwood town | 837 | 44.8% | 489.3 | 0.0% | NA |
| Harrington city | 3,174 | 37.3% | 612.8 | 64.6% | 48.4% |
| Hartly town | 78 | -27.1% | 519.7 | 0.0% | NA |
| Henlopen Acres town | 139 | 29.9% | 210.1 | 53.2% | 53.0% |
| Highland Acres CDP | 3,379 | 7.2% | 835.1 | 100.0% | 0.0% |
| Hockessin CDP | 12,902 | NA | 496.8 | 84.9% | 11.5% |
| Houston town | 430 | -11.7% | 441.9 | 74.9% | NA |
| Kent Acres CDP | 1,637 | -9.4% | 715.2 | 35.7% | -62.5% |
| Kenton town | 237 | 2.2% | 531.2 | 0.0% | NA |
| Laurel town | 3,668 | 13.7% | 855.6 | 73.3% | -20.5% |
| Leipsic town | 203 | -14.0% | 278.8 | 0.0% | NA |
| Lewes city | 2,932 | 27.8% | 309.4 | 51.2% | 23.7% |
| Little Creek town | 195 | 16.8% | 687.5 | 0.0% | NA |
| Long Neck CDP | 1,629 | 83.9% | 252.9 | 94.8% | NA |
| Magnolia town | 226 | 7.1% | 455.1 | 100.0% | NA |
| Middletown town | 6,161 | 60.7% | 371.6 | 32.7% | 81.6% |
| Milford city | 6,732 | 11.5% | 467.3 | 74.4% | 9.1% |
| Millsboro town | 2,360 | 43.6% | 528.2 | 83.9% | 28.5% |
| Milville town | 259 | 25.7% | 206.2 | 82.6% | NA |
| Milton town | 1,657 | 16.9% | 605.6 | 0.0% | NA |
| New Castle city | 4,862 | 0.5% | 615.7 | 100.0% | 19.9% |
| Newark city | 28,547 | 13.7% | 1,235.0 | 99.8% | 0.2% |
| Newport town | 1,122 | -9.5% | 986.1 | 94.0% | 20.4% |
| North Star CDP | 8,277 | NA | 467.0 | 75.7% | 28.2% |
| Ocean View town | 1,006 | 66.0% | 191.1 | 63.4% | NA |
| Odessa town | 286 | -5.6% | 252.0 | 0.0% | NA |
| Pike Creek CDP | 19,751 | 94.3% | 1,243.6 | 100.0% | 0.1% |
| Rehoboth Beach city | 1,495 | 21.2% | 489.0 | 86.2% | -5.4% |
| Rising Sun-Lebanon CDP | 2,458 | 12.9% | 279.6 | 70.9% | 56.8% |
| Riverview CDP | 1,583 | 39.1% | 169.9 | 34.1% | 582.4% |
| Rodney Village CDP | 1,602 | -8.2% | 1,024.2 | 100.0% | 0.0% |
| Seaford city | 6,699 | 17.8% | 743.6 | 94.7% | 0.6% |
| Selbyville town | 1,645 | 23.2% | 454.4 | 0.0% | NA |
| Slaughter Beach town | 198 | 73.7% | 57.1 | 0.0% | NA |
| Smyrna town | 5,679 | 8.6% | 595.3 | 64.2% | 53.8% |
| South Bethany town | 492 | 232.4% | 366.2 | 87.5% | NA |
| Townsend town | 346 | 7.5% | 224.8 | 0.0% | NA |
| Viola town | 156 | 2.0% | 339.2 | 92.8% | -7.2% |
| Wilmington city | 72,664 | 1.6% | 2,586.1 | 64.3% | 1.8% |
| Wilmington Manor CDP | 8,262 | -3.6% | 1,964.5 | 99.8% | -0.2% |
| Woodside East CDP | 2,174 | 31.4% | 491.4 | 99.9% | 76.2% |
| Woodside town | 184 | 31.4% | 436.6 | 100.0% | 24.4% |
| Wyoming town | 1,141 | 16.8% | 652.5 | 64.2% | 2.1% |

County Subdivisions (Table 3)

- maximum percent population change (1990-2000): Central Pencader CCD(81.1%)
- minimum percent population change (1990-2000): Brandywine CCD (-2.3%)
- maximum population density: Wilmington CCD (2,620.7 people/km²)
- minimum population density: Bridgeville-Greenwood CCD (34.1 people/km²)

Table 3. 2000 Population characteristics, population change (1990 – 2000), percent of land classified as urban or as communities within county subdivision.

| Name | Population | | | Urban Area | | Community Area | |
|---------------------------------|------------|--------------------|-----------------------------------|------------|--------------------|----------------|--------------------|
| | 2000 | % change from 1990 | Density (people/Km ²) | % | % change from 1990 | % | % change from 1990 |
| Brandywine CCD | 78,620 | -2.3% | 972.4 | 72.7% | -1.2% | 12.2% | -38.8% |
| Bridgeville-Greenwood CCD | 9,462 | 37.2% | 34.1 | 0.0% | NA | 1.3% | -0.8% |
| Central Kent CCD | 18,267 | 15.3% | 85.5 | 20.4% | 252.6% | 10.7% | 0.3% |
| Central Pencader CCD | 32,096 | 81.1% | 388.6 | 73.5% | 179.0% | 34.2% | 21718.4% |
| Dover CCD | 66,555 | 11.9% | 167.3 | 17.1% | -1.6% | 19.6% | 4.7% |
| Felton CCD | 5,493 | 13.4% | 37.3 | 0.1% | 22.4% | 1.0% | 53.0% |
| Georgetown CCD | 11,811 | 51.9% | 64.3 | 4.3% | 28.9% | 5.8% | 71.0% |
| Greater Newark CCD | 67,114 | 10.0% | 863.6 | 82.0% | 4.4% | 47.7% | 3.1% |
| Harrington CCD | 10,352 | 14.8% | 39.2 | 2.1% | 87.5% | 2.4% | 34.0% |
| Kenton CCD | 5,337 | 20.5% | 42.8 | 0.0% | NA | 0.4% | 11.9% |
| Laurel-Delmar CCD | 20,410 | 35.3% | 43.2 | 2.2% | -20.4% | 1.7% | 28.4% |
| Lewes CCD | 21,517 | 57.9% | 109.7 | 14.5% | 16.5% | 6.5% | 2.7% |
| Lower Christiana CCD | 36,250 | -0.8% | 1,203.7 | 98.5% | 17.7% | 13.7% | 11.7% |
| Middletown-Odessa CCD | 29,682 | 59.8% | 61.2 | 2.8% | 110.1% | 4.0% | 85.9% |
| Milford North CCD | 8,786 | 30.0% | 43.9 | 5.0% | 198.2% | 4.9% | 3.8% |
| Milford South CCD | 16,525 | 17.7% | 50.0 | 4.8% | -20.4% | 3.5% | 13.9% |
| Millsboro CCD | 19,558 | 51.6% | 82.6 | 12.7% | 246.2% | 4.7% | 18.8% |
| Milton CCD | 10,611 | 38.3% | 65.0 | 4.4% | -14.6% | 1.8% | 21.2% |
| New Castle CCD | 82,021 | 21.0% | 846.6 | 73.7% | 21.5% | 24.1% | 129.0% |
| Piedmont CCD | 29,388 | 20.4% | 288.4 | 52.3% | 14.9% | 47.5% | 125907.0% |
| Pike Creek-Central Kirkwood CCD | 42,312 | 9.2% | 1,127.3 | 100.0% | 0.0% | 38.1% | 95.5% |
| Red Lion CCD | 5,589 | 38.6% | 106.3 | 14.1% | 144.3% | 6.0% | 1.5% |
| Seaford CCD | 22,498 | 19.1% | 92.6 | 12.2% | 22.0% | 4.1% | 9.2% |
| Selbyville-Frankford CCD | 24,246 | 48.5% | 74.6 | 9.2% | 775.5% | 5.8% | 19.1% |
| Smyrna CCD | 11,907 | 12.0% | 66.4 | 6.7% | 28.9% | 6.6% | 40.2% |
| Upper Christiana CCD | 24,529 | 15.8% | 791.8 | 100.0% | 45.3% | 0.0% | -100.0% |
| Wilmington CCD | 72,664 | 1.6% | 2,620.7 | 63.9% | 0.1% | 100.0% | 0.2% |

Counties (Table 4)

- maximum percent population change (1990-2000): Sussex County (38.3%)
- minimum percent population change (1990-2000): New Castle County (13.2%)
- maximum population density: New Castle County (453.1 people/km²)
- minimum population density: Sussex County (64.5 people/km²)

Table 4. 2000 Population characteristics, population change (1990 – 2000), percent of land classified as urban or as communities within counties.

| Name | Population | | | Urban Area | | Community Area | |
|-------------------|------------|--------------------|----------------------|------------|--------------------|----------------|--------------------|
| | 2000 | % change from 1990 | Density (people/Km2) | % | % change from 1990 | % | % change from 1990 |
| Kent County | 126,697 | 14.1% | 83.0 | 9.1% | 42.7% | 8.6% | 7.9% |
| New Castle County | 500,265 | 13.2% | 453.1 | 40.8% | 22.7% | 20.4% | 74.8% |
| Sussex County | 156,638 | 38.3% | 64.5 | 6.8% | 49.1% | 3.8% | 18.2% |

Urban and Community Area (Figures 2-3)

Urban area comprises 15.4 percent of the land area of Delaware, while lands within communities make up 8.8 percent of the state. Between 1990 and 2000, urban area increased from 11.8 percent of the state land area to 15.4 percent, which is a 30.8 percent increase in urban area (Table 1). Urban area in Delaware is projected to increase to 39.5 percent based on average urban growth pattern of the 1990s (Nowak and Walton, 2005). Overall, both urban area (attaining minimum population density) and community area (within political boundaries) increased in the past decade. However, urban or community areas can decrease through time at the local scale due to movements of people and changes in political boundaries due to incorporation, annexation, consolidation, or reduction.

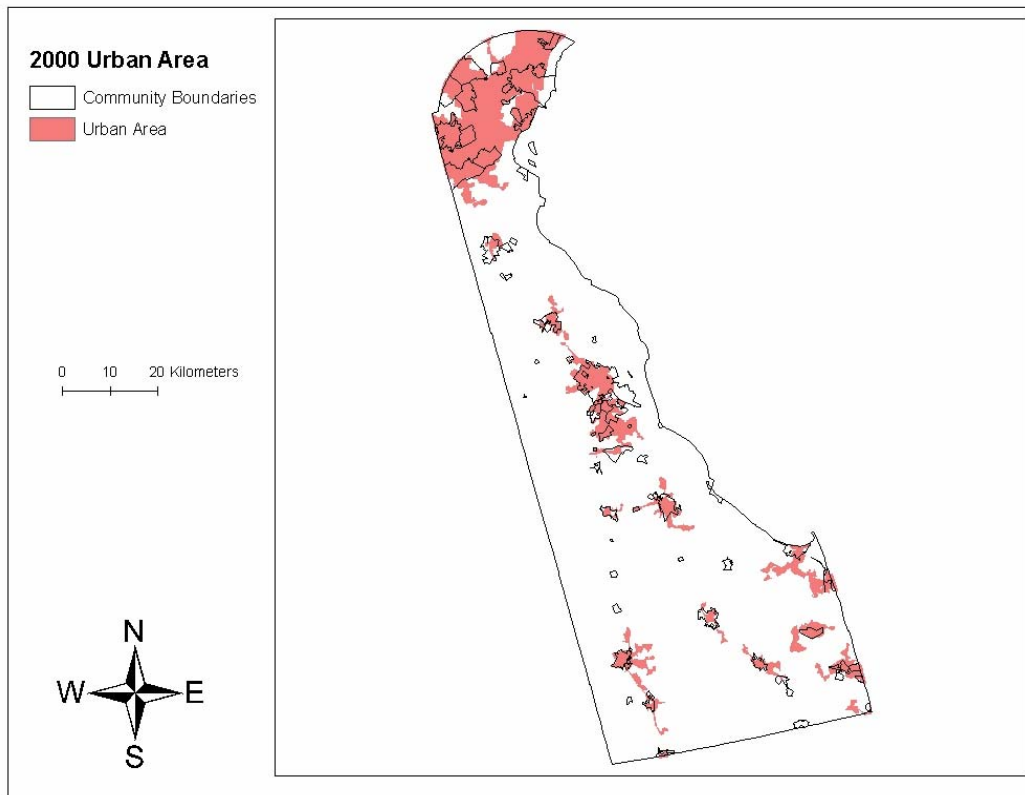


Figure 2. Urban area relative to community boundaries.

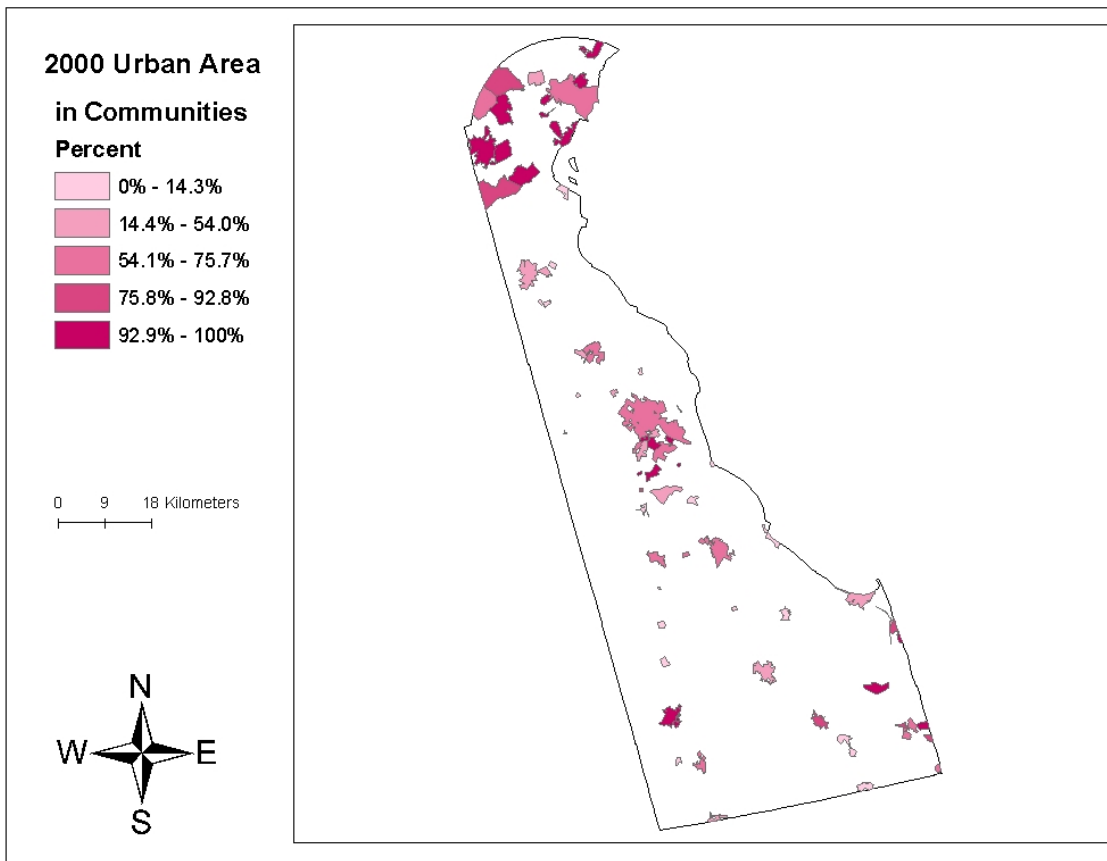


Figure 3. Percent of community area classified as urban area.

Communities (Table 2; Figure 3)

- maximum percent growth in urban area (1990-2000): Riverview CDP (582.4%)
- minimum percent growth in urban area (1990-2000): Kent Acres CDP (-62.5%)

County Subdivisions (Table 3)

- maximum percent growth in urban area (1990-2000): Selbyville-Frankford CCD (775.5%)
- minimum percent growth in urban area (1990-2000): Milford-South CCD (-20.4%)
- maximum percent growth in community area (1990-2000): Piedmont CCD (125,907%)
- minimum percent growth in community area (1990-2000): Upper Christiana CCD (-100%)

Counties (Table 4)

- maximum percent growth in urban area (1990-2000): Sussex County (49.1%)
- minimum percent growth in urban area (1990-2000): New Castle County (22.7%)
- maximum percent growth in community area (1990-2000): New Castle County (74.8%)
- minimum percent growth in community area (1990-2000): Kent County (7.9%)

Tree Canopy Cover (Figures 4-6)

Tree canopy cover is a critical measure of the urban and community forest resource as it gives a broad indication of the overall forest resource and its associated benefits. To assess urban and community cover characteristics, the Multi-Resolution Land Characteristics Consortium's National Land Cover Database (NLCD 2001) was used (Homer et al 2004; Yang et al, 2003; USGS, 2007). These data provide estimates of percent tree and impervious surface cover within 30 m pixels across the state.

In a study of 2001 land cover data from urban places in NLCD 2001 Mapping Zone 63 (western New York State), the mean absolute error between the NLCD-derived tree canopy estimate and the photo-interpreted reference value was 7.1%, with error decreasing as area of analysis increased (Walton, 2005). While the NLCD was an improvement over the earlier AVHRR-based assessment, Walton (2005) demonstrated a tendency for the NLCD to over predict tree cover in more developed, lower tree covered, urban areas in the test zone. However, data from Baltimore and Philadelphia show that NLCD maps tends to under predict tree cover compared to field data (USDA Forest Service, unpublished data). Further research is needed to determine how actual tree cover in urban areas may differ from NLCD tree cover estimates.

While further studies are needed to assess the accuracy of the NLCD cover maps, these maps provide reasonable estimates (with an inherent degree of error and uncertainty) of tree and impervious cover at the community to state scale. Higher resolution digital cover maps may provide more accurate results at the local scale, but the national cover maps provide a means to consistently assess the relative impacts of urban cover types at a local to national scale.

In addition to percent tree cover, four other canopy cover attributes were assessed:

- 1) potential growing space: Total area minus impervious and water cover. This estimates pervious cover in an area that could potentially be planted with trees (i.e., grass, soil, or tree covered areas).
- 2) tree canopy stocking: tree cover divided by potential growing space. This value is the proportion of the potential growing space that is filled by trees.
- 3) available growing space: potential growing space minus tree cover. This value is amount of grass and soil area not covered with tree canopies (available for planting).
- 4) tree cover per capita: tree cover (m^2) divided by the number of people within the area of analysis.

Average tree cover in Delaware is 23.1 percent, with 96.5 percent potential growing space, 23.9 percent canopy stocking, and 1,488.6 m^2 of canopy cover per capita. Average tree cover in urban areas in Delaware was 16.6 percent, with 83.4 percent potential growing space, 19.9 percent canopy stocking and 206.0 m^2 of canopy cover

per capita. Within community lands in Delaware, average tree cover was 14.8 percent, with 82.8 percent potential growing space, 17.9 percent canopy stocking and 191.2 m² of canopy cover per capita (Table 1). Tree canopy cover, stocking levels, and tree cover per capita varied among communities, county subdivisions and counties.

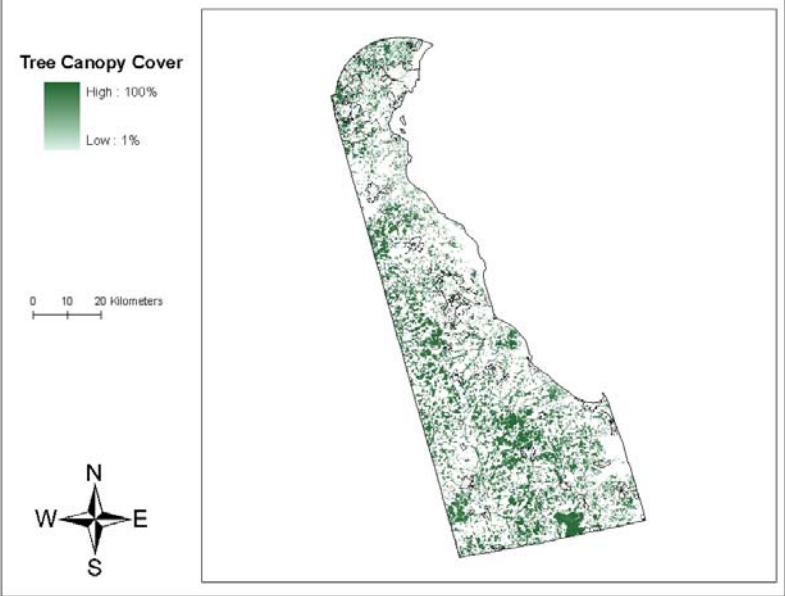


Figure 4. Percent tree canopy cover.

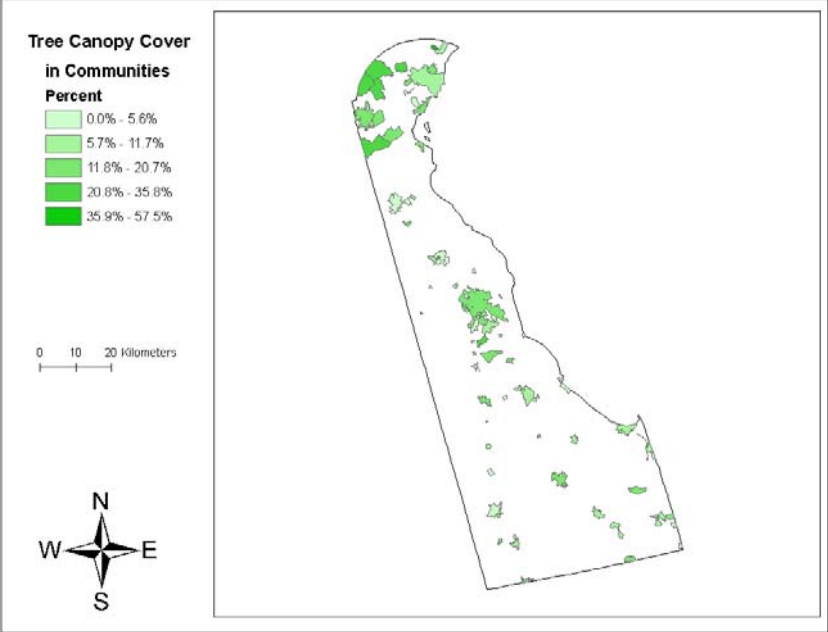


Figure 5. Percent tree canopy cover within communities.

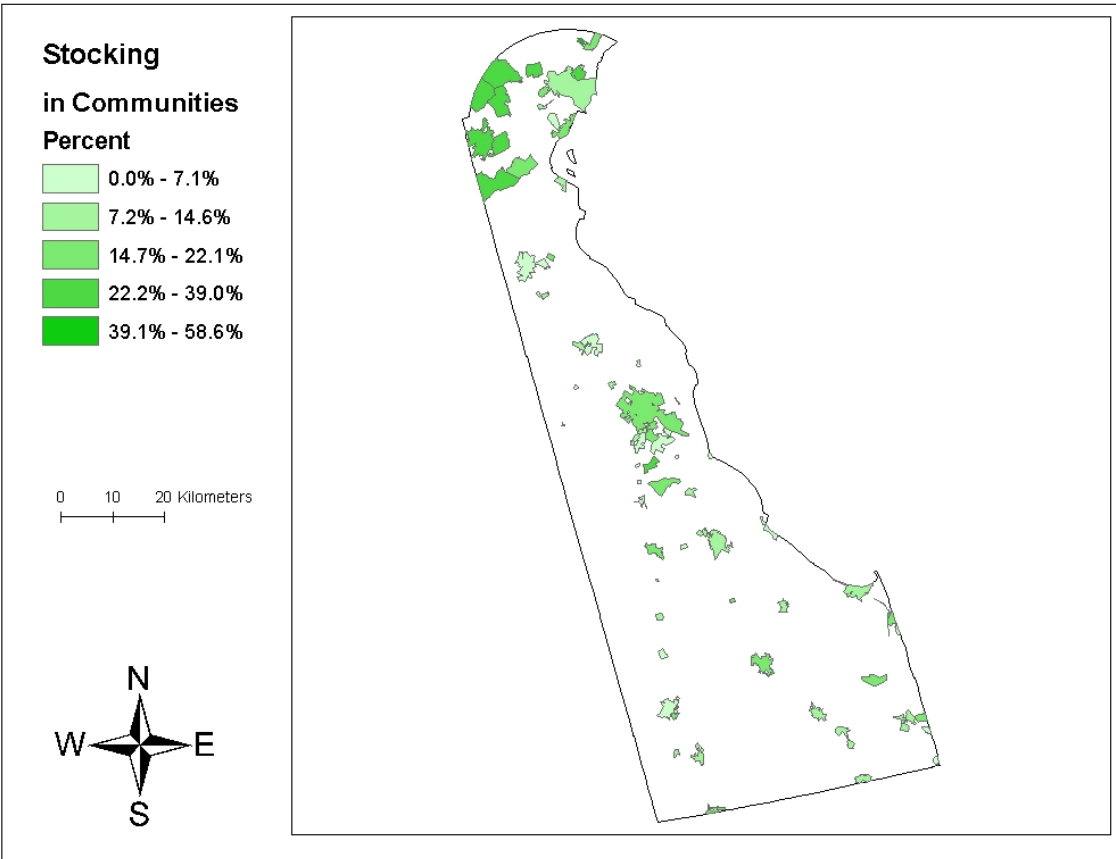


Figure 6. Percent tree canopy stocking in communities.

Communities (Table 5; Figures 5-6)

- maximum percent tree canopy cover: Arden village (57.5%)
- minimum percent tree canopy cover: Fenwick Island town (0.0%)
- maximum tree canopy per capita : Henlopen Acres town (1,612.5m²/person)
- minimum tree canopy per capita: Fenwick Island town (0.5 m²/person)
- maximum tree canopy stocking: Arden village (58.6%)
- minimum tree canopy stocking: Fenwick Island town (0.0%)

Table 5. Tree canopy and impervious surface cover characteristics by community.

| Name | Impervious Surface Cover | | Tree Canopy Cover | | |
|------------------------|--------------------------|------------------------|-------------------|------------------------|------------|
| | % | m ² /person | % | m ² /person | Stocking % |
| Arden village | 1.8% | 24.6 | 57.5% | 796.4 | 58.6% |
| Ardencroft village | 8.4% | 99.5 | 50.8% | 599.2 | 55.5% |
| Ardentown village | 5.2% | 103.2 | 50.0% | 986.1 | 52.8% |
| Bear CDP | 15.3% | 129.8 | 14.9% | 126.4 | 17.6% |
| Bellefonte town | 33.7% | 124.0 | 8.9% | 32.7 | 13.4% |
| Bethany Beach town | 29.4% | 962.8 | 12.9% | 421.7 | 18.3% |
| Bethel town | 2.7% | 166.9 | 13.3% | 822.1 | 13.7% |
| Blades town | 17.3% | 199.0 | 16.7% | 192.1 | 20.2% |
| Bowers town | 13.8% | 327.4 | 6.1% | 145.2 | 7.1% |
| Bridgeville town | 20.3% | 289.8 | 4.5% | 64.4 | 5.7% |
| Brookside CDP | 23.9% | 162.7 | 18.3% | 124.9 | 24.1% |
| Camden town | 11.2% | 257.2 | 5.6% | 128.6 | 6.3% |
| Cheswold town | 9.8% | 349.0 | 10.0% | 358.0 | 11.1% |
| Claymont CDP | 36.3% | 212.8 | 11.7% | 68.9 | 18.4% |
| Clayton town | 14.1% | 292.4 | 10.2% | 212.3 | 11.9% |
| Dagsboro town | 7.1% | 444.1 | 8.9% | 556.5 | 9.6% |
| Delaware City city | 6.1% | 133.7 | 13.7% | 303.0 | 14.6% |
| Delmar town | 15.2% | 272.7 | 14.3% | 255.9 | 16.8% |
| Dewey Beach town | 54.4% | 1,651.6 | 2.3% | 69.4 | 5.0% |
| Dover Base Housing CDP | 16.1% | 84.0 | 1.5% | 7.8 | 1.8% |
| Dover city | 20.1% | 368.2 | 12.2% | 223.8 | 15.3% |
| Edgemoor CDP | 37.7% | 291.2 | 14.6% | 113.1 | 23.5% |
| Ellendale town | 9.4% | 188.2 | 14.2% | 285.0 | 15.7% |
| Elsmere town | 38.3% | 167.4 | 12.7% | 55.3 | 20.6% |
| Farmington town | 7.1% | 167.8 | 1.4% | 33.0 | 1.5% |
| Felton town | 11.4% | 208.5 | 4.4% | 80.5 | 5.0% |
| Fenwick Island town | 47.4% | 1,188.4 | 0.0% | 0.5 | 0.0% |
| Frankford town | 9.2% | 223.9 | 9.4% | 228.9 | 10.3% |
| Frederica town | 5.0% | 165.9 | 12.9% | 425.4 | 13.6% |
| Georgetown town | 15.8% | 366.3 | 18.6% | 431.3 | 22.1% |
| Glasgow CDP | 9.0% | 179.0 | 25.9% | 514.8 | 28.5% |
| Greenville CDP | 5.0% | 153.5 | 34.9% | 1,068.1 | 36.8% |
| Greenwood town | 15.0% | 282.8 | 6.6% | 124.3 | 7.8% |
| Harrington city | 17.9% | 293.3 | 14.1% | 231.0 | 17.2% |
| Hartly town | 15.1% | 345.8 | 8.8% | 201.2 | 10.4% |
| Henlopen Acres town | 8.0% | 360.3 | 35.8% | 1,612.5 | 39.0% |
| Highland Acres CDP | 13.1% | 157.8 | 14.6% | 175.8 | 16.8% |
| Hockessin CDP | 5.6% | 113.2 | 29.7% | 595.5 | 31.5% |
| Houston town | 6.5% | 145.9 | 0.5% | 10.6 | 0.5% |
| Kent Acres CDP | 10.8% | 151.2 | 15.7% | 220.3 | 17.6% |
| Kenton town | 8.1% | 170.7 | 0.8% | 16.5 | 0.9% |
| Laurel town | 18.2% | 221.7 | 11.2% | 136.4 | 13.7% |
| Leipsic town | 7.4% | 271.7 | 4.7% | 171.5 | 5.1% |
| Lewes city | 15.3% | 500.1 | 8.1% | 263.6 | 9.5% |
| Little Creek town | 18.7% | 230.8 | 1.9% | 23.8 | 2.4% |
| Long Neck CDP | 10.0% | 396.0 | 19.5% | 775.3 | 21.7% |
| Magnolia town | 7.9% | 163.7 | 1.2% | 23.8 | 1.3% |
| Middletown town | 7.7% | 207.2 | 4.9% | 130.7 | 5.3% |
| Millford city | 17.5% | 379.1 | 8.2% | 177.6 | 9.9% |
| Millsboro town | 17.2% | 357.7 | 10.7% | 222.4 | 12.9% |
| Millville town | 10.0% | 494.5 | 11.0% | 546.1 | 12.3% |
| Milton town | 15.5% | 260.8 | 11.2% | 188.4 | 13.2% |
| New Castle city | 19.3% | 308.7 | 14.4% | 230.6 | 17.9% |
| Newark city | 26.3% | 216.8 | 18.0% | 148.2 | 24.4% |
| Newport town | 55.3% | 554.8 | 3.6% | 35.8 | 8.0% |
| North Star CDP | 3.0% | 64.5 | 27.9% | 596.0 | 28.8% |
| Ocean View town | 7.9% | 413.5 | 7.8% | 409.0 | 8.5% |
| Odessa town | 7.3% | 295.4 | 14.6% | 590.4 | 15.7% |
| Pike Creek CDP | 13.2% | 106.1 | 22.2% | 177.8 | 25.5% |
| Rehoboth Beach city | 35.7% | 718.2 | 10.6% | 212.5 | 16.4% |
| Rising Sun-Lebanon CDP | 2.8% | 105.6 | 6.7% | 247.5 | 6.9% |
| Riverview CDP | 0.2% | 10.6 | 20.7% | 1,234.5 | 20.8% |
| Rodney Village CDP | 18.2% | 162.3 | 7.6% | 67.8 | 9.3% |
| Seaford city | 26.6% | 357.0 | 5.1% | 68.6 | 7.0% |
| Selbyville town | 15.6% | 360.3 | 12.2% | 282.4 | 14.5% |
| Slaughter Beach town | 4.6% | 772.4 | 3.4% | 570.0 | 3.6% |
| Smyrna town | 11.6% | 202.0 | 5.5% | 94.7 | 6.2% |
| South Bethany town | 37.4% | 1,030.9 | 2.2% | 60.4 | 3.5% |
| Townsend town | 5.7% | 250.0 | 12.6% | 555.0 | 13.3% |
| Viola town | 2.1% | 61.8 | 1.8% | 52.8 | 1.8% |
| Wilmington city | 47.1% | 191.8 | 6.5% | 26.3 | 12.2% |
| Wilmington Manor CDP | 38.7% | 195.3 | 2.9% | 14.6 | 4.7% |
| Woodside East CDP | 2.2% | 43.7 | 23.3% | 472.5 | 23.8% |
| Woodside town | 10.8% | 236.9 | 3.7% | 81.2 | 4.1% |
| Wyoming town | 14.7% | 229.6 | 10.6% | 166.7 | 12.5% |

County Subdivisions (Table 6)

- maximum percent tree canopy cover: Georgetown CCD(39.5%)
- minimum percent tree canopy cover: Wilmington CCD (6.5%)
- maximum tree canopy cover per capita: Felton CCD (7,325.1 m²/person)
- minimum tree canopy cover per capita: Wilmington CCD (26.1 m²/person)
- maximum tree canopy stocking: Georgetown CCD (40.1%)
- minimum tree canopy stocking: Smyrna CCD (8.7%)

Table 6. Tree canopy and impervious surface cover characteristics by county subdivision.

| Name | Impervious Surface Cover | | Tree Canopy Cover | | |
|---------------------------------|--------------------------|------------------------|-------------------|------------------------|------------|
| | % | m ² /person | % | m ² /person | Stocking % |
| Brandywine CCD | 19.4% | 199.7 | 25.8% | 265.6 | 32.0% |
| Bridgeville-Greenwood CCD | 0.7% | 208.4 | 23.5% | 6,902.7 | 23.7% |
| Central Kent CCD | 0.7% | 79.0 | 26.2% | 3,066.2 | 26.3% |
| Central Pencader CCD | 6.9% | 177.2 | 29.9% | 771.8 | 32.1% |
| Dover CCD | 4.6% | 275.3 | 17.6% | 1,044.4 | 18.4% |
| Felton CCD | 0.4% | 104.2 | 27.3% | 7,325.1 | 27.4% |
| Georgetown CCD | 1.6% | 253.3 | 39.5% | 6,152.2 | 40.1% |
| Greater Newark CCD | 16.6% | 191.6 | 27.0% | 312.1 | 32.3% |
| Harrington CCD | 0.8% | 200.6 | 25.7% | 6,564.1 | 25.9% |
| Kenton CCD | 0.3% | 65.4 | 25.4% | 5,932.8 | 25.5% |
| Laurel-Delmar CCD | 0.7% | 169.8 | 27.0% | 6,256.6 | 27.2% |
| Lewes CCD | 5.1% | 471.6 | 18.7% | 1,715.4 | 19.7% |
| Lower Christiana CCD | 29.3% | 245.0 | 15.5% | 129.7 | 21.9% |
| Middletown-Odessa CCD | 0.9% | 153.7 | 18.2% | 2,958.2 | 18.3% |
| Milford North CCD | 1.4% | 317.3 | 17.5% | 3,962.3 | 17.8% |
| Milford South CCD | 1.0% | 194.4 | 24.2% | 4,827.7 | 24.4% |
| Millsboro CCD | 2.2% | 272.5 | 24.7% | 2,993.8 | 25.2% |
| Milton CCD | 1.1% | 176.8 | 25.2% | 3,900.3 | 25.5% |
| New Castle CCD | 21.4% | 252.4 | 10.7% | 126.5 | 13.6% |
| Piedmont CCD | 3.4% | 119.1 | 31.6% | 1,098.0 | 32.7% |
| Pike Creek-Central Kirkwood CCD | 17.1% | 151.4 | 18.8% | 166.5 | 22.7% |
| Red Lion CCD | 7.9% | 739.4 | 13.4% | 1,252.2 | 14.5% |
| Seaford CCD | 2.3% | 251.5 | 22.9% | 2,471.7 | 23.4% |
| Selbyville-Frankford CCD | 3.2% | 425.4 | 27.5% | 3,699.6 | 28.4% |
| Smyrna CCD | 1.4% | 204.7 | 8.5% | 1,279.8 | 8.7% |
| Upper Christiana CCD | 20.8% | 259.8 | 19.2% | 239.7 | 24.3% |
| Wilmington CCD | 47.1% | 188.5 | 6.5% | 26.1 | 12.3% |

Counties (Table 7)

- maximum percent tree canopy cover: Sussex County (25.8%)
- minimum percent tree canopy cover: New Castle County (20.3%)
- maximum tree canopy cover per capita: Sussex County (4,006.8 m²/person)
- minimum tree canopy cover per capita: New Castle County (446.9 m²/person)
- maximum tree canopy stocking: Sussex County (26.3%)
- minimum tree canopy stocking: Kent County (21.1%)

Table 7. Tree canopy and impervious surface cover characteristics by county.

| Name | Impervious Surface Cover | | Tree Canopy Cover | | |
|-------------------|--------------------------|------------------------|-------------------|------------------------|------------|
| | % | m ² /person | % | m ² /person | Stocking % |
| Kent County | 1.8% | 220.9 | 20.7% | 2,489.6 | 21.1% |
| New Castle County | 9.3% | 204.9 | 20.3% | 446.9 | 22.3% |
| Sussex County | 1.8% | 287.1 | 25.8% | 4,006.8 | 26.3% |

Impervious Surface Cover (Figures 7- 8)

Similar to tree cover, impervious surface cover gives another valuable piece of information related to the urban environment. Impervious surface cover gives an indication of developed hardscape within an area, which has important influences on urban air temperatures and water flows, but also yields general information on limitations to urban tree cover. Impervious surface cover was derived from National Land Cover Database (USGS, 2007).

Average impervious surface cover in Delaware is 3.5 percent of the land area, with 223.9 m² of impervious surface cover per capita. Average impervious surface cover in urban areas in Delaware was 16.6 percent, with 206.0 m² of impervious surface cover per capita. Within community lands in Delaware, average impervious surface cover was 17.2 percent, with 222.6 m² of impervious surface cover per capita (Table 1).

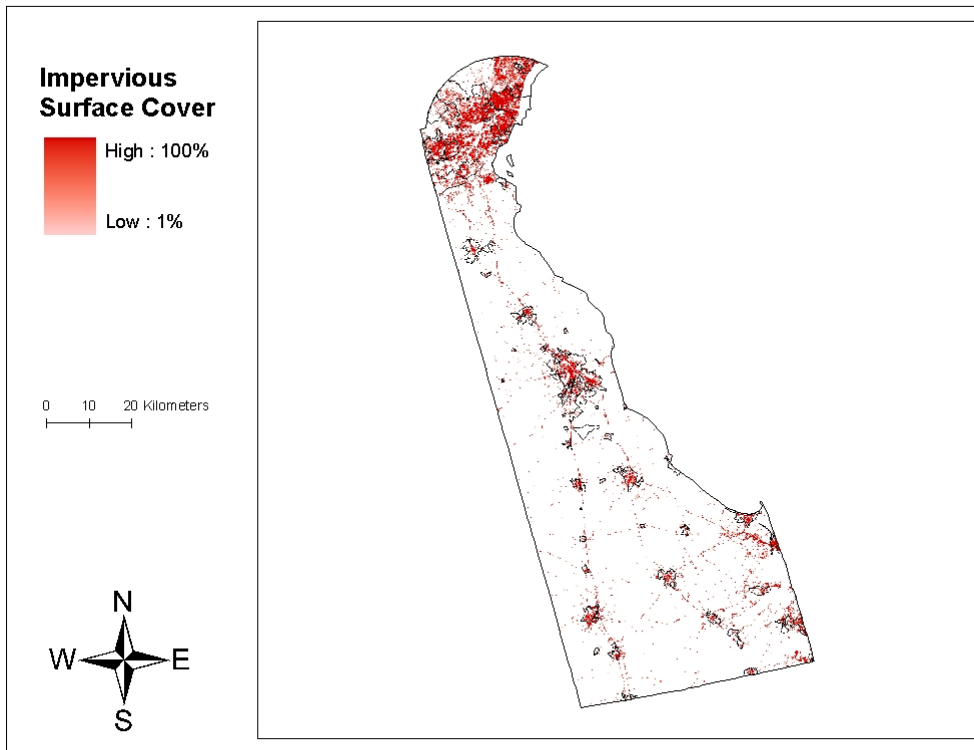


Figure 7. Percent impervious surface cover.

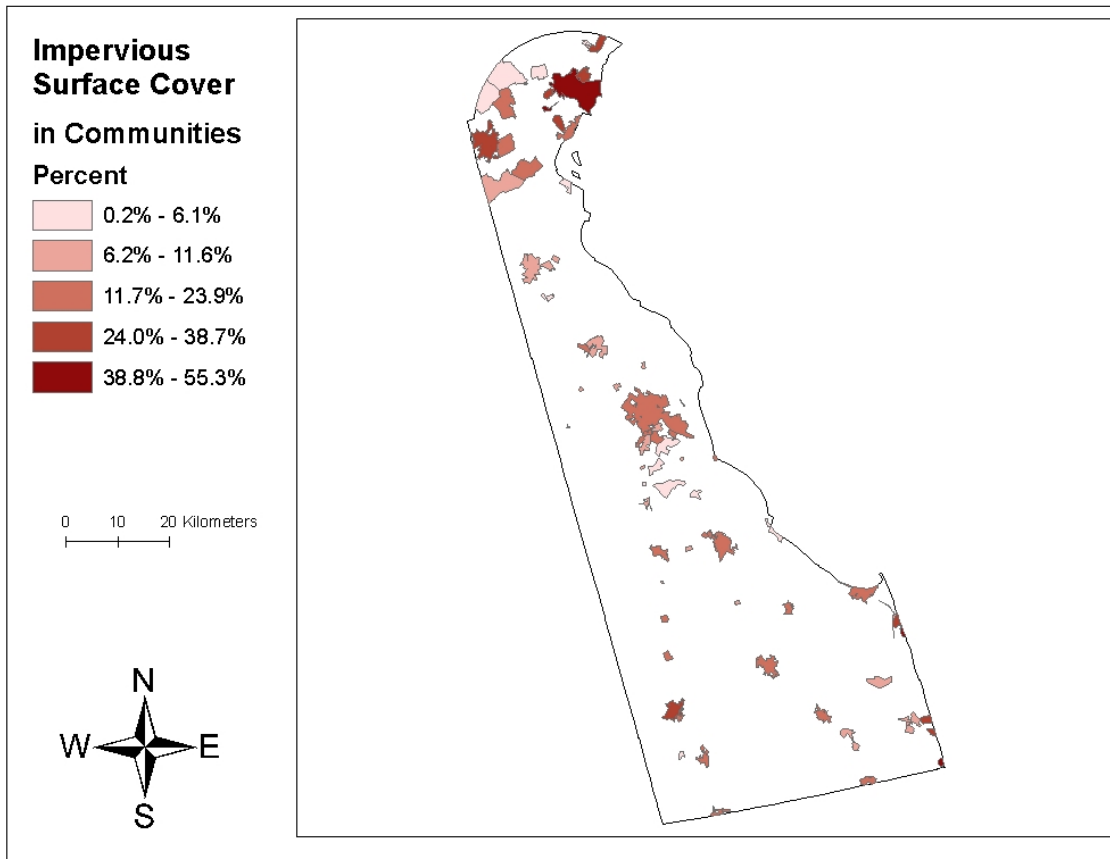


Figure 8. Percent impervious surface cover within communities.

Communities (Table 5; Figure 8)

- maximum percent impervious surface cover: Newport town (55.3%)
- minimum percent impervious surface cover: Riverview CDP (0.2%)
- maximum impervious surface cover per capita: Dewey Beach town (1,651.6 m²/person)
- minimum impervious surface cover per capita: Riverview CDP (10.6 m²/person)

County Subdivisions (Table 6)

- maximum percent impervious surface cover: Wilmington CCD (47.1%)
- minimum percent impervious surface cover: Kenton CCD (0.3%)
- maximum impervious surface cover per capita: Red Lion CCD (739.4 m²/person)
- minimum impervious surface cover per capita: Kenton CCD (65.4 m²/person)

Counties (Table 7)

- maximum percent impervious surface cover: New Castle County (9.3%)
- minimum percent impervious surface cover: Kent County (1.8%)
- maximum impervious surface cover per capita: Sussex County (287.1 m²/person)
- minimum impervious surface cover per capita: New Castle County (204.9 m²/person)

Land Cover Types (Figure 9)

Like tree canopy and impervious surface cover, the land cover types are summarized using Landsat Thematic Mapper satellite data that was classified consistently over the United States with the USGS land cover categorization scheme based on a modified Anderson land cover classification. These data were derived from the National Land Cover Database (USGS, 2007). Tables 8-10 summarize the land area, tree canopy cover, and available growing space of and within generalized land cover categories and for the communities, county subdivisions, counties, and state. The generalized land cover categories are derived from NLCD 2001 land cover classes.

Overall, the generalized land cover characteristics as a percent of the total state land area in Delaware are as follows:

- Developed 10.2%
- Barren 1.3%
- Forested 25.3%
- Agricultural 57.5%
- Wetland 5.7%

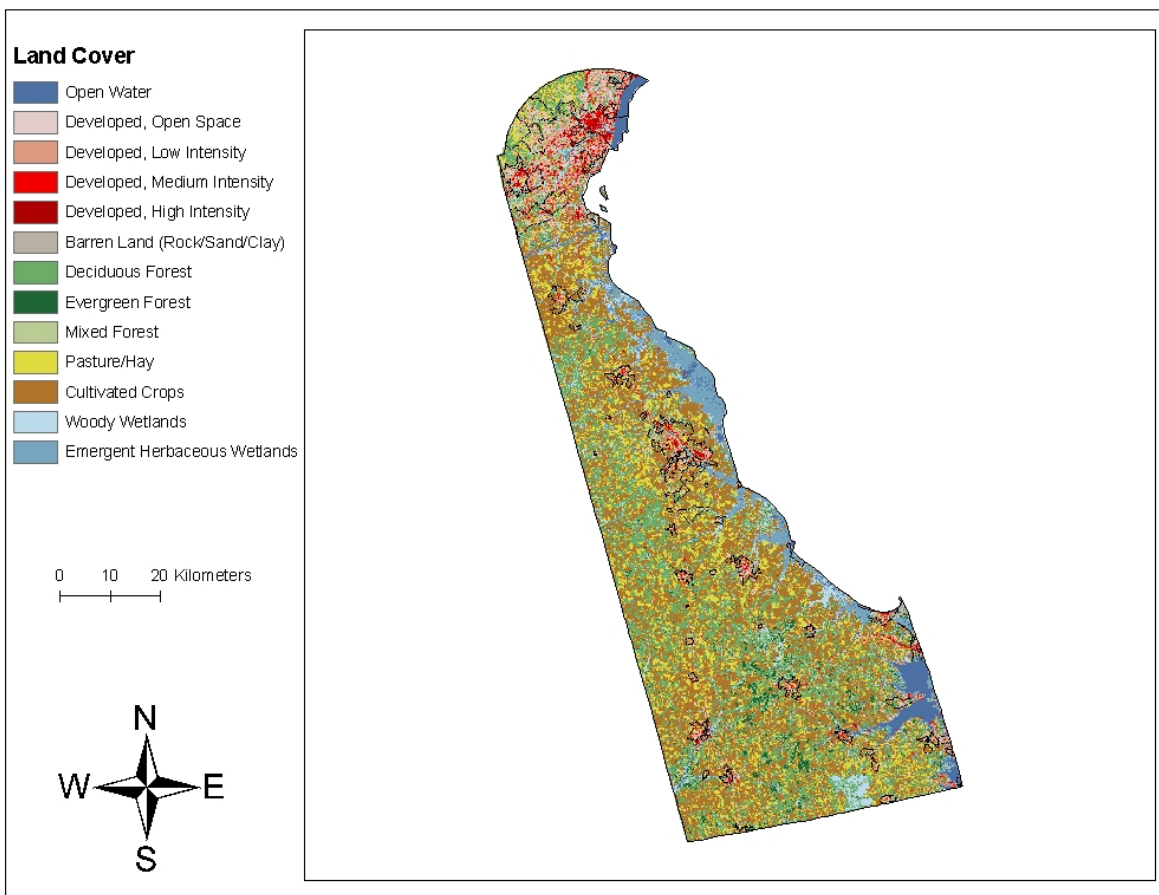


Figure 9. Classified land cover.

Table 8. Land area, tree canopy cover, and available growing space distributed within generalized land cover categories for communities.

| Name | Developed ¹ | | | | Barren ² | | | | Forested ³ | | | | Agriculture ⁴ | | | | Wetland ⁵ | | | |
|------------------------|---------------------------|-------------|--------|--------------------|---------------------------|-------------|--------|--------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|--------|---------------------------|-------------|--------|--------|
| | Land Area Km ² | Land Area % | Tree % | AGS % ⁶ | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % |
| Arden village | 0.2 | 25.4% | 40.8% | 52.2% | 0.0 | 0.0% | NA | NA | 0.4 | 55.4% | 73.9% | 26.1% | 0.1 | 19.2% | 32.5% | 67.5% | 0.0 | 0.0% | NA | NA |
| Ardencroft village | 0.1 | 44.6% | 26.3% | 54.8% | 0.0 | 0.0% | NA | NA | 0.2 | 15.9% | 72.1% | 27.9% | 0.0 | 4.9% | 53.4% | 46.6% | 0.0 | 0.0% | NA | NA |
| Ardentown village | 0.2 | 40.3% | 24.9% | 62.1% | 0.0 | 0.0% | NA | NA | 0.3 | 27.8% | 72.6% | 27.4% | 0.1 | 12.6% | 46.1% | 53.9% | 0.0 | 0.0% | NA | NA |
| Bear CDP | 6.5 | 44.0% | 3.7% | 61.5% | 0.3 | 2.1% | 0.0% | 100.0% | 1.7 | 171.4% | 70.1% | 29.9% | 6.3 | 42.2% | 12.4% | 87.6% | 0.0 | 0.2% | 1.0% | 99.0% |
| Bellefonte town | 0.4 | 97.7% | 8.4% | 57.1% | 0.0 | 0.0% | NA | NA | 0.0 | 0.6% | 42.1% | 57.9% | 0.0 | 1.0% | 15.2% | 84.8% | 0.0 | 0.0% | NA | NA |
| Bethany Beach town | 2.4 | 80.3% | 6.3% | 55.0% | 0.1 | 2.7% | 0.0% | 100.0% | 0.3 | 28.2% | 55.5% | 44.5% | 0.1 | 3.6% | 24.9% | 75.1% | 0.1 | 3.9% | 1.6% | 98.4% |
| Bethel town | 0.2 | 20.6% | 8.6% | 80.2% | 0.0 | 0.0% | NA | NA | 0.1 | 12.2% | 62.7% | 37.3% | 0.8 | 66.3% | 7.8% | 92.2% | 0.0 | 2.5% | 3.0% | 97.0% |
| Blades town | 0.5 | 44.8% | 5.3% | 56.1% | 0.0 | 0.9% | 0.0% | 100.0% | 0.2 | 19.6% | 59.3% | 40.7% | 0.4 | 36.2% | 10.2% | 89.8% | 0.0 | 0.3% | 20.3% | 79.8% |
| Bowers town | 0.3 | 35.3% | 3.4% | 57.5% | 0.1 | 12.8% | 0.0% | 100.0% | 0.0 | 0.8% | 47.7% | 52.3% | 0.3 | 37.5% | 10.8% | 89.2% | 0.1 | 13.3% | 2.5% | 97.5% |
| Bridgeville town | 1.2 | 58.4% | 2.4% | 62.9% | 0.0 | 1.8% | 0.0% | 100.0% | 0.1 | 9.3% | 56.2% | 43.8% | 0.6 | 31.4% | 1.6% | 98.4% | 0.1 | 3.8% | 1.2% | 98.8% |
| Brookside CDP | 6.5 | 64.6% | 3.3% | 59.7% | 0.1 | 0.7% | 0.0% | 100.0% | 1.1 | 108.7% | 78.0% | 22.0% | 2.4 | 23.6% | 32.8% | 67.2% | 0.0 | 0.2% | 2.4% | 97.6% |
| Camden town | 1.5 | 30.9% | 3.6% | 60.1% | 0.0 | 0.1% | 0.0% | 100.0% | 0.2 | 18.3% | 73.5% | 26.5% | 3.0 | 63.4% | 2.7% | 97.3% | 0.1 | 1.7% | 0.0% | 100.0% |
| Cheswold town | 0.3 | 29.0% | 2.7% | 63.6% | 0.0 | 0.4% | 0.0% | 100.0% | 0.1 | 13.3% | 70.5% | 29.5% | 0.7 | 58.5% | 1.4% | 98.6% | 0.0 | 0.2% | 0.0% | 100.0% |
| Claymont CDP | 4.7 | 87.0% | 6.8% | 51.5% | 0.0 | 0.2% | 0.0% | 100.0% | 0.4 | 40.0% | 64.1% | 35.9% | 0.3 | 5.2% | 21.7% | 78.3% | 0.0 | 0.2% | 0.0% | 100.0% |
| Clayton town | 1.0 | 37.0% | 3.1% | 58.8% | 0.0 | 0.1% | 0.0% | 100.0% | 0.3 | 29.5% | 63.1% | 36.9% | 1.4 | 51.3% | 4.0% | 96.0% | 0.0 | 0.4% | 0.0% | 100.0% |
| Dagsboro town | 0.7 | 21.6% | 3.2% | 63.9% | 0.1 | 1.8% | 0.0% | 100.0% | 0.4 | 39.9% | 58.6% | 41.4% | 2.1 | 64.2% | 1.6% | 98.4% | 0.0 | 0.1% | 0.0% | 100.0% |
| Delaware City city | 0.7 | 22.1% | 6.1% | 66.4% | 0.5 | 16.5% | 0.2% | 99.8% | 0.1 | 11.2% | 70.8% | 29.2% | 1.6 | 50.5% | 19.4% | 80.6% | 0.2 | 7.3% | 1.6% | 98.4% |
| Delmar town | 1.0 | 41.0% | 2.7% | 60.2% | 0.0 | 0.9% | 0.0% | 100.0% | 0.5 | 47.0% | 69.9% | 30.1% | 1.0 | 38.7% | 0.4% | 99.6% | 0.0 | 0.8% | 0.0% | 100.0% |
| Dewey Beach town | 0.7 | 79.7% | 2.5% | 29.3% | 0.2 | 18.0% | 0.0% | 100.0% | 0.0 | 0.4% | 69.8% | 30.3% | 0.0 | 0.6% | 0.0% | 100.0% | 0.0 | 1.1% | 0.0% | 100.0% |
| Dover Base Housing CDP | 1.2 | 65.3% | 1.7% | 73.7% | 0.0 | 0.0% | NA | NA | 0.0 | 0.0% | NA | NA | 0.5 | 29.9% | 0.8% | 99.2% | 0.1 | 4.8% | 3.7% | 96.3% |
| Dover city | 26.1 | 44.4% | 3.0% | 51.7% | 0.2 | 0.4% | 0.4% | 99.6% | 7.1 | 708.6% | 70.7% | 29.3% | 25.7 | 42.7% | 5.5% | 94.5% | 0.3 | 0.5% | 4.9% | 95.1% |
| Edgemoor CDP | 3.7 | 80.2% | 8.5% | 44.5% | 0.0 | 0.0% | NA | NA | 0.4 | 38.7% | 60.4% | 39.6% | 0.5 | 10.4% | 26.3% | 73.7% | 0.0 | 1.1% | 1.8% | 98.2% |
| Ellendale town | 0.2 | 36.6% | 2.0% | 72.4% | 0.0 | 6.0% | 0.0% | 100.0% | 0.1 | 11.1% | 69.0% | 31.0% | 0.3 | 40.5% | 4.6% | 95.4% | 0.0 | 0.0% | NA | NA |
| Elmers town | 2.1 | 84.9% | 4.4% | 50.5% | 0.0 | 0.4% | 0.0% | 100.0% | 0.1 | 12.3% | 72.7% | 27.3% | 0.2 | 9.7% | 56.1% | 43.9% | 0.0 | 0.1% | 0.0% | 100.0% |
| Farmington town | 0.1 | 48.5% | 2.9% | 82.6% | 0.0 | 0.0% | NA | NA | 0.0 | 0.0% | NA | NA | 0.1 | 51.5% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA |
| Fellon town | 0.4 | 31.1% | 2.5% | 60.9% | 0.0 | 1.6% | 0.0% | 100.0% | 0.1 | 5.2% | 76.1% | 23.9% | 0.8 | 55.0% | 1.6% | 98.4% | 0.1 | 8.7% | 0.0% | 100.0% |
| Ferriek Island town | 0.7 | 81.6% | 0.0% | 41.9% | 0.1 | 10.4% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA | 0.0 | 1.2% | 0.0% | 100.0% | 0.1 | 6.8% | 0.0% | 100.0% |
| Frankford town | 0.6 | 36.3% | 4.0% | 70.7% | 0.1 | 3.4% | 0.0% | 100.0% | 0.2 | 20.6% | 64.3% | 35.7% | 0.8 | 47.9% | 0.7% | 99.3% | 0.0 | 0.6% | 0.0% | 100.0% |
| Frederica town | 0.4 | 20.0% | 5.9% | 68.9% | 0.0 | 0.2% | 0.0% | 100.0% | 0.1 | 13.6% | 69.8% | 30.2% | 1.2 | 54.0% | 12.6% | 87.4% | 0.4 | 19.5% | 2.5% | 97.5% |
| Georgetown town | 4.2 | 39.3% | 3.9% | 55.9% | 0.1 | 0.6% | 0.0% | 100.0% | 2.3 | 229.1% | 78.1% | 21.9% | 4.1 | 38.2% | 2.2% | 97.8% | 0.1 | 0.6% | 3.6% | 96.4% |
| Glasgow CDP | 7.5 | 29.4% | 3.9% | 65.5% | 0.5 | 2.0% | 0.3% | 99.7% | 6.0 | 599.2% | 78.3% | 21.7% | 11.3 | 44.3% | 15.4% | 84.6% | 0.2 | 0.8% | 4.9% | 95.1% |
| Greenview CDP | 1.7 | 23.4% | 17.9% | 60.6% | 0.6 | 8.5% | 0.8% | 99.2% | 2.6 | 260.8% | 81.3% | 18.7% | 2.2 | 30.9% | 2.8% | 97.2% | 0.0 | 0.6% | 13.1% | 86.9% |
| Greenwood town | 0.7 | 45.1% | 3.4% | 63.2% | 0.0 | 2.5% | 0.0% | 100.0% | 0.1 | 10.4% | 70.4% | 29.6% | 0.7 | 45.8% | 0.8% | 99.2% | 0.0 | 0.0% | NA | NA |
| Harrington city | 2.3 | 44.2% | 2.6% | 56.9% | 0.0 | 0.8% | 0.0% | 100.0% | 0.8 | 82.8% | 76.6% | 23.4% | 2.0 | 37.6% | 1.9% | 98.1% | 0.1 | 1.4% | 0.4% | 99.6% |
| Harly town | 0.1 | 54.0% | 4.6% | 67.3% | 0.0 | 0.0% | NA | NA | 0.0 | 1.8% | 62.4% | 37.6% | 0.1 | 35.9% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA |
| Henlopen Acres town | 0.2 | 35.1% | 23.2% | 54.0% | 0.0 | 4.7% | 0.0% | 100.0% | 0.3 | 25.2% | 80.5% | 19.5% | 0.0 | 6.0% | 37.4% | 62.6% | 0.1 | 13.8% | 7.7% | 92.3% |
| Highland Acres CDP | 2.1 | 51.5% | 8.8% | 65.8% | 0.0 | 0.0% | NA | NA | 0.4 | 41.4% | 67.2% | 32.8% | 1.5 | 35.7% | 8.6% | 91.4% | 0.1 | 2.6% | 5.2% | 94.8% |
| Hockessin CDP | 8.2 | 31.6% | 11.4% | 70.7% | 1.2 | 4.5% | 0.6% | 99.4% | 7.7 | 772.6% | 82.7% | 17.3% | 8.8 | 33.8% | 4.0% | 96.0% | 0.1 | 0.2% | 10.4% | 89.6% |
| Houston town | 0.3 | 33.7% | 1.3% | 79.5% | 0.0 | 0.6% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA | 0.8 | 65.7% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA |
| Kent Acres CDP | 1.0 | 42.7% | 9.1% | 65.8% | 0.0 | 1.5% | 0.0% | 100.0% | 0.2 | 24.9% | 67.6% | 32.4% | 0.9 | 39.4% | 11.1% | 88.9% | 0.1 | 5.6% | 2.3% | 97.7% |
| Kenton town | 0.2 | 43.7% | 1.6% | 79.9% | 0.0 | 0.7% | 0.0% | 100.0% | 0.0 | 0.1% | 48.0% | 52.0% | 0.3 | 55.4% | 0.0% | 100.0% | 0.0 | 0.0% | NA | NA |
| Laurel town | 2.3 | 51.3% | 4.1% | 60.3% | 0.1 | 1.3% | 0.0% | 100.0% | 0.6 | 60.4% | 58.4% | 41.6% | 1.4 | 31.5% | 3.6% | 96.4% | 0.1 | 2.4% | 2.6% | 97.4% |
| Lepic town | 0.2 | 24.8% | 5.8% | 64.2% | 0.0 | 0.0% | NA | NA | 0.0 | 1.4% | 71.1% | 28.9% | 0.3 | 39.1% | 3.9% | 96.1% | 0.3 | 34.2% | 1.1% | 99.9% |
| Lewes city | 3.9 | 40.7% | 4.3% | 58.2% | 1.4 | 14.2% | 1.2% | 98.8% | 0.6 | 61.6% | 65.3% | 34.7% | 2.7 | 28.2% | 6.4% | 93.6% | 1.0 | 10.5% | 1.4% | 98.6% |
| Little Creek town | 0.1 | 59.3% | 3.0% | 65.5% | 0.0 | 0.0% | NA | NA | 0.0 | 0.0% | NA | NA | 0.1 | 39.9% | 0.4% | 99.6% | 0.0 | 0.7% | 0.0% | 100.0% |
| Long Neck CDP | 2.0 | 30.8% | 6.2% | 61.4% | 0.4 | 5.8% | 0.6% | 99.4% | 1.6 | 162.4% | 66.3% | 33.7% | 1.8 | 27.8% | 2.9% | 97.1% | 0.7 | 10.5% | 1.2% | 98.8% |
| Mannola town | 0.1 | 25.1% | 2.1% | 66.3% | 0.0 | 1.0% | 0.0% | 100.0% | 0.0 | 0.1% | 79.0% | 21.0% | 0.3 | 73.7% | 0.7% | 99.3% | 0.0 | 0.0% | NA | NA |
| Middletown town | 3.2 | 19.2% | 1.7% | 58.2% | 0.1 | 0.3% | 0.0% | 100.0% | 0.7 | 65.8% | 84.8% | 15.2% | 12.3 | 74.3% | 2.6% | 97.4% | 0.4 | 2.2% | 2.0% | 98.0% |
| Milford city | 6.3 | 43.1% | 2.2% | 57.1% | 0.1 | 0.9% | 0.0% | 100.0% | 1.3 | 126.3% | 84.7% | 15.3% | 6.8 | 46.5% | 3.5% | 96.5% | 0.1 | 0.6% | 1.6% | 98.2% |
| Millisboro town | 2.1 | 43.6% | 2.3% | 58.4% | 0.1 | 1.6% | 0.0% | 100.0% | 0.5 | 52.5% | 61.2% | 38.8% | 1.9 | 38.7% | 7.6% | 92.4% | 0.3 | 5.5% | 3.6% | 96.4% |
| Millville town | 0.5 | 38.7% | 5.9% | 68.3% | 0.0 | 0.6% | 0.0% | 100.0% | 0.2 | 19.4% | 51.5% | 48.5% | 0.6 | 44.6% | 2.0% | 98.0% | 0.0 | 1.0% | 1.8% | 98.2% |
| Millton town | 1.3 | 44.9% | 3.3% | 62.3% | 0.1 | 3.0% | 0.4% | 99.6% | 0.3 | 31.8% | 69.5% | 30.5% | 1.0 | 36.4% | 4.4% | 92.6% | 0.1 | 4.3% | 5.4% | 94.6% |
| New Castle city | 3.9 | 50.7% | 4.6% | 56.9% | 0.1 | 1.5% | 0.0% | 100.0% | 0.5 | 51.8% | 69.0% | 31.0% | 2.7 | 35.3% | 22.5% | 77.5% | 0.4 | 5.4% | 1.5% | 98.5% |
| Newark city | 15.4 | 65.4% | 6.8% | 52.9% | 0.4 | 1.5% | 0.2% | 99.8% | 2.2 | 219.8% | 73.8% | 26.2% | 5.5 | 23.4% | 28.3% | 71.7% | 0.1 | 0.4% | 6.7% | 93.3% |
| Newport town | 1.0 | 89.7% | 13.3% | 37.1% | 0.0 | 0.8% | 0.0% | 100.0% | 0.0 | 1.7% | 43.1% | 56.9% | 0.1 | 5.9% | 29.5% | 70.5% | 0.0 | 2.1% | 0.0% | 100.0% |
| North Star CDP | 3.9 | 22.0% | 9.1% | 77.2% | 0.4 | 2.0% | 0.2% | 99.8% | 5.3 | 531.7% | 84.9% | 15.1% | 8.1 | 45.9% | 0.8% | 99.2% | 0.0 | 0.0% | 0.0% | 100.0% |
| Ocean View town | 1.7 | 32.6% | 5.2% | 70.6% | 0.1 | 1.3% | 0.0% | 100.0% | 0.6 | 55.7% | 52.3% | 47.7% | 2.8 | 53.8% | 1.0% | 99.0% | 0.1 | 1.9% | 1.8% | 98.2% |
| Odess town | 0.4 | 35.0% | 10.1% | 69.1% | 0.0 | 0.9% | 0.0% | 100.0% | 0.1 | 9.3% | 68.6% | 31.4% | 0.6 | 54.2% | 10.2% | 89.8% | 0.0 | 1.9% | 1.1% | 98.9% |
| Pike Creek CDP | 7.9 | 49.8% | 7.3% | 66.1% | 0.3 | 1.8% | 0.4% | 99.6% | 3.2 | 317.3% | 78.4% | 21.6% | 4.4 | 28.0% | 9.9% | 90.1% | 0.1 | 0.4% | 7.1% | 92.9% |
| Rahoth Beach city | 2.2 | 72.7% | 7.5% | 43.3% | 0.2 | 6.5% | 0.0% | 100.0% | 0.2 | 20.8% | 59.8% | 40.2% | 0.1 | 3.9% | 19.1% | 80.9% | 0.3 | 9.6% | 2.2% | 97.8% |
| Rising Sun-Lebanon CDP | 1.0 | 10.7% | 6.7% | 66.6% | 0.0 | 0.2% | 0.0% | 100.0% | 0.5 | 48.7% | 71.3% | 28.7% | 6.7 | 73.7% | 2.7% | 97.3% | 0.9 | 10.1% | 1.4% | 98.6% |
| Riverview CDP | 0.1 | 1.0% | 4.0% | 77.9% | 0.1 | 0.6% | 0.0% | 100.0% | 2.2 | 222.9% | 74.1% | 25.9% | 6.9 | 73.2% | 4.1% | 95.9% | 0.1 | 1.6% | 9.2% | 90.8% |
| Rodney Village CDP | 0.6 | 38.8% | 2.4% | 60.7% | 0.0 | 0.0% | NA | NA | 0.1 | 10.4% | 72.6% | 27.4% | 0.6 | 38.9% | 2.9% | 97.1% | 0.2 | 15.0% | 1.6% | 98.4% |
| Seaford city | 5.5 | 61.1% | 2.7% | 63.9% | 0.0 | 0.4% | 0.0% | 100.0% | 0.4 | 39.3% | 63.4% | 36.6% | 3.0 | 33.7% | 2.0% | 98.0% | 0.0 | 0.5% | 5.5% | 94.5% |
| Seffsville town | 1.5 | 40.8% | 3.2% | 58.3% | 0.1 | 1.8% | 0.0% | 100.0% | 0.6 | 54.4% | 63.0% | 37.0% | 1.5 | 39.3% | 0.5% | 99.5% | 0.1 | 1.4% | 3.6% | 96.4% |
| Slaughter Beach town | 0.4 | 11.9% | 4.9% | 56.0% | | | | | | | | | | | | | | | | |

Table 9. Land area, tree canopy cover, and available growing space distributed within generalized land cover categories for county subdivisions.

| Name | Developed ¹ | | | | Barren ² | | | | Forested ³ | | | | Agricultural ⁴ | | | | Wetland ⁵ | | | |
|---------------------------------|---------------------------|-------------|--------|--------------------|---------------------------|-------------|--------|--------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|-------|
| | Land Area Km ² | Land Area % | Tree % | AGS % ⁶ | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % |
| Brandywine CCD | 51.1 | 63.2% | 12.7% | 56.8% | 0.9 | 1.1% | 0.7% | 99.3% | 15.8 | 19.6% | 76.7% | 23.3% | 12.5 | 15.4% | 17.6% | 82.4% | 0.6 | 0.7% | 7.5% | 92.9% |
| Bridgeville-Greenwood CCD | 6.8 | 2.5% | 2.6% | 68.5% | 2.1 | 0.8% | 0.0% | 100.0% | 84.5 | 30.5% | 72.5% | 27.5% | 182.4 | 65.7% | 2.1% | 97.9% | 1.7 | 0.6% | 0.9% | 99.1% |
| Central Kent CCD | 6.8 | 3.1% | 6.2% | 71.2% | 0.7 | 0.3% | 0.1% | 99.9% | 63.8 | 29.8% | 78.0% | 22.0% | 138.9 | 84.9% | 4.1% | 95.9% | 4.1 | 0.9% | 1.5% | 98.1% |
| Centreville Penrose CCD | 18.9 | 22.7% | 4.2% | 65.8% | 1.8 | 2.2% | 0.1% | 99.9% | 21.9 | 26.4% | 77.8% | 22.4% | 39.5 | 47.7% | 17.5% | 82.5% | 0.8 | 0.9% | 3.5% | 95.5% |
| Coates CCD | 59.0 | 12.6% | 4.1% | 59.2% | 3.3 | 0.8% | 0.1% | 99.9% | 71.7 | 18.1% | 75.3% | 24.7% | 218.3 | 55.2% | 5.0% | 94.0% | 52.6 | 13.3% | 0.5% | 99.5% |
| Felton CCD | 2.0 | 1.3% | 3.8% | 67.2% | 0.3 | 0.2% | 0.1% | 99.9% | 47.5 | 32.2% | 79.0% | 21.0% | 95.7 | 64.9% | 2.7% | 97.3% | 2.0 | 1.4% | 2.1% | 97.9% |
| Georgetown CCD | 8.4 | 4.6% | 4.7% | 59.8% | 1.5 | 1.3% | 0.1% | 99.9% | 84.2 | 45.8% | 78.1% | 21.9% | 87.6 | 47.6% | 7.4% | 92.6% | 1.3 | 0.7% | 2.4% | 97.6% |
| Greater Newark CCD | 35.3 | 45.5% | 6.3% | 57.3% | 1.3 | 1.7% | 0.2% | 99.8% | 16.8 | 21.6% | 81.3% | 18.7% | 24.0 | 30.9% | 21.1% | 78.9% | 0.3 | 0.3% | 6.7% | 93.3% |
| Harrington CCD | 6.6 | 2.5% | 3.0% | 65.8% | 0.9 | 0.3% | 0.0% | 100.0% | 86.3 | 32.6% | 76.2% | 23.8% | 168.3 | 63.6% | 1.2% | 98.8% | 2.4 | 0.9% | 1.6% | 98.4% |
| Kenton CCD | 2.2 | 1.8% | 4.8% | 79.2% | 0.3 | 0.2% | 0.0% | 100.0% | 32.0 | 26.7% | 76.1% | 23.9% | 88.4 | 71.1% | 8.1% | 91.9% | 1.5 | 1.2% | 1.3% | 98.7% |
| Lafayette-Delmar CCD | 12.0 | 2.5% | 4.3% | 66.8% | 5.3 | 1.1% | 0.1% | 99.9% | 161.7 | 34.2% | 74.5% | 25.5% | 291.3 | 61.5% | 2.2% | 97.8% | 3.0 | 0.6% | 3.6% | 96.4% |
| Lewes CCD | 29.5 | 14.9% | 5.4% | 60.1% | 10.6 | 5.3% | 0.5% | 99.5% | 37.6 | 19.1% | 70.3% | 29.7% | 86.5 | 43.8% | 9.8% | 90.2% | 33.2 | 16.8% | 1.0% | 99.0% |
| Lower Christiana CCD | 21.7 | 71.7% | 4.3% | 54.9% | 0.3 | 1.1% | 0.2% | 99.8% | 2.6 | 8.7% | 72.9% | 27.1% | 4.9 | 16.1% | 37.5% | 62.5% | 0.7 | 2.4% | 2.0% | 98.0% |
| Middletown-Odessa CCD | 15.6 | 3.2% | 4.0% | 66.8% | 2.8 | 0.6% | 0.1% | 99.9% | 83.2 | 17.2% | 75.0% | 25.0% | 344.1 | 71.2% | 7.1% | 92.9% | 37.8 | 7.8% | 1.0% | 99.0% |
| Milford North CCD | 8.2 | 4.1% | 3.5% | 62.4% | 2.7 | 1.3% | 0.3% | 99.7% | 31.1 | 15.6% | 74.1% | 25.9% | 124.7 | 62.8% | 9.1% | 90.9% | 32.0 | 16.1% | 0.6% | 99.4% |
| Milford South CCD | 11.5 | 3.5% | 4.0% | 68.2% | 5.5 | 1.7% | 0.1% | 99.9% | 85.9 | 26.0% | 73.7% | 26.3% | 205.6 | 62.3% | 7.7% | 92.3% | 21.2 | 6.4% | 0.8% | 99.2% |
| Millsboro CCD | 17.0 | 7.1% | 4.8% | 63.7% | 4.8 | 2.0% | 0.1% | 99.9% | 78.1 | 32.1% | 70.9% | 29.1% | 132.0 | 55.6% | 2.8% | 97.2% | 7.4 | 3.1% | 2.3% | 97.7% |
| Milton CCD | 7.1 | 4.3% | 4.5% | 69.2% | 1.6 | 1.0% | 0.3% | 99.7% | 51.8 | 31.6% | 72.0% | 28.0% | 101.9 | 62.2% | 3.7% | 96.3% | 1.5 | 0.9% | 4.0% | 96.0% |
| New Castle CCD | 51.4 | 63.0% | 2.8% | 56.9% | 2.7 | 2.8% | 0.0% | 100.0% | 6.0 | 6.2% | 65.1% | 34.9% | 33.9 | 35.0% | 14.6% | 85.4% | 2.9 | 3.0% | 2.0% | 98.5% |
| Piedmont CCD | 21.5 | 21.1% | 12.2% | 71.5% | 3.8 | 3.7% | 0.7% | 99.3% | 33.8 | 33.1% | 83.3% | 16.7% | 42.3 | 41.5% | 3.3% | 96.7% | 0.6 | 0.6% | 14.5% | 85.0% |
| Pike Creek-Central Kirkwood CCD | 22.4 | 99.9% | 6.1% | 65.4% | 0.6 | 1.6% | 0.3% | 99.7% | 6.0 | 16.0% | 78.1% | 21.9% | 8.3 | 22.1% | 11.9% | 88.1% | 0.2 | 0.4% | 7.6% | 92.4% |
| Red Lion CCD | 11.2 | 21.3% | 4.0% | 59.0% | 2.0 | 3.9% | 0.1% | 99.9% | 4.5 | 8.6% | 64.1% | 35.9% | 32.8 | 62.7% | 11.0% | 89.0% | 1.8 | 3.5% | 1.9% | 98.1% |
| Seaford CCD | 16.9 | 9.9% | 4.9% | 61.8% | 2.9 | 1.0% | 0.1% | 99.9% | 70.1 | 29.8% | 71.5% | 28.5% | 151.1 | 69.1% | 3.0% | 97.0% | 2.8 | 1.2% | 2.6% | 97.4% |
| Seaford-Frankford CCD | 31.6 | 9.7% | 5.0% | 62.4% | 6.0 | 1.8% | 0.1% | 99.9% | 80.4 | 27.7% | 69.8% | 30.4% | 179.1 | 54.9% | 13.3% | 86.1% | 19.2 | 5.9% | 1.6% | 98.4% |
| Smyma CCD | 7.6 | 4.3% | 4.1% | 63.8% | 0.9 | 0.5% | 0.0% | 100.0% | 12.5 | 7.0% | 69.5% | 30.5% | 103.6 | 58.1% | 5.9% | 94.1% | 53.8 | 30.2% | 0.4% | 99.6% |
| Upper Christiana CCD | 16.2 | 53.0% | 3.9% | 56.7% | 0.9 | 2.9% | 0.3% | 99.7% | 3.5 | 11.5% | 69.3% | 30.7% | 9.1 | 29.9% | 30.7% | 89.3% | 0.9 | 2.8% | 1.5% | 98.5% |
| Wilmington CCD | 24.8 | 85.2% | 4.0% | 40.8% | 0.5 | 1.8% | 0.6% | 99.4% | 0.4 | 1.5% | 60.1% | 39.9% | 2.4 | 8.3% | 25.5% | 74.5% | 0.9 | 3.2% | 2.7% | 97.3% |

¹ Developed is NLCD 2001 classes 21 (Developed-Open Space), 22 (Developed-Low Intensity), 23 (Developed-Medium Intensity), and 24 (Developed-High Intensity) (USGS, 2007).

² Barren is NLCD 2001 class 31 (Barren Land (Rock/Sand/Clay)) (USGS, 2007).

³ Forested is NLCD 2001 classes 41 (Deciduous Forest), 42 (Evergreen Forest), and 43 (Mixed Forest) (USGS, 2007).

⁴ Shrub/Scrub is NLCD 2001 class 52 (Shrub/Scrub) (USGS, 2007).

⁵ Grassland is NLCD 2001 class 71 (Grassland/Herbaceous) (USGS, 2007).

⁶ Agriculture is NLCD 2001 classes 81 (Pasture/Hay), and 82 (Cultivated Crops) (USGS, 2007).

⁷ Wetland is NLCD 2001 classes 90 (Woody Wetlands), and 95 (Emergent Herbaceous Wetlands) (USGS, 2007).

⁸ Available Growing Space (AGS) is Potential Growing Space-Tree Canopy Cover (if the calculated value is less than 0, then value set at 0).

Table 10. Land area, tree canopy cover, and available growing space distributed within generalized land cover categories for counties and state.

| Name | Developed ¹ | | | | Barren ² | | | | Forested ³ | | | | Agricultural ⁴ | | | | Wetland ⁵ | | | |
|------------------------|---------------------------|-------------|--------|--------------------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|-------|---------------------------|-------------|--------|-------|
| | Land Area Km ² | Land Area % | Tree % | AGS % ⁶ | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % | Land Area Km ² | Land Area % | Tree % | AGS % |
| Kent County | 83.1 | 5.5% | 4.1% | 62.2% | 8.9 | 0.6% | 0.1% | 99.9% | 344.8 | 22.6% | 76.3% | 23.7% | 937.9 | 61.6% | 5.1% | 94.9% | 148.3 | 9.7% | 0.6% | 99.4% |
| New Castle County | 290.1 | 26.3% | 6.4% | 58.3% | 17.8 | 1.6% | 0.3% | 99.7% | 194.6 | 17.6% | 76.8% | 23.2% | 553.9 | 50.2% | 9.9% | 90.1% | 47.4 | 4.3% | 1.5% | 98.5% |
| Subsex County | 140.8 | 5.8% | 4.7% | 63.3% | 40.6 | 1.7% | 0.2% | 99.8% | 742.2 | 30.5% | 73.0% | 27.0% | 1,417.6 | 58.3% | 5.5% | 94.5% | 91.4 | 3.8% | 1.4% | 98.6% |
| Statewide for Delaware | 514.0 | 10.2% | 5.6% | 60.3% | 67.3 | 1.3% | 0.2% | 99.8% | 1,281.7 | 25.3% | 74.5% | 25.6% | 2,809.4 | 57.5% | 6.2% | 93.8% | 287.2 | 5.7% | 1.0% | 99.0% |

¹ Developed is NLCD 2001 classes 21 (Developed-Open Space), 22 (Developed-Low Intensity), 23 (Developed-Medium Intensity), and 24 (Developed-High Intensity) (USGS, 2007).

² Barren is NLCD 2001 class 31 (Barren Land (Rock/Sand/Clay)) (USGS, 2007).

³ Forested is NLCD 2001 classes 41 (Deciduous Forest), 42 (Evergreen Forest), and 43 (Mixed Forest) (USGS, 2007).

⁴ Shrub/Scrub is NLCD 2001 class 52 (Shrub/Scrub) (USGS, 2007).

⁵ Grassland is NLCD 2001 class 71 (Grassland/Herbaceous) (USGS, 2007).

⁶ Agriculture is NLCD 2001 classes 81 (Pasture/Hay), and 82 (Cultivated Crops) (USGS, 2007).

⁷ Wetland is NLCD 2001 classes 90 (Woody Wetlands), and 95 (Emergent Herbaceous Wetlands) (USGS, 2007).

⁸ Available Growing Space (AGS) is Potential Growing Space-Tree Canopy Cover (if the calculated value is less than 0, then value set at 0).

Grading (Figures 10-13)

A question commonly asked in assessing the urban and community forest resource is: “How does my jurisdiction compare with other local governments?” To help answer this question, each local governmental unit was compared with similar units within the same ecological region. To determine comparable local government units, each unit was assigned into one of seven population density classes located within the same NLCD 2001 mapping or “ecological” zones (USGS, 2007).

The following population density classes were established:

- 0 to 100 people per square mile (population density class 1),
- 100 to 250 people per square mile (population density class 2),
- 250 to 500 people per square mile (population density class 3),
- 500 to 750 people per square mile (population density class 4),
- 750 to 1000 people per square mile (population density class 5),
- 1000 to 5000 people per square mile (population density class 6), and
- 5000 or greater people per square mile (population density class 7).

To locate geopolitical units within an ecological zone centroid (geometric center) points of the local governments were used (Figure 10).

NLCD 2001 National Land Cover by State and Mapping or "Ecological" Zone

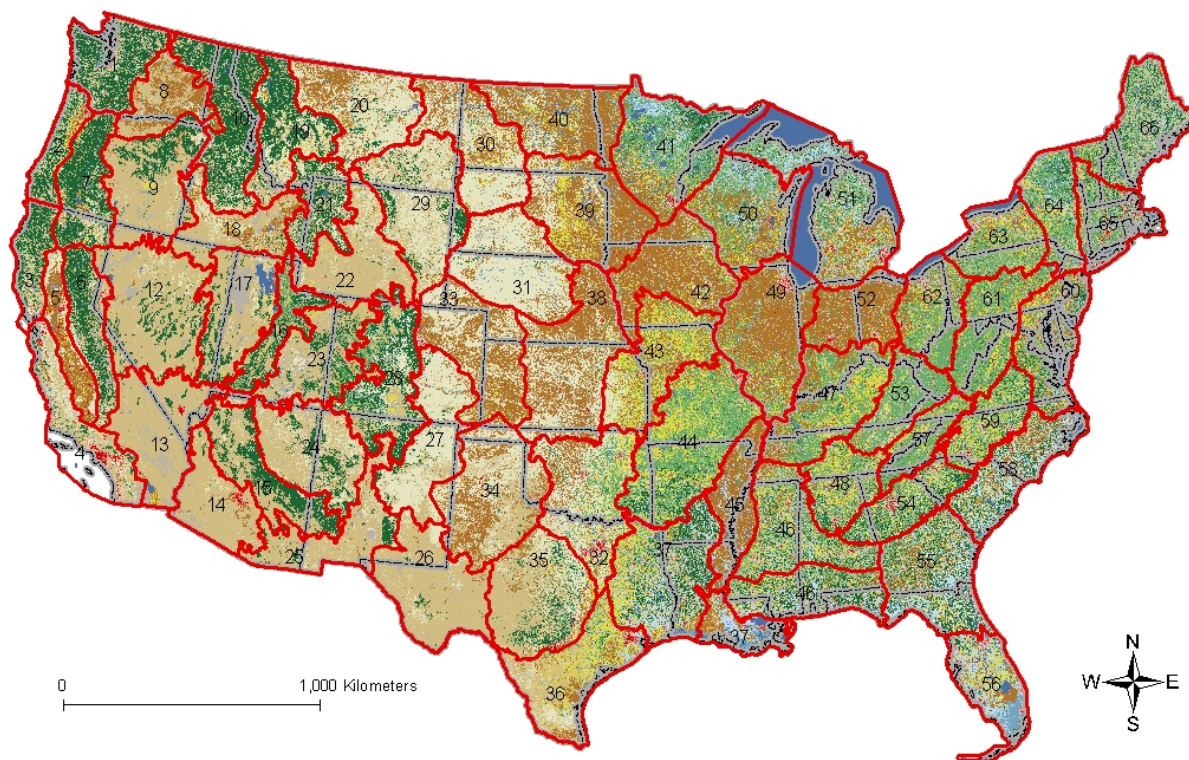


Figure 10. The mapping or "ecological" zones of the continental United States relative to states and land cover.

Local government units within the same mapping (ecological) zone and population density class were then assigned a letter grade (A+ to F) for the following variables:

- Percent tree canopy cover
- Percent impervious surface cover
- Percent tree canopy stocking
- Environment: the sum of standardized tree and pervious cover (100-impervious cover) score.

Each unit was assigned a letter grade within each category based on their rank among comparable units in the category:

- A+ = top 5% of units in the category
- A = top 5.1 -15%
- A- = 15.1 – 20%
- B+ = 20.1 – 25%

- B = 25.1 – 35%
- B- = 35.1 – 40%
- C+ = 40.1 – 45%
- C = 45.1 – 55%
- C- = 55.1 – 60%
- D+ = 60.1 – 65%
- D = 65.1 – 75%
- D- = 75.1 – 80%
- F = 80.1 – 100%

Local government units with the highest tree cover were given the highest letter grade for the percent tree cover category. Local governments with the lowest impervious surface cover were given the highest letter grade for the percent impervious surface cover category. The environment grade is an indicator that equally weights tree canopy and impervious surface cover. This grade was designed to rate the relative overall environment based on tree and impervious cover with the assumption that the higher the percent tree cover and lower percent impervious cover would lead to a higher environment letter grade.

The canopy stocking grade compares how well the potential growing space is filled with trees. This grade gives an indication of the success of management efforts in conjunction with land use restrictions, in terms of filling potential pervious land with trees. If a local government has land use restrictions to filling growing space with trees (e.g., most of the potential growing space is in agricultural lands or athletic fields), then even a good tree enhancement program would grade poorly in stocking due to the land use restrictions. However, if a local government has no real land use restrictions to filling growing space, then a poor stocking grade could be an indication of a preference for non-treed open space, a large disturbance (storm damage or pest infestation), poor planning, or poor management efforts to enhance urban canopy cover in a community. To help understand reasons for various stocking grades, tree cover and available growing space data by land cover type (Tables 8-10) should be referenced. These tables can also be used to determine the amount of growing space available to increase tree canopy cover within communities, by land cover type, to help set reasonable and attainable tree canopy goals.

Table 14 summarizes the minimum, median, and maximum values for percent tree canopy cover, percent impervious surface cover, and percent tree canopy stocking for each of the seven population density classes of each political subdivision within the ecological zones found within the state. This information can be used to understand the actual range and values used for the grades.

The relatively low grades in Delaware are likely due to the fairly large amounts of agricultural land found within the jurisdictional boundaries.

Tree Canopy Cover Grades (Top 5)

- Communities (Table 11; Figure 11)
 1. Arden village, A+
 2. Ardencroft village, A+
 3. Ardentown village, A+
 4. Henlopen Acres town, B+
 5. Greenville CDP, B

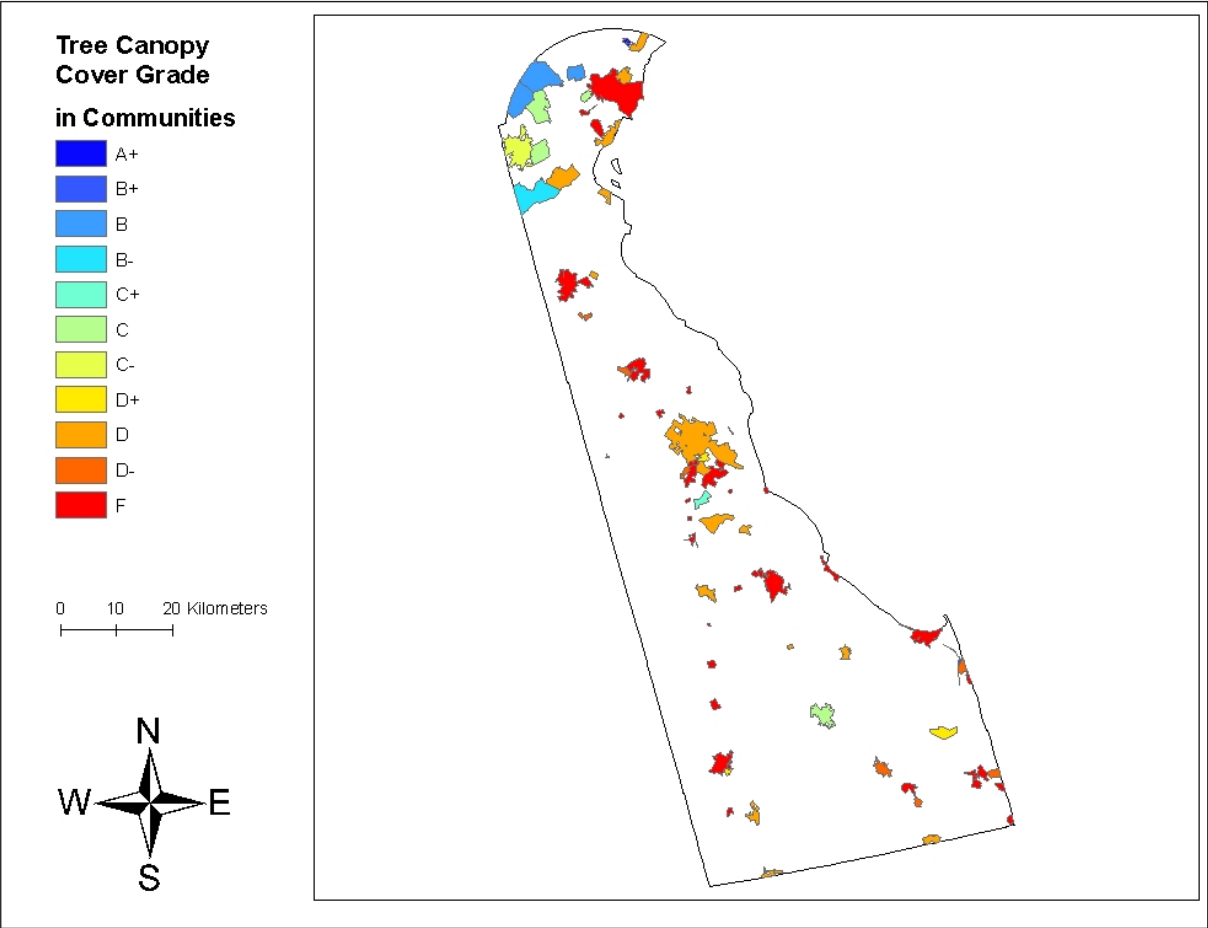


Figure 11. Tree canopy cover grades within communities.

Table 11. Tree canopy cover, impervious surface cover, environment (tree canopy and impervious surface cover), and stocking grades for communities.

| Name | Mapping Zone | Population Density Class ¹ | Grading ² | | | |
|------------------------|--------------|---------------------------------------|----------------------|--------------------------|-------------|----------|
| | | | Tree Canopy Cover | Impervious Surface Cover | Environment | Stocking |
| Arden village | 60 | 6 | A+ | A+ | A+ | A+ |
| Ardencroft village | 60 | 6 | A+ | A | A+ | A+ |
| Ardentown village | 60 | 6 | A+ | A | A+ | A+ |
| Bear CDP | 60 | 6 | D | C+ | C | D |
| Bellefonte town | 60 | 7 | D | B- | C | D- |
| Bethany Beach town | 60 | 5 | D- | F | F | D+ |
| Bethel town | 60 | 3 | F | C+ | F | F |
| Blades town | 60 | 6 | D+ | C | C | D+ |
| Bowers town | 60 | 6 | F | B | D | F |
| Bridgeville town | 60 | 6 | F | D+ | F | F |
| Brookside CDP | 60 | 6 | C | D | D+ | C |
| Camden town | 60 | 6 | F | B+ | D+ | F |
| Cheswold town | 60 | 4 | F | F | F | F |
| Claymont CDP | 60 | 6 | D | F | F | D |
| Clayton town | 60 | 6 | D- | B- | D+ | D- |
| Dagsboro town | 60 | 3 | F | F | F | F |
| Delaware City city | 60 | 6 | D | A | B- | D |
| Delmar town | 60 | 6 | D | C+ | C | D |
| Dewey Beach town | 60 | 5 | F | F | F | F |
| Dover Base Housing CDP | 60 | 7 | F | A+ | B | F |
| Dover city | 60 | 6 | D | D+ | D | D |
| Edgemoor CDP | 60 | 6 | D | F | F | C- |
| Ellendale town | 60 | 6 | D | A- | C+ | D |
| Elsmere town | 60 | 7 | C | C- | C- | C |
| Farmington town | 60 | 6 | F | A | D | F |
| Felton town | 60 | 6 | F | B+ | D | F |
| Ferwick Island town | 60 | 5 | F | F | F | F |
| Frankford town | 60 | 6 | D- | A- | C | F |
| Frederica town | 60 | 5 | D | A- | D+ | D- |
| Georgetown town | 60 | 6 | C | C+ | C | C- |
| Glasgow CDP | 60 | 6 | B- | A- | B+ | C+ |
| Greenville CDP | 60 | 5 | B | A- | B | B- |
| Greenwood town | 60 | 6 | F | C+ | D | F |
| Harrington city | 60 | 6 | D | C | D+ | D |
| Hartly town | 60 | 6 | F | C+ | D | F |
| Henlopen Acres town | 60 | 4 | B+ | D- | B | B+ |
| Highland Acres CDP | 60 | 6 | D | B | C | D |
| Hockessin CDP | 60 | 6 | B | A | A | B- |
| Houston town | 60 | 6 | F | A | D | F |
| Kent Acres CDP | 60 | 6 | D+ | B+ | C+ | D |
| Kenton town | 60 | 6 | F | A | D | F |
| Laurel town | 60 | 6 | D | C | D | D- |
| Leipsic town | 60 | 4 | F | D | F | F |
| Lewes city | 60 | 5 | F | F | F | F |
| Little Creek town | 60 | 6 | F | C- | F | F |
| Long Neck CDP | 60 | 4 | D+ | F | D | C |
| Magnolia town | 60 | 6 | F | A | D | F |
| Middletown town | 60 | 5 | F | C+ | F | F |
| Milford city | 60 | 6 | F | C | D | F |
| Millsboro town | 60 | 6 | D- | C | D | D- |
| Millville town | 60 | 4 | F | F | F | F |
| Milton town | 60 | 6 | D | C+ | D+ | D- |
| New Castle city | 60 | 6 | D | C- | D+ | D |
| Newark city | 60 | 6 | C- | D- | D | C |
| Newport town | 60 | 6 | F | F | F | F |
| North Star CDP | 60 | 6 | B | A+ | A | C+ |
| Ocean View town | 60 | 3 | F | F | F | F |
| Odessa town | 60 | 4 | D | D | D- | D |
| Pike Creek CDP | 60 | 6 | C | B | B | C |
| Rehoboth Beach city | 60 | 6 | D- | F | F | D |
| Rising Sun-Lebanon CDP | 60 | 4 | F | A | F | F |
| Riverview CDP | 60 | 3 | D | A+ | D+ | D |
| Rodney Village CDP | 60 | 6 | F | C | D- | F |
| Seaford city | 60 | 6 | F | D- | F | F |
| Selbyville town | 60 | 6 | D | C+ | C- | D |
| Slaughter Beach town | 60 | 2 | F | F | F | F |
| Smyrna town | 60 | 6 | F | B+ | D | F |
| South Bethany town | 60 | 5 | F | F | F | F |
| Townsend town | 60 | 4 | D- | C | D- | D- |
| Viola town | 60 | 5 | F | A+ | D | F |
| Wilmington city | 60 | 7 | F | F | F | D- |
| Wilmington Manor CDP | 60 | 7 | F | C- | D- | F |
| Woodside East CDP | 60 | 6 | C+ | A+ | A- | C- |
| Woodside town | 60 | 6 | F | B+ | D | F |
| Wyoming town | 60 | 6 | D- | B- | D+ | D- |

¹ Population Density Classes are as follows: 1. 0 to100 people per square mile; 2. 100 to 250 people per square mile; 3. 250 to 500 people per square mile;

4. 500 to 750 people per square mile; 5. 750 to 1,000 people per square mile; 6. 1,000 to 5,000 people per square mile; and 7. 5,000 or greater people per square mile.

² If there are two or fewer units within a population density class, then no grade was assigned. The number of units within geography class is noted in Table 14.

- County Subdivisions (Table 12)
 1. Central Pencader CCD, B
 2. Brandywine CCD, B-
 3. Greater Newark CCD, B-
 4. Georgetown CCD, B-
 5. Piedmont, CCD, C+

Table 12. Tree canopy cover, impervious surface cover, environment (tree canopy and impervious surface cover), and stocking grades for county subdivisions.

| Name | Mapping Zone | Population Density Class ^A | Grading ^B | | | |
|---------------------------------|--------------|---------------------------------------|----------------------|--------------------------|-------------|----------|
| | | | Tree Canopy Cover | Impervious Surface Cover | Environment | Stocking |
| Brandywine CCD | 60 | 6 | B- | C | C+ | C+ |
| Bridgeville-Greenwood CCD | 60 | 1 | D- | F | D- | D- |
| Central Kent CCD | 60 | 2 | D+ | B | D+ | D+ |
| Central Pencader CCD | 60 | 6 | B | A | A- | C+ |
| Dover CCD | 60 | 3 | F | F | F | F |
| Felton CCD | 60 | 1 | D | D | D | D |
| Georgetown CCD | 60 | 2 | B- | F | B- | B- |
| Greater Newark CCD | 60 | 6 | B- | C+ | B | B- |
| Harrington CCD | 60 | 2 | D+ | B- | D+ | D+ |
| Kenton CCD | 60 | 2 | D+ | A | D+ | D+ |
| Laurel-Delmar CCD | 60 | 2 | D+ | B- | C- | D+ |
| Lewes CCD | 60 | 3 | F | F | F | F |
| Lower Christiana CCD | 60 | 6 | D | F | D- | D |
| Middletown-Odessa CCD | 60 | 2 | D- | C | D- | D- |
| Milford North CCD | 60 | 2 | F | D | D- | F |
| Milford South CCD | 60 | 2 | D | C | D | D |
| Millsboro CCD | 60 | 2 | D | F | D | D |
| Milton CCD | 60 | 2 | D+ | D+ | D+ | D+ |
| New Castle CCD | 60 | 6 | D- | C- | D | D- |
| Piedmont CCD | 60 | 4 | C+ | A- | C+ | C+ |
| Pike Creek-Central Kirkwood CCD | 60 | 6 | C- | C+ | C | D |
| Red Lion CCD | 60 | 3 | F | F | F | F |
| Seaford CCD | 60 | 2 | D | F | D | D |
| Selbyville-Frankford CCD | 60 | 2 | C- | F | D+ | C- |
| Smyrna CCD | 60 | 2 | F | D | F | F |
| Upper Christiana CCD | 60 | 6 | C- | C- | C- | C- |
| Wilmington CCD | 60 | 7 | D- | D- | F | D |

^A. Population Density Classes are as follows: 1. 0 to100 people per square mile; 2. 100 to 250 people per square mile; 3. 250 to 500 people per square mile;

4. 500 to 750 people per square mile; 5. 750 to 1,000 people per square mile; 6. 1,000 to 5,000 people per square mile; and 7. 5,000 or greater people per square mile.

^B. If there are two or fewer units within a population density class, then no grade was assigned. The number of units within geography class is noted in Table 14.

- Counties (Table 13)
 1. Sussex County, D
 2. New Castle County, F
 3. Kent County, F

Table 13. Tree canopy cover, impervious surface cover, environment (tree canopy and impervious surface cover), and stocking grades for counties.

| Name | Mapping Zone | Population Density Class ^A | Grading ^B | | | |
|-------------------|--------------|---------------------------------------|----------------------|--------------------------|-------------|----------|
| | | | Tree Canopy Cover | Impervious Surface Cover | Environment | Stocking |
| Kent County | 60 | 2 | F | D | F | F |
| New Castle County | 60 | 6 | F | A- | C | F |
| Sussex County | 60 | 2 | D | F | D | D |

^A. Population Density Classes are as follows: 1. 0 to100 people per square mile; 2. 100 to 250 people per square mile; 3. 250 to 500 people per square mile;

4. 500 to 750 people per square mile; 5. 750 to 1,000 people per square mile; 6. 1,000 to 5,000 people per square mile; and 7. 5,000 or greater people per square mile.

^B. If there are two or fewer units within a population density class, then no grade was assigned. The number of units within geography class is noted in Table 14.

Impervious Surface Cover Grades (Top 5)

- Communities (Table 11; Figure 12)
 1. Arden village, A+
 2. North Star CDP, A+
 3. Woodside East CDP, A+
 4. Riverview CDP, A+
 5. Dover Base Housing CDP, A+

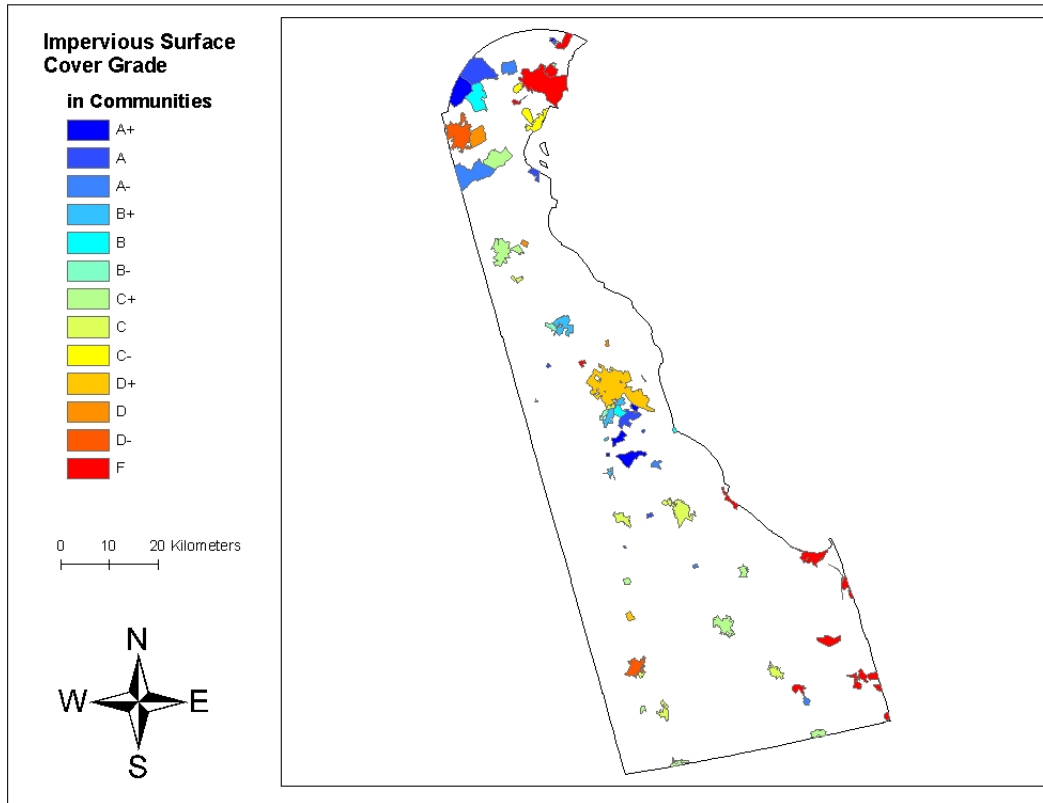


Figure 12. Impervious surface cover grades within communities.

- County Subdivisions (Table 12)
 1. Central Pencader CCD, A
 2. Kenton CCD, A
 3. Piedmont, A-
 4. Central Kent CCD, B
 5. Harrington, B-
- Counties (Table 13)
 1. New Castle County, A-
 2. Kent County, D
 3. Sussex County, F

Urban Environment Grades (Top 5)

- Communities (Table 11: Figure 13)
 1. Arden village, A+
 2. Ardentown village, A+
 3. Ardencroft village, A+
 4. Hockessin CDP, A
 5. North Star CDP, A

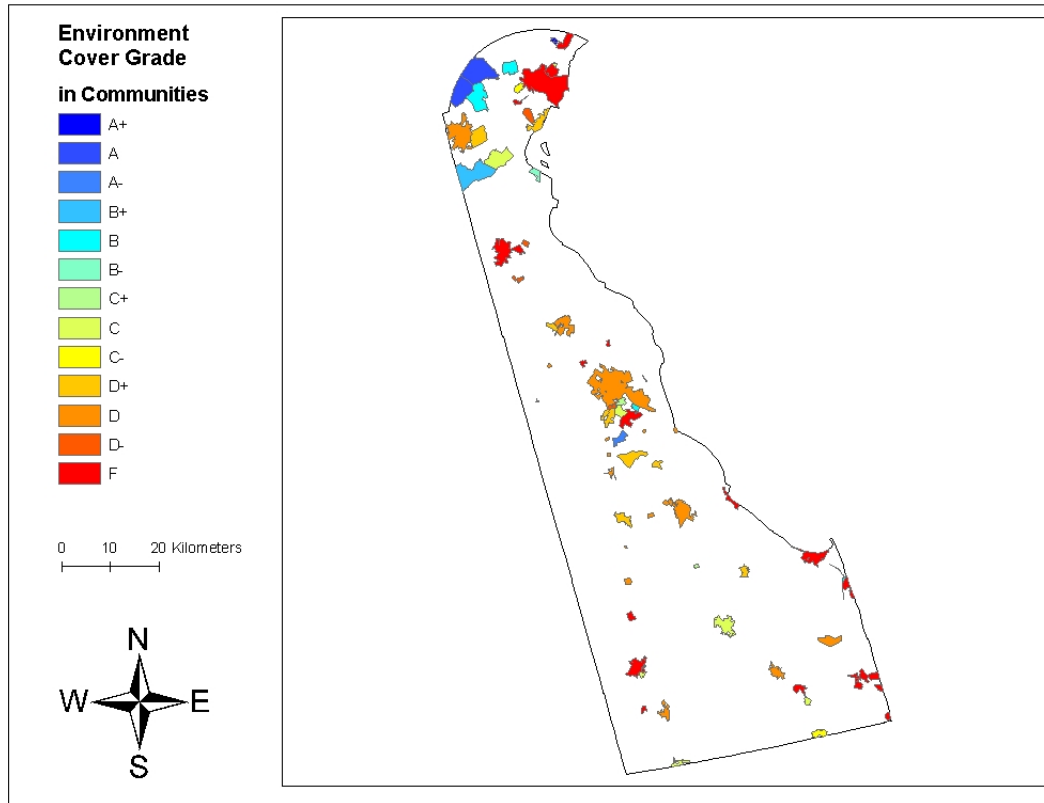


Figure 13. Environment grades (combined tree canopy cover and impervious surface cover grades) within communities.

- County Subdivisions (Table 12)
 1. Central Pencader CCD, A-
 2. Greater Newark CCD, B
 3. Georgetown CCD, B-
 4. Piedmont CCD, C+
 5. Brandywine CCD, C+
- Counties (Table 13)
 1. New Castle County, C
 2. Sussex County, D
 3. Kent County, F

Tree Canopy Stocking Grades (Top 5)

- Communities (Table 11; Figure 14)
 1. Arden village, A+
 2. Ardencroft village, A+
 3. Ardentown village, A+
 4. Henlopen Acres town, B+
 5. Hockessin CDP, D

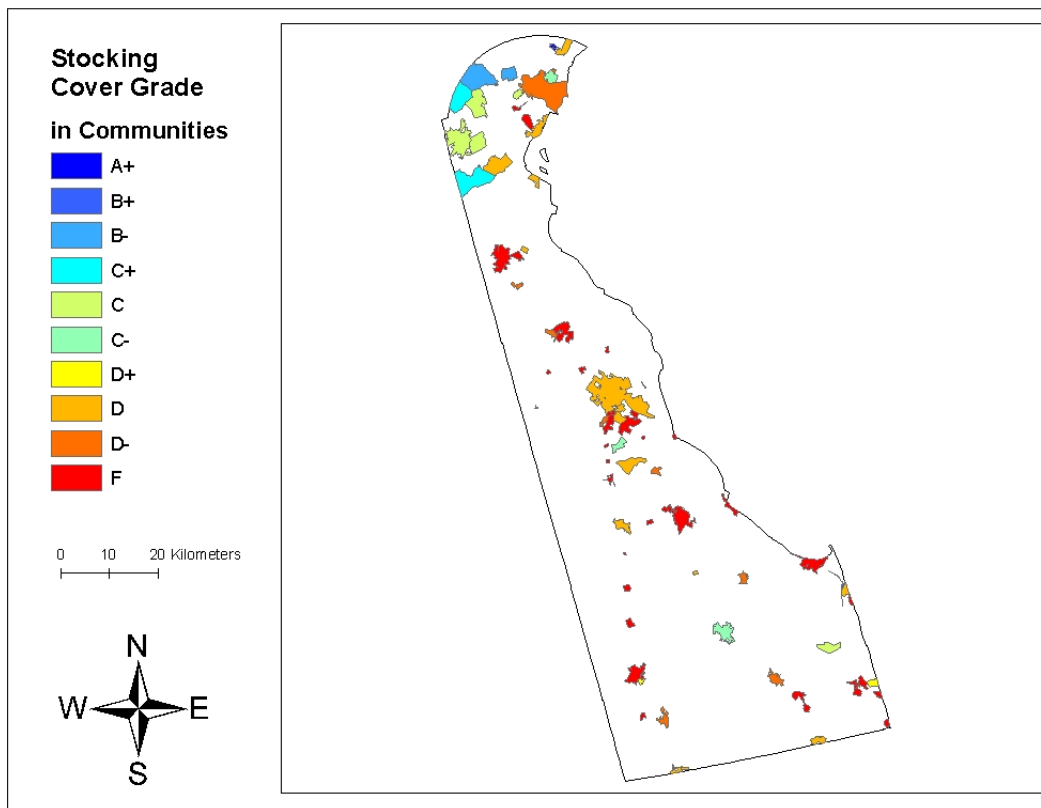


Figure 14. Tree cover stocking grades within communities.

- County Subdivisions (Table 12)
 1. Greater Newark CCD, B-
 2. Georgetown CCD, B-
 3. Central Pencader CCD, C+
 4. Piedmont CCD, C+
 5. Brandywine CCD, C+
- Counties (Table 13)
 1. Sussex County, D
 2. New Castle County, F
 3. Kent County, F

Table 14. Statistical summary of mapping or “ecological” zone values used to calculate grading.

| Mapping Zone | Geography | Population Density Class ^A | Geographic Units ^B | Tree Canopy Cover | | | Impervious Surface Cover | | | Stocking | | |
|--------------|--------------------|---------------------------------------|-------------------------------|-------------------|---------|--------|--------------------------|---------|--------|----------|---------|--------|
| | | | | Maximum | Minimum | Median | Maximum | Minimum | Median | Maximum | Minimum | Median |
| 60 | Community | 1 | 18 | 64.4% | 1.4% | 34.5% | 9.7% | 0.1% | 0.5% | 69.3% | 1.4% | 34.7% |
| | | 2 | 23 | 56.0% | 3.4% | 38.8% | 4.6% | 0.3% | 1.3% | 57.2% | 3.6% | 39.0% |
| | | 3 | 80 | 76.1% | 0.5% | 30.3% | 20.2% | 0.1% | 3.1% | 76.9% | 0.6% | 31.9% |
| | | 4 | 67 | 61.6% | 0.0% | 24.2% | 47.3% | 0.1% | 5.6% | 63.5% | 0.1% | 26.5% |
| | | 5 | 71 | 66.0% | 0.0% | 24.6% | 54.4% | 0.4% | 8.3% | 67.4% | 0.0% | 26.9% |
| | | 6 | 766 | 81.8% | 0.0% | 20.2% | 79.8% | 1.1% | 17.3% | 83.6% | 0.0% | 26.4% |
| | | 7 | 186 | 42.6% | 0.3% | 13.0% | 73.7% | 11.4% | 36.2% | 59.0% | 0.7% | 20.9% |
| | County Subdivision | 1 | 234 | 66.8% | 0.5% | 41.2% | 7.1% | 0.0% | 0.3% | 69.3% | 0.5% | 41.3% |
| | | 2 | 230 | 72.3% | 0.5% | 31.7% | 6.9% | 0.1% | 0.9% | 72.5% | 0.6% | 32.2% |
| | | 3 | 147 | 64.5% | 0.8% | 32.0% | 10.7% | 0.1% | 2.9% | 66.0% | 0.9% | 33.1% |
| | | 4 | 73 | 64.4% | 0.0% | 29.2% | 47.3% | 1.5% | 5.1% | 66.8% | 0.1% | 30.9% |
| | | 5 | 64 | 64.1% | 0.6% | 32.8% | 48.9% | 1.8% | 7.6% | 66.4% | 1.0% | 36.0% |
| | | 6 | 439 | 81.8% | 0.0% | 22.3% | 79.8% | 2.0% | 19.1% | 83.6% | 0.0% | 28.2% |
| | | 7 | 121 | 42.6% | 0.3% | 11.8% | 73.7% | 17.1% | 38.9% | 59.0% | 0.7% | 19.3% |
| | County | 1 | 36 | 61.5% | 15.7% | 49.5% | 1.5% | 0.1% | 0.4% | 61.7% | 15.8% | 49.7% |
| | | 2 | 16 | 56.4% | 18.3% | 31.6% | 2.0% | 0.4% | 1.4% | 57.2% | 18.6% | 32.1% |
| | | 3 | 14 | 55.1% | 16.0% | 35.9% | 6.9% | 1.0% | 2.5% | 56.3% | 16.8% | 37.1% |
| | | 4 | 5 | 52.7% | 14.0% | 41.3% | 5.1% | 3.5% | 4.4% | 55.1% | 14.7% | 43.2% |
| | | 5 | 8 | 45.6% | 27.7% | 32.8% | 12.0% | 5.7% | 8.1% | 50.4% | 29.4% | 36.6% |
| | | 6 | 27 | 44.1% | 8.1% | 27.7% | 33.7% | 7.9% | 15.9% | 49.6% | 12.2% | 34.7% |
| | | 7 | 8 | 30.3% | 10.7% | 17.4% | 51.0% | 26.9% | 38.4% | 44.1% | 21.7% | 27.7% |

^A Population Density Classes are as follows: 1. 0 to 100 people per square mile; 2. 100 to 250 people per square mile; 3. 250 to 500 people per square mile; 4. 500 to 750 people per square mile; 5. 750 to 1,000 people per square mile; 6. 1,000 to 5,000 people per square mile; and 7. 5,000 or greater people per square mile.
^B Number of units within the geography class analyzed. If there are two or fewer units within a population density class, then no grade was assigned.

Priority Planting Areas

To determine the best locations to plant trees, tree canopy and impervious cover data from NLCD 2001 were used in conjunction with 2000 U.S. Census data to produce an index of priority planting areas. Index values were produced for several geographic units (e.g., community, county) with the higher the index value, the higher the priority of the area for tree planting / establishment. This index is a type of “environmental equity” index with areas of higher human population density and lower tree stocking and trees per capita tending to get the higher index value. The criteria used to make the index were:

- Population density: the greater the population density, the greater the priority for tree planting
- Tree stocking levels: the lower the tree stocking level (the percent of total potential growing space - tree, grass, and soil cover areas - that is occupied by tree canopies), the greater the priority for tree planting
- Tree cover per capita: the lower the amount of tree canopy cover per person (m²/capita), the greater the priority for tree planting

Each criteria was standardized¹ on a scale of 0 to 100 with 100 representing the jurisdictional unit with the highest value in relation to priority of tree planting (i.e., the unit

¹ Standardized value for population density was calculated as $PD = (n - m) / r$, where PD is the value (0-100), n is the value for the geopolitical unit (population / km²), m is the minimum value for all units, and r is the range of values among all units (maximum value – minimum value). Standardized value for tree stocking was calculated as $TS = (1 -$

with highest population density, lowest stocking density or lowest tree cover per capita were standardized to a rating of 100). Individual scores were combined and standardized based on the following formula to produce an overall priority index value between 0 and 100:

$$I = (PD * 40) + (TS * 30) + (TPC * 30)$$

Where I = index value, PD is standardized population density, TS is standardized tree stocking, and TPC is standardized tree cover per capita. The planting priority index (PPI) ranks communities, county subdivisions, and counties of the state with values from 100 (highest) to 0 (lowest) priority.

Communities (Table 15; Figure 15)

- Highest Priority: Bellefonte town
- Lowest Priority: Henlopen Acres town

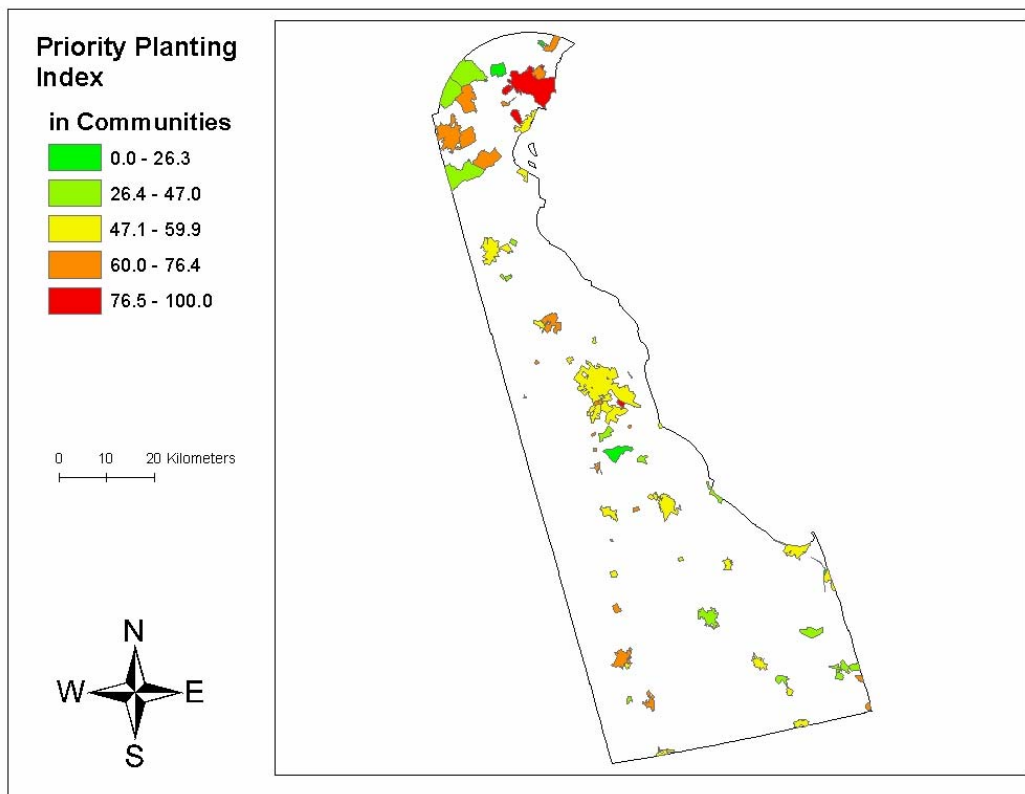


Figure 15. Priority Planting Index for communities. The higher the index value, the greater priority for planting.

($T/TPGS$)), where TS is the value (0-100), T is percent tree cover, and TPGS is percent total potential growing space. Standardized value for tree cover per capita was calculated as $TPC = 1 - [(n - m) / r]$, where TPC is the value (0-100), n is the value for the geopolitical unit ($m^2/capita$), m is the minimum value for all units, and r is the range of values among all units (maximum value – minimum value).

Table 15. Priority planting index for communities.

| Name | Planting Priority Index |
|------------------------|-------------------------|
| Arden village | 15.3 |
| Ardencroft village | 26.3 |
| Ardentown village | 11.2 |
| Bear CDP | 66.2 |
| Bellefonte town | 100.0 |
| Bethany Beach town | 42.5 |
| Bethel town | 33.5 |
| Blades town | 56.8 |
| Bowers town | 58.1 |
| Bridgeville town | 66.0 |
| Brookside CDP | 67.3 |
| Camden town | 59.5 |
| Cheswold town | 48.2 |
| Claymont CDP | 76.4 |
| Clayton town | 54.8 |
| Dagsboro town | 42.3 |
| Delaware City city | 50.3 |
| Delmar town | 52.4 |
| Dewey Beach town | 59.9 |
| Dover Base Housing CDP | 93.4 |
| Dover city | 53.7 |
| Edgemoor CDP | 64.3 |
| Ellendale town | 51.0 |
| Elsmere town | 86.2 |
| Farmington town | 64.4 |
| Felton town | 62.5 |
| Fenwick Island town | 65.5 |
| Frankford town | 53.8 |
| Frederica town | 45.3 |
| Georgetown town | 42.3 |
| Glasgow CDP | 37.6 |
| Greenville CDP | 16.2 |
| Greenwood town | 59.6 |
| Harrington city | 53.4 |
| Hartly town | 56.7 |
| Henlopen Acres town | 0.0 |
| Highland Acres CDP | 59.1 |
| Hockessin CDP | 33.7 |
| Houston town | 66.0 |
| Kent Acres CDP | 55.4 |
| Kenton town | 67.3 |
| Laurel town | 62.4 |
| Leipsic town | 56.4 |
| Lewes city | 52.0 |
| Little Creek town | 69.1 |
| Long Neck CDP | 31.2 |
| Magnolia town | 65.5 |
| Middletown town | 58.9 |
| Millford city | 56.6 |
| Millsboro town | 54.8 |
| Millville town | 41.7 |
| Milton town | 56.8 |
| New Castle city | 53.0 |
| Newark city | 62.3 |
| Newport town | 70.8 |
| North Star CDP | 34.9 |
| Ocean View town | 47.0 |
| Odessa town | 39.3 |
| Pike Creek CDP | 61.0 |
| Rehoboth Beach city | 52.0 |
| Rising Sun-Lebanon CDP | 53.5 |
| Riverview CDP | 19.6 |
| Rodney Village CDP | 69.9 |
| Seaford city | 66.2 |
| Selbyville town | 51.0 |
| Slaughter Beach town | 43.9 |
| Smyrna town | 63.3 |
| South Bethany town | 61.6 |
| Townsend town | 41.2 |
| Viola town | 62.3 |
| Wilmington city | 98.0 |
| Wilmington Manor CDP | 91.5 |
| Woodside East CDP | 41.3 |
| Woodside town | 62.0 |
| Wyoming town | 58.7 |

County Subdivisions (Table 16)

- Highest Priority: Wilmington
- Lowest Priority: Georgetown

Table 16. Priority planting index for county subdivisions.

| Name | Planting Priority Index |
|---------------------------------|-------------------------|
| Brandywine CCD | 50.4 |
| Bridgeville-Greenwood CCD | 13.3 |
| Central Kent CCD | 28.7 |
| Central Pencader CCD | 38.2 |
| Dover CCD | 47.4 |
| Felton CCD | 7.6 |
| Georgetown CCD | 0.0 |
| Greater Newark CCD | 48.0 |
| Harrington CCD | 12.6 |
| Kenton CCD | 15.9 |
| Laurel-Delmar CCD | 12.7 |
| Lewes CCD | 42.1 |
| Lower Christiana CCD | 65.4 |
| Middletown-Odessa CCD | 37.1 |
| Milford North CCD | 32.9 |
| Milford South CCD | 22.1 |
| Millsboro CCD | 30.1 |
| Milton CCD | 25.4 |
| New Castle CCD | 68.1 |
| Piedmont CCD | 34.3 |
| Pike Creek-Central Kirkwood CCD | 63.2 |
| Red Lion CCD | 49.6 |
| Seaford CCD | 34.5 |
| Selbyville-Frankford CCD | 23.5 |
| Smyrna CCD | 54.9 |
| Upper Christiana CCD | 55.5 |
| Wilmington CCD | 100.0 |

Counties (Table 17)

- Highest Priority: New Castle
- Lowest Priority: Sussex

Table 17. Priority planting index for counties.

| Name | Planting Priority Index |
|-------------------|-------------------------|
| Kent County | 48.1 |
| New Castle County | 100.0 |
| Sussex County | 0.0 |

Urban Tree Benefits

Urban and community forests are important both for human and ecological health. The benefits ascribed to urban and community trees include air pollution removal, surface air temperature reduction, reduced building energy use, absorption of ultraviolet radiation, improved water quality, reduced noise pollution, improved human comfort, increased property value, improved human physiological and psychological well-being, improved aesthetics, and improved community cohesion (Nowak and Dwyer, 2007). To help understand the contribution and magnitude of the tree resource in urban and/or community lands, the total number of trees, carbon storage and annual uptake (sequestration), air pollution removal, and their associated dollar values are estimated for the state.

To estimate these values, average urban forest data from several U.S. communities (Table 18), and state tree cover, pollution, and weather data were used. To estimate the total number of trees in urban and/or community lands, the average number of trees per hectare of tree cover (477 trees/ha) from various city studies was applied to the hectares of tree cover in urban and/or community lands. Similarly, to estimate the amount carbon stored and sequestered by urban trees, the average carbon storage (9.1 kgC/m²) and sequestration values (0.3 kgC/m²) were applied to the amount of cover in the area (Table 18). To estimate monetary values associated with urban tree carbon storage and sequestration, carbon values were multiplied by \$22.8/tC based on the estimated marginal social costs of carbon dioxide emissions (Fankhauser, 1994).

For air pollution removal estimates, hourly pollution data in each county along with one hourly weather station for each county (Wilmington, Dover, Georgetown) for 2000 were combined with the tree cover total in urban and/or community areas in the county to estimate annual pollution removal using the UFORE model (Nowak et al., 1998; Nowak et al., 2000; Nowak and Crane, 2000; Nowak et al., 2002; Nowak et al., 2006d). Pollution removal value was estimated using national median externality values (Murray et al., 1994), were adjusted to 2006 values based on the consumer price index (Federal Reserve Bank of Minneapolis, 2007). Values were based on the median monetized dollar per ton externality values used in energy decision making from various studies. These values, in dollars per metric ton (t) are: NO₂ = \$9,183 t⁻¹, PM₁₀ = \$6,131 t⁻¹, SO₂ = \$2,248 t⁻¹, and CO = \$1,304 t⁻¹. Externality values for O₃ were set to equal the value for NO₂. Externality values can be considered the estimated cost of pollution to society that is not accounted for in the market price of the goods or services that produced the

pollution. Based on these analyses, the following urban forest attributes and benefits are estimated for the urban or community land in Delaware:

- 7,100,000 trees,
- 1,300,000 metric tons/year of carbon stored (\$29,600,000 value),
- 44,000 metric tons/year of carbon sequestered (\$1,003,000 value),
- 1,431 metric tons/year total pollution removal (\$10,400,000 value)
 - 26 metric tons/year of carbon monoxide removed (\$34,000 value),
 - 47 metric tons/year of nitrogen dioxide removed (\$436,000 value),
 - 725 metric tons/year of ozone removed (\$6,661,000 value),
 - 152 metric tons/year of sulfur dioxide removed (\$341,000 value), and
 - 480 metric tons/year of particulate matter less than 10 microns removed (\$2,944,000 value).

Discussion

The data presented in this report are the most accurate and up-to-date assessment of urban and community forests in Delaware and provide baseline data for assessing future changes in urban forest cover. Cover information in this report was based on higher resolution data than used in the original urban forests assessment (1991 AVHRR data; Dwyer et al., 2000). Because the methodologies for quantifying tree cover have changed between the original assessment and this new assessment, assessing changes in tree cover is not possible as the detected changes could be due to either actual changes or changes due to differences in methodology.

Though the data used in this report are based on wall-to-wall coverage of cover characteristics in the state, there are some data limitations, particularly at the local scale (e.g., block level). Initial canopy results reveal mean absolute errors (mean of the absolute difference between predicted and actual values) from 8.4 percent to 14.1 percent, with correlation coefficients between predicted and actual values ranging from 0.78 to 0.93. Impervious cover results reveal mean absolute errors from 4.6 percent to 7 percent, with *r*-values from 0.83 to 0.91 (Homer et al., 2004). However, aggregating the pixels into larger groups reduces the overall error in cover estimates. It is likely that the cover estimate errors for individual places, counties, and the state are less than 3% (Walton, 2005).

Though limited urban and community forest field data exist in Delaware (exclusive of some street tree inventory data and a Wilmington UFORE analysis), median data from other urban and community forests were used to estimate the number of trees and carbon storage by trees. The coarse state estimates reveal that urban forests in Delaware contain a large number of trees and provide significant environmental benefits. However, this resource and its benefits vary throughout the state. Field data are needed in Delaware to help improve these estimates, as well as to estimate other forest effects (e.g., building energy conservation). Long-term monitoring of urban and community forest field data used in conjunction with satellite-based cover maps will

provide essential information to assess forest health and change, and to improve urban and community forest management.

The new data presented in this report provide the beginning of a better understanding of Delaware's urban and community forest and can be used to advance urban and community forest policy and management decisions to improve environmental quality and human health throughout Delaware. In addition, the cover maps themselves can be integrated in local Geographic Information Systems to assist in local policy, design, and management decisions throughout the state.

These data establish a baseline to assess change and can be used to understand:

- Extent of the urban forest resource
- Variations in the resource across the state
- Magnitude and value of the urban forest resource
- Urban growth in Delaware
- Implication of policy decisions related to urban sprawl and urban forest management

Local Data to Assist Urban Forest Management

Because the tree and impervious cover maps have a resolution of 30 meters, these data can be useful to guide urban and community forest management. The impervious and canopy map information is in 1% cover classes for each pixel. This type of geographic information integrated with other information within the community geographic information system can help improve management decisions related to urban forests across a community. The cover maps are available for download from the USGS (2007).

Practical Applications for Managers

The data from this report can be used to directly aid urban forest management at both the state and local level in Delaware. Data can be used to:

- Establish statewide standards related to urban and community forest (e.g., establishing minimum goals of percent stocking or tree cover per capita and directing resources so that all communities reach the minimum standards).
- Set local trees goal in context of existing tree cover and space available to plant trees
- Determine areas of greatest development (sprawl) to direct policies to minimize the negative impacts of sprawl in these areas.
- Justify urban and community forestry budgets by establishing the values of local forests in comparison with other local government services.
- Improve urban and community forest management and local budgets by providing an estimate of the number of trees in each geopolitical unit (i.e., urban area size (ha) x percent tree cover x 477 trees / ha -- or local tree density information from local research).
- Determine locations available to plant trees and which areas should have the highest priority for planting, such as using the Planting Priority Index. By integrating the tree cover data with census data, areas with relative low tree cover and high population densities could be identified. This type of analysis would reveal areas that have

relatively few trees per person and help facilitate environmental equity at the state and/or local level.

- Determine how well your community compares with similar communities in terms of tree and impervious cover. Data could be used to help promote improvement in the urban forest resource and its management.
- Improve local urban forest and city management by allowing a GIS layer of tree cover to be integrated with existing GIS layers related to city infrastructure (e.g., buildings, roads, utilities). The NCLD data provide cover data at 30 meter resolution. Higher resolution (e.g., sub-meter) cover data can provide more spatially accurate data to aid urban forest management and setting tree canopy goals, but require increased costs due to data acquisition and analysis.

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Table 18. Average number of trees, carbon storage (kgC) and carbon sequestration (kgC) per unit of tree cover in cities.

| City | Trees (#/ha cover) | Carbon | |
|--------------------------------|-----------------------|---------------------------------------|---|
| | | Storage (kgC/m ² cover) | Sequestration (kgC/m ² cover) |
| Atlanta, GA ¹ | 751.5 | 9.7 | 0.3 |
| Baltimore, MD ¹ | 598.1 | 12.3 | 0.3 |
| Boston, MA ¹ | 371.7 | 9.1 | 0.3 |
| Chicago, IL ² | 618.0 | 12.9 | na |
| Casper, WY ³ | 252.8 | 7.0 | 0.2 |
| Freehold, NJ ¹ | 275.0 | 10.4 | 0.3 |
| Jersey City, NJ ¹ | 308.7 | 4.4 | 0.2 |
| Minneapolis, MN ⁴ | 245.5 | 5.7 | 0.2 |
| Moorestown, NJ ¹ | 547.9 | 9.9 | 0.3 |
| Morgantown, WV ¹ | 829.6 | 10.6 | 0.3 |
| New York, NY ⁵ | 312.0 | 7.3 | 0.2 |
| Philadelphia, PA ⁶ | 394.3 | 9.0 | 0.3 |
| San Francisco, SF ⁷ | 468.1 | 12.3 | 0.3 |
| Syracuse, NY ⁸ | 583.1 | 10.5 | 0.3 |
| Oakland, CA ⁹ | 570.0 | 5.2 | na |
| Washington, DC ¹⁰ | 423.4 | 10.4 | 0.3 |
| Woodbridge, NJ ¹ | 557.3 | 8.2 | 0.3 |
| Mean | 476.9 | 9.1 | 0.3 |

¹ Unpublished data analyzed using UFORE model

² Nowak 1994a,b

³ Nowak et al. 2006a

⁴ Nowak et al. 2006b

⁵ Nowak et al. 2007a

⁶ Nowak et al. 2007b

⁷ Nowak et al. 2007c

⁸ Nowak et al. 2001a

⁹ Nowak 1993; Nowak and Crane 2002

¹⁰ Nowak et al. 2006c

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Draft Text Correction 4/16/07 (pp 29-30)

Priority Planting Areas

To determine the best locations to plant trees, tree canopy and impervious cover data from NLCD 2001 were used in conjunction with 2000 U.S. Census data to produce an index of priority planting areas. Index values were produced for several geographic units (e.g., community, county) with the higher the index value, the higher the priority of the area for tree planting / establishment. This index is a type of “environmental equity” index with areas of higher human population density and lower tree stocking and trees per capita tending to get the higher index value. The criteria used to make the index were:

- Population density: the greater the population density, the greater the priority for tree planting
- Tree stocking levels: the lower the tree stocking level (the percent of total potential growing space - tree, grass, and soil cover areas - that is occupied by tree canopies), the greater the priority for tree planting
- Tree cover per capita: the lower the amount of tree canopy cover per person (m²/capita), the greater the priority for tree planting

Each criteria was standardized¹ on a scale of 0 to 1 with 1 representing the jurisdictional unit with the highest value in relation to priority of tree planting (i.e., the unit with highest population density, lowest stocking density or lowest tree cover per capita were standardized to a rating of 1). Individual scores were combined based on the following formula and standardized again to produce an overall priority index value between 0 and 100:

$$I = (PD * 40) + (TS * 30) + (TPC * 30)$$

Where I = index value, PD is standardized population density, TS is standardized tree stocking, and TPC is standardized tree cover per capita. The planting priority index (PPI) ranks communities, county subdivisions, and counties of the state with values from 100 (highest) to 0 (lowest) priority.

¹ Standardized value for population density (PD) was calculated as $PD = (n - \min) / r$, where SPD is the value (0-1), n is the value for the geopolitical unit (population / km²), min is the minimum value for all units, and r is the range of values among all units (maximum value – minimum value). Standardized value for tree stocking (TS) was calculated as $TS = (\max - n) / r$, where TS is the value (0-1), max is the maximum value for all units, n is the value for the geopolitical unit (tree canopy/total potential growing space * 100) and r is the range of values among all units (maximum value – minimum value). Standardized value for tree cover per capita (TPC) was calculated as $TPC = (\max - n) / r$, where TPC is the value (0-1), max is the maximum value for all units, n is the value for the geopolitical unit (m²/capita), and r is the range of values among all units (maximum value – minimum value).