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Regional Wastewater Management Plan
Environmental Assessment - Land Use

MARCH 2013

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Introduction

As a fragile coastal peninsula, Cape Cod has a finite capacity to accommodate development and simultaneously maintain the healthy human and natural environments upon which the region's economy depends. Capacity and land use are directly related. How and where the Cape's landscape is developed has a tremendous effect on the capacity of the environment to absorb that additional growth.

The region's early development was located in dense village centers surrounded by less developed outlying areas. More convenient access to the region led to substantial growth in the tourist industry and, beginning in the 1970s, in the year-round population. New development occurred along roadways, coastal areas, and in large residential subdivisions. Zoning regulations, first established to exclude incompatible uses from residential areas, contributed to this sprawling pattern of growth by requiring large setbacks and prohibiting the mix of uses traditionally found in village centers. In many cases, zoning bylaws, crafted more than 30 years ago, are still in effect today across Cape Cod, and preexisting nonconforming uses limit the towns' ability to reestablish compact land use patterns. Under current zoning, the sprawl development has already compromised Cape Cod's natural systems.

The location of infrastructure and public facilities, in addition to zoning, drives land use patterns. The development of infrastructure, from wastewater to telecommunications, will be essential to regional economic growth that doesn't further degrade the human or natural environment. Compact forms of growth reduce the cost of needed infrastructure and allow for more types of residential and commercial development at a range of prices. In addition, open space in more sensitive areas may be protected, thus improving the ability of the natural environment to further absorb human impacts. Conversely, a sprawling pattern of growth not only increases infrastructure costs but also makes the delivery of services such as public transit less practical.

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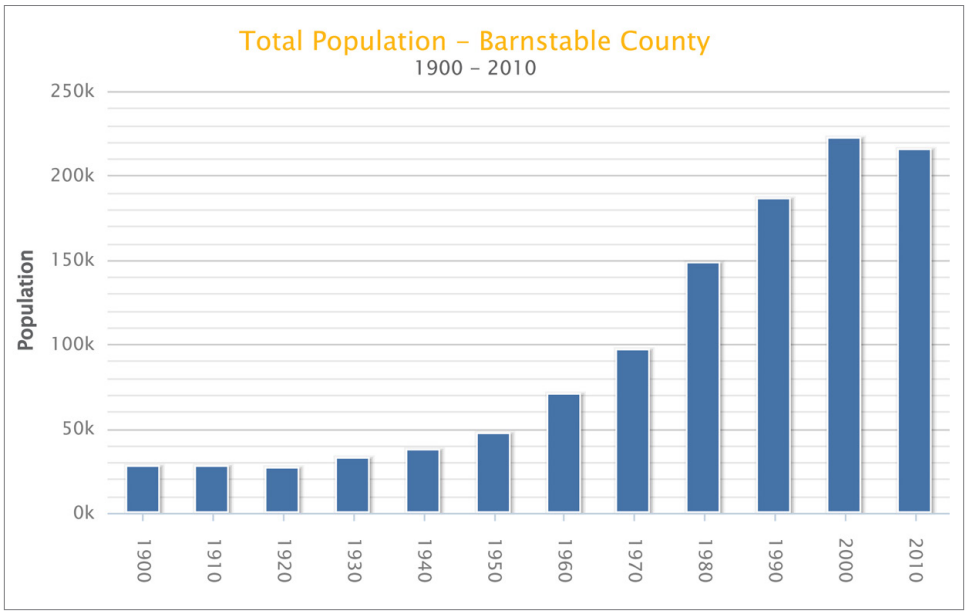
Population and Land Use

Cape Cod's great natural beauty, bountiful recreational opportunities, and proximity to major urban areas have led to a rapid increase in population over the last half century. The Cape's traditional farming and fishing way of life underwent a slow transformation in the early part of the 20th century as seaside resorts began to attract summer visitors. The advent of rail travel soon after added to the accessibility and thus the popularity of Cape Cod. The population began to rise more quickly in the 1950s and then even more steeply from the 1970s through the early 2000s as Cape Cod became a desired location for retirees and second-home buyers (Figure EAL-1). Most of this development has been residential with associated commercial, industrial, and tourism-based land uses.

Recently, population has decreased from about 227,000 in 2001 to an estimated 215,000 in 2011. The decline is attributed, in part, to the increasingly high cost of Cape Cod real estate as the market boomed in the last decades of the 20th century, followed by the swift market decline toward the end of the first decade of the 21st century. As the Woods Hole Research Center notes: "Cape Codders are still grappling with the effects of a population that grew by 400 percent between 1950 and 1990." (WHRC 2012)

FIGURE EAL-1: Population Growth on Cape Cod between 1930 and 2010



SOURCE: StatsCapeCod

CHANGE IN LAND USE AND DENSITY

During the first half of the 20th century, much of the interior of the Cape remained wooded or in agriculture while the coastal areas, especially the south coast, developed more densely.

Figure EAL-2 shows the pattern of land use in 1950 when much of the interior of the Cape remained as open space (shown in green) and the coasts were the location of dense residential development (shown in yellow).

By 2005, as seen in Figure EAL-3, much of the interior had been developed as residential land.

Density of human habitation increased from about 118 people per square mile Cape-wide in 1950 to about 582 per square mile in 2010. The density in 2010 is far from uniform, as Figure EAL-4 illustrates, ranging from as few as 36 people per square mile in many areas to as many as about 4,500 people per square mile in a few places.

As expected, the density of housing units mirrors that of the population, as shown in Figure EAL-5.

SEASONALITY

In the past several decades the number of people living year-round on Cape Cod has increased, as has the concomitant conversion of seasonal homes for year-round use. The 2010 Census listed about 57,000 seasonal housing units, or approximately one third of the housing stock on Cape Cod. As illustrated in Figure EAL-6, the US Census 2010 shows that seasonal homes are much more prevalent in coastal areas than inland on Cape Cod.

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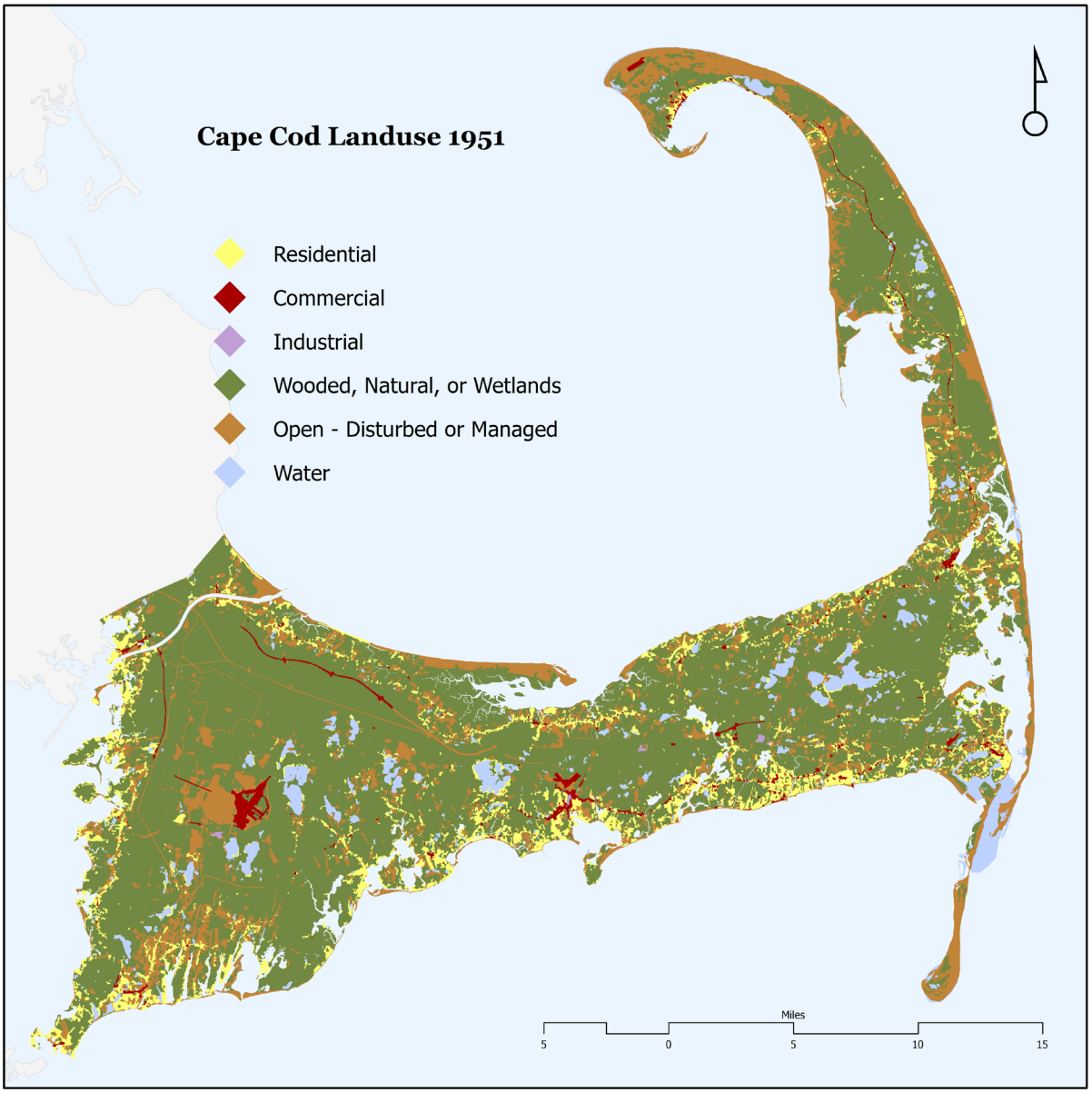
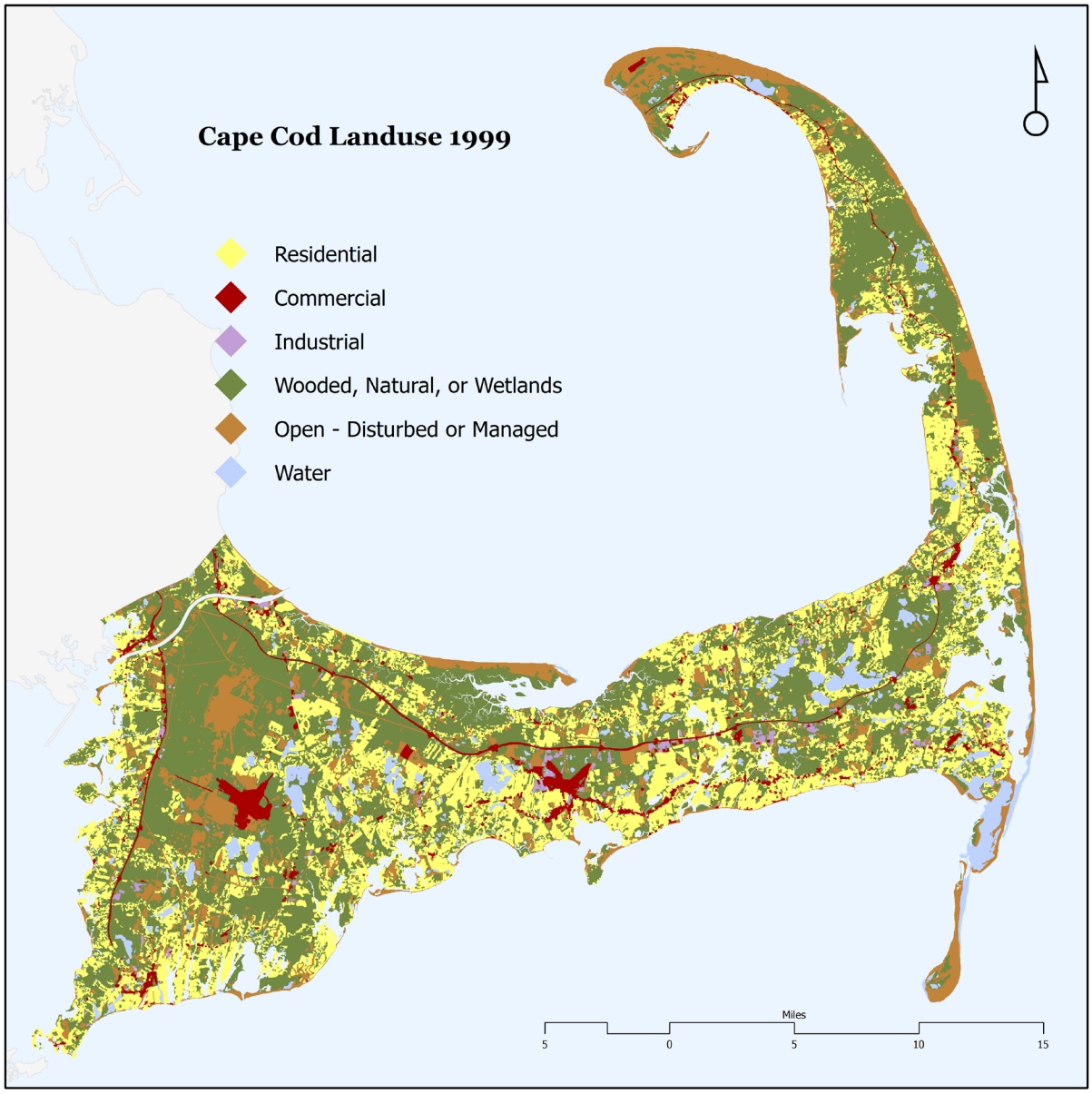
FIGURE EAL-2: Land Use on Cape Cod in 1951



SOURCE: CCC GIS and Woods Hole Research Center

FIGURE EAL-3: Land Use on Cape Cod in 1999



SOURCE: CCC GIS and Woods Hole Research Center

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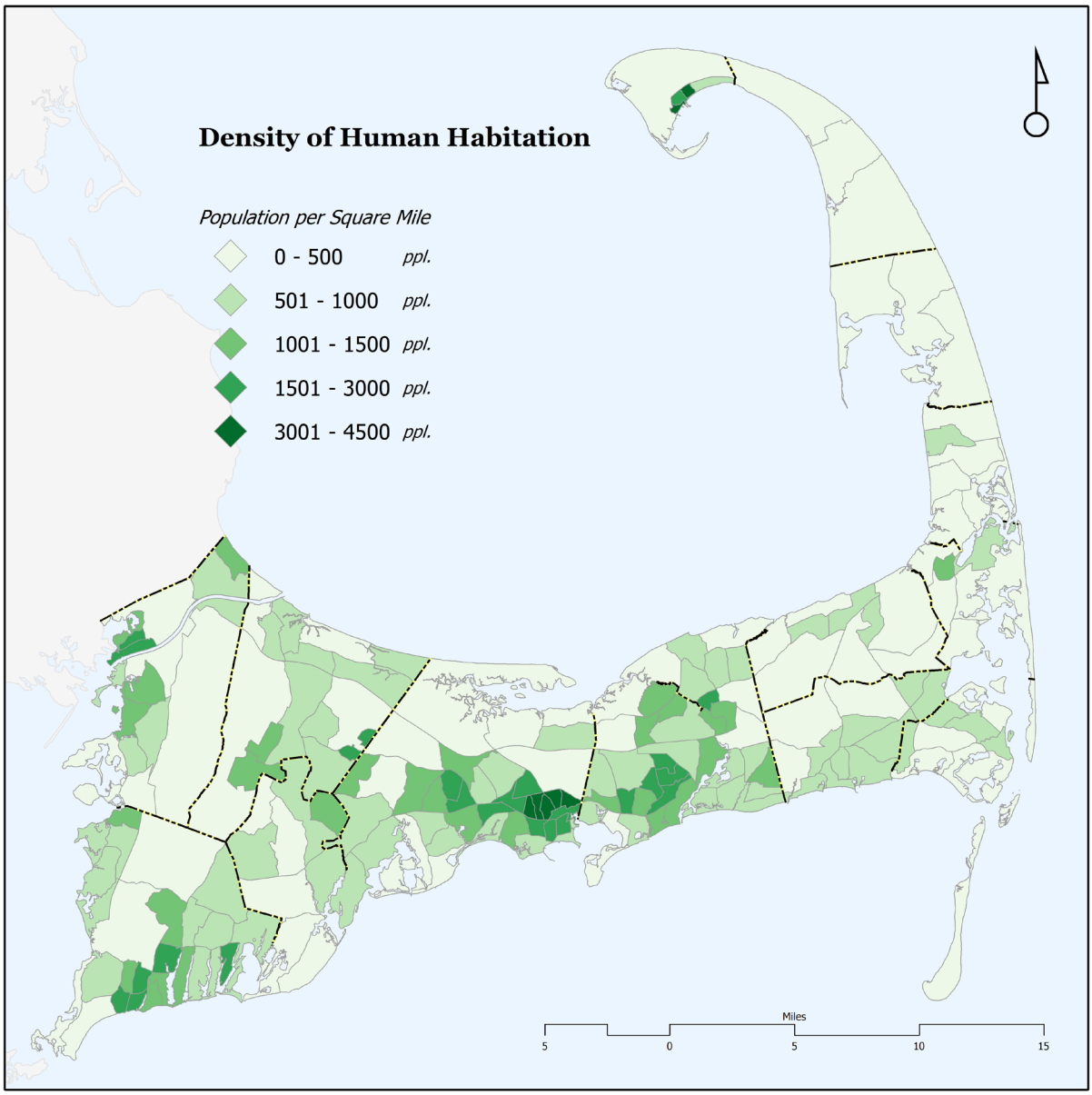
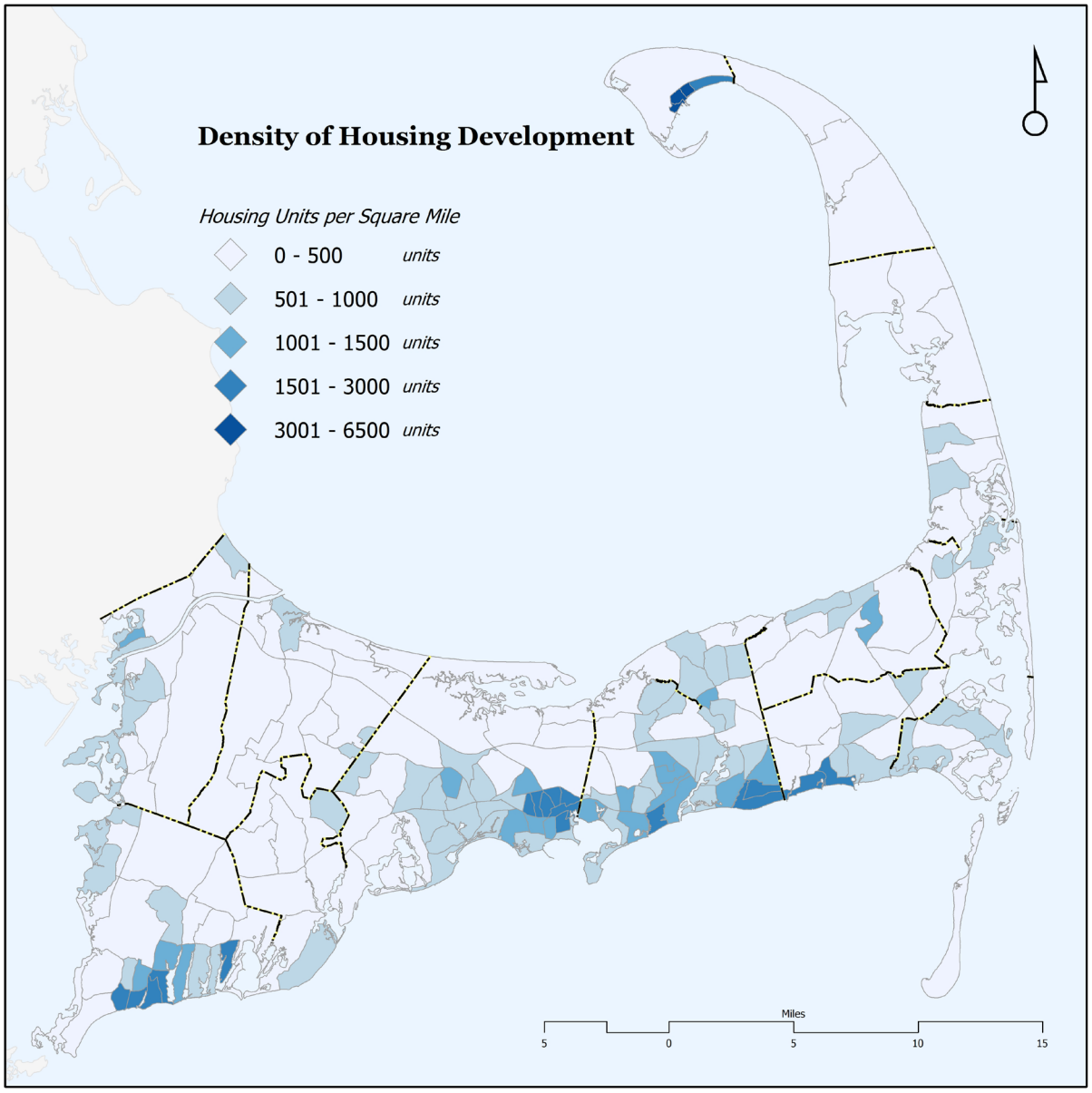
FIGURE EAL-4: Density of Human Habitation on Cape Cod in 2010



SOURCE: US Census 2010

FIGURE EAL-5: Density of Housing Development on Cape Cod in 2010



SOURCE: US Census 2010

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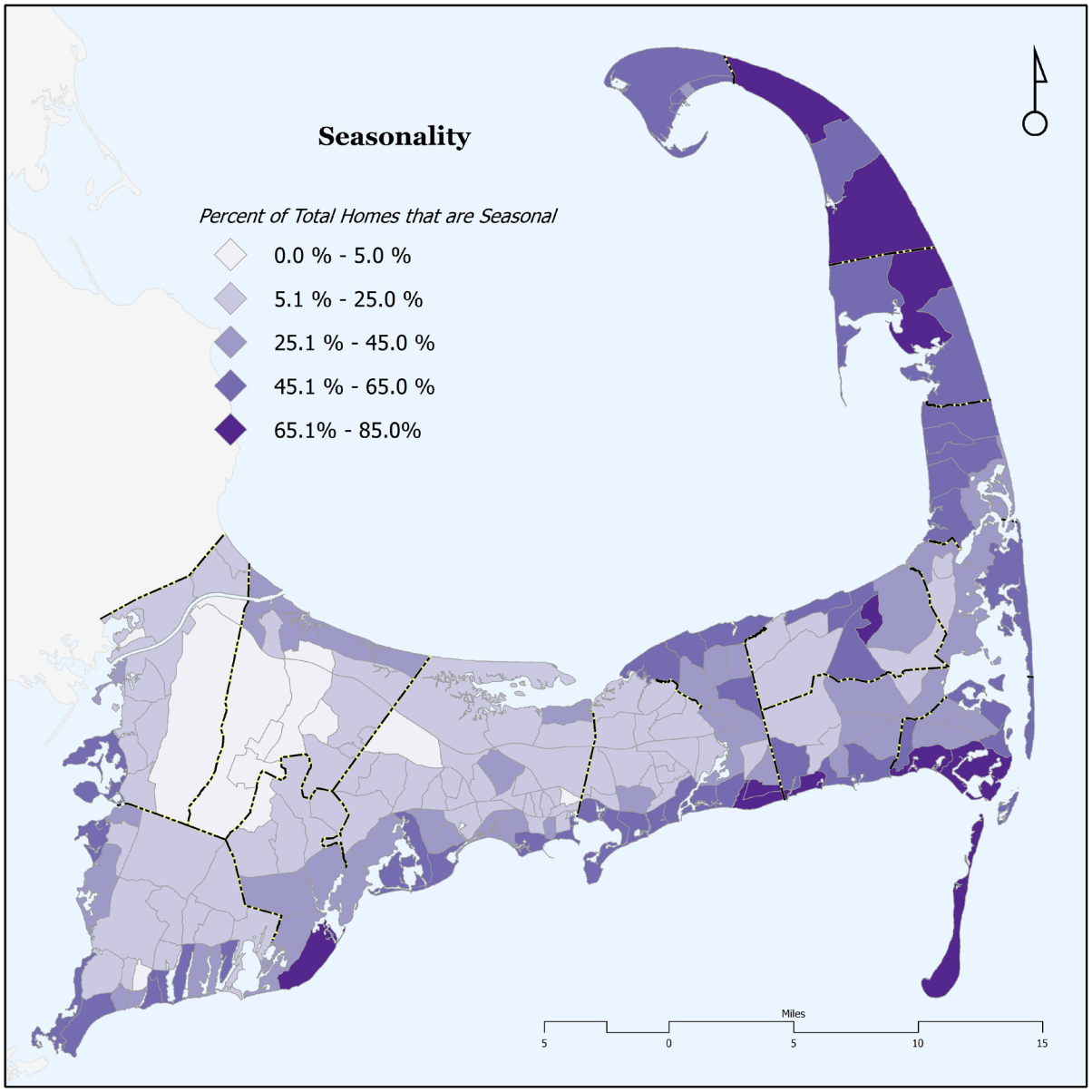
FIGURE EAL-6: Percent of Seasonal Homes in Different Parts of Cape Cod in 2010



SOURCE: US Census 2010

Land Use and Provision of Wastewater Infrastructure

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The cost of off-site wastewater infrastructure depends largely on the amount, kind, and pattern of development to be served. The amount and kind of development determines the volume of flow to be treated and disposed. The pattern of development determines the extent of the collection system required to transport wastewater away from individual properties. Wastewater infrastructure must be sized not only to treat current needs, but also to support future growth.

Up-to-date and accurate assessing data are critical for wastewater planning in order to establish the amount and kind of current land use from which to measure potential future changes in development. The information can be used to identify areas where wastewater treatment may be most needed in the future or areas where growth should be directed based on existing wastewater infrastructure. In addition, assessing data can be used to inform analyses about the distances between existing development from which wastewater will be collected. As wastewater collection costs comprise up to 70% of the costs of providing wastewater infrastructure, prioritizing areas for collection from higher to lower density can substantially minimize collection costs.

To assess current development and future development potential (build-out), the Cape Cod Commission acquired the parcel boundaries and assessing data (from 2010 to 2012) for all Cape towns except Wellfleet from the Massachusetts Office of Geographic Information (MassGIS). MassGIS created the parcel data using its "Standard for Digital Parcels and Related Data Sets." The Commission then applied this standard to Wellfleet. Although MassGIS conducted quality assurance and quality control on the data at a state-wide level, many improvements to the data were made to account for the many inconsistencies due to differences in the ways that towns collect assessing information. A brief overview of the methodology used to evaluate current and future development is provided below.

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METHODOLOGY FOR EVALUATING LAND USE AND FUTURE DEVELOPMENT POTENTIAL

The methodology evaluates how zoning regulations enable and guide development potential. The additional residential and non-residential development possible under current zoning was estimated using the density and dimensional requirements under zoning regulations. The development potential was estimated for all parcels that are developable or potentially developable. Developable parcels include properties that are currently vacant and properties that are currently developed but may have additional development potential (i.e., are under-developed).

BUILDOUT LIMITATIONS

The buildout estimates the amount of development permitted under the zoning in place at the time of the analysis and provides an estimate of the spatial distribution of such future development. However, as with all buildout methodologies, it is not a prediction of the future. Many other factors, rules, regulations, and economic decisions affect the development of property—not all of these factors can be accounted for in the buildout analysis.

It was necessary to make a number of simplifications to the methodology and apply some generalized assumptions to the analysis in order to conduct a Cape-wide buildout. Thus, the buildout does not encompass many of the situations that occur or the micro-scale regulations and circumstances that affect development at the parcel level. The buildout also relies heavily on the robustness and accuracy of the source datasets as inaccurate, inconsistent, and out-of-date data directly affect the results of the buildout. In some cases, information essential to calculating buildout conditions did not exist and so assumptions were made to account for this missing information.

DATA PREPARATION AND AVAILABILITY

The first step in the buildout process was the division of all parcels into those that would be included in the analysis and those that would be excluded. The intent was to exclude parcels that appeared undevelopable or were considered unlikely to be developed within a 25- to 30-year planning horizon.

The state class codes assigned to each property were used to determine which parcels would be included or excluded from the analysis. These codes are assigned by the town assessor and follow a three-digit numerical system outlined in the Massachusetts Department of Revenue "Property Type Classification Codes" (State Class Codes) dated June 2009.

Using the state class codes to determine which parcels to include or exclude was complicated by several factors:

- Some codes, such as "undevelopable lands," apply to property that is not developable, but many codes (e.g., properties where development seems unlikely at present but may have development potential under more favorable market conditions, or municipal properties that are not permanently protected) require some judgment to determine whether development is possible. In cases where development seemed possible but unlikely in the planning horizon and in cases of municipal ownership, properties were excluded so the buildout would not over-inflate the development potential for the region.
- Many entries in town assessors' databases are not consistent with the state's three-digit system. Many towns add a digit to the state class codes to sub-categorize the coding system. The analysis required accounting for all the combinations of state class codes appearing in the database (746 unique combinations in the database, but only 250 state class codes).
- The latest version of the Property Type Classification Codes references revised, reorganized, and deleted state class codes, many of which still appear in the assessors' data available to the Cape Cod Commission.
- The state class code is occasionally left blank or the entry does not match any current state class code.

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MAJOR ASSUMPTIONS

Because the Cape-wide buildout is intended to create a parcel-based estimate of future development potential, it must be possible to estimate all inputs and apply them to specific locations (i.e., a parcel) on the ground. In many cases, factors affecting development can be reasonably estimated but they cannot be accurately distributed spatially and applied to individual parcels. For this reason, the buildout numbers should be assumed to have a margin of error of +/- 5%. Some of the major assumptions made about the buildout are provided in brief below:

- The buildout assumes that owners will make the highest and best use of their properties.
- Parcels were assumed to be developable unless the assessor had categorized them as "undevelopable."
- The buildout does not take into account how the Cape Cod Commission's regulatory review affects development decisions made by property owners.
- The buildout does not take into account additional development over that allowed under zoning. For example, Chapter 40B projects may increase density more than allowed by zoning.
- The buildout does not account for the granting of local variances to parking requirements, lot coverage, or density.
- The buildout does not account for potential accessory dwellings that may be allowed under local ordinances.
- The buildout does not account for changes to non-conforming uses into the future; for example, commercial uses in residential districts and vice versa.

PROCEDURE

The general buildout procedure followed the methodology established by MassGIS, in particular the formula for estimating future development potential. Community Viz, a GIS extension, was used to run the buildout calculations. Community Viz is capable of calculating buildout based on a variety of inputs and assumptions about density and the estimated gross floor area. A summary of the procedure follows:

Step 1: Gather data.
The most recent available data, including updated parcel and assessor's records, were combined with resource information from the Cape Cod Commission GIS and MassGIS.

Step 2: Link zoning to parcels.
Modify the state zoning layer to reflect local overlay districts that affect the density or allowable lot coverage (e.g., wellhead protection districts). Use the modified state zoning layer to assign a zoning designation to each parcel.

Step 3: Calculate input formulas.
To each state zoning designation, assign a density for residential development, or an "Effective Floor Area Ratio" for non-residential development, or both in the case of a mixed-use category.

Step 4: Create a constraint layer of parcels to be excluded from the analysis.
This layer includes all permanently protected open space, wetlands, water bodies, and rights-of-way, and all the parcels with state class codes that were undeveloped based on constraints and, therefore, excluded from the analysis.

Step 5: Create existing development data layer.
Create a GIS layer that includes the existing dwellings and non-residential square footage for every parcel listed in the assessor's data.

Step 6: Run buildout using Community Viz.
Community Viz calculates the potential development on each parcel and then establishes the net additional development by subtracting the existing development from the maximum buildout potential. The results provide additional dwelling units and/or existing non-residential square footage for each parcel.

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Current Development and Future Development Potential: Results of Land Use Analysis

The results are considered draft at this time for the following reasons:

- Although the buildout results and mapping provide a regional view of potential areas of growth, unexpectedly large amounts of growth appear possible from the calculations in many communities. Many of these clusters of potential growth coincide with golf courses, parking lots, or parcels used less intensely than may be permitted under zoning regulations. Although the transformation of large private golf courses into large numbers of additional dwelling units is possible, the timeframe over which the development of these locations may occur is unknown, and the likelihood of all of them being developed to the maximum under zoning is small.
- In addition, the buildout analysis uses only the minimum lot size or density requirements of the zoning to estimate the additional dwelling units allowed. It does not account for additional requirements of the bylaws (particularly frontage requirements and shape requirements) that might otherwise further restrict the density allowed. The result of these anomalies is higher than expected buildout numbers (particularly in Provincetown, Truro, and Wellfleet).
- Finally, certain state class codes that were assumed to be developable areas (such as commercial parking lots and land held by charitable organizations) resulted in unusually large additional dwelling units. This is particularly true in Provincetown, where the density allowed under zoning is higher than most other locations on the Cape.

The Cape Cod Commission intends to investigate anomalies such as the ones described here and refine the assumptions and buildout layer in the future to establish a more fine-grained picture of the buildout potential in the region. This work is expected to be completed early in 2013. Starting in 2013, the Commission will work with town planners across the Cape to develop annual updates to the Cape-wide buildout analysis. The Commission will also work with the staff at the University of Massachusetts School for Marine Science and Technology (SMAST) to offer updated buildout analysis that may be incorporated into Massachusetts Estuaries Project (MEP) analyses.

The results presented here should thus be interpreted as demonstrating the approach that is being used by the Cape Cod Commission to understand current development and future potential development at a regional scale.

CAPE COD DEVELOPED PARCELS

The analysis indicated that the total number of developed parcels on Cape Cod is 133,500. (Note: This varies slightly from the developed parcels used in the Cape-wide cost estimate because updated data were obtained prior to initiating this analysis.) Of these, 120,500 are single-family residential; 7,700 are multi-family residential; and 5,300 are non-residential parcels. Table EAL -1 shows the percent of residential and non-residential parcels by town.

TABLE EAL-1: Percent of Residential and Non-Residential Parcels by Town

TOWN	PERCENT (%) OF CAPE COD RESIDENTIAL PARCELS	PERCENT (%) OF CAPE COD NON-RESIDENTIAL PARCELS
Barnstable	17.17%	17.65%
Bourne	6.32%	6.93%
Brewster	4.42%	5.15%
Chatham	4.73%	4.06%
Dennis	9.68%	10.72%
Eastham	4.21%	2.86%
Falmouth	14.77%	12.90%
Harwich	6.86%	5.68%
Mashpee	5.62%	6.70%
Orleans	3.21%	4.35%
Provincetown	1.32%	1.80%
Sandwich	6.67%	4.87%
Truro	1.78%	3.04%
Wellfleet	2.60%	5.56%
Yarmouth	10.64%	7.73%
TOTAL:	100.00%	100.00%

SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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DWELLING UNITS AND NON-RESIDENTIAL DEVELOPMENT

The results of the land use analysis showed that there are about 152,000 dwelling units on Cape Cod presently, and that approximately 27,800 additional dwelling units could be built under current zoning. There is almost 60,000,000 square feet of non-residential development at present, with the potential of an additional 32,000,000 square feet at buildout. Table EAL-2 presents the results by town and land use codes.

TABLE EAL-2: Current and Potential Number of Dwelling Units and of Non-Residential Square Footage

TOWN	DWELLINGS ALL LAND USE CODES			NON-RESIDENTIAL SQUARE FOOTAGE LAND USE CODES 013, 031, 300–999		
	EXISTING	ADDITIONAL	% CHANGE	EXISTING	ADDITIONAL	% CHANGE
Barnstable	25,167	4,296	17	19,442,037	4,577,937	24
Bourne	9,587	2,524	26	3,977,036	4,743,325	119
Brewster	7,440	1,661	22	1,092,877	1,184,883	108
Chatham	6,729	904	13	3,203,061	857,329	27
Dennis	14,816	1,185	8	3,021,445	3,313,741	110
Eastham	5,930	565	10	709,739	1,062,236	150
Falmouth	20,940	3,774	18	7,728,402	2,955,858	38
Harwich	10,038	2,063	21	1,993,037	1,062,282	53
Mashpee	9,687	1,559	16	2,406,349	3,922,966	163
Orleans	5,049	778	15	1,924,894	1,579,296	82
Provincetown	4,306	1,325	31	1,561,678	125,475	8
Sandwich	9,258	2,492	27	1,959,446	3,122,267	159
Truro	2,941	1,697	58	457,248	533,608	117
Wellfleet	3,958	1,463	37	583,288	794,772	136
Yarmouth	16,307	1,556	10	9,863,508	2,206,716	22
TOTAL:	152,153	27,842	18	59,924,044	32,042,693	53

SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

The results of the analysis were also used to generate maps illustrating current and future residential development (dwelling units per acre; Figures EAL-7 and EAL-8, respectively) and current and future non-residential development (square feet per acre; Figures EAL-11 and EAL-12, respectively). For more information on development density, see the development density section in Cape-wide Cost Estimate.

WATERSHED DEVELOPMENT

Population growth and development in Cape Cod watersheds have increased the delivery of nitrogen to many coastal embayments, resulting in degradation of water quality. Restoration will require reducing the amount of nitrogen entering the water, in some cases through the construction of expensive wastewater treatment facilities. Such facilities must be sized to handle current and future planned development.

Table EAL-3 shows the existing number of dwelling units and square footage of non-residential land use and the additional amount of development allowed under current zoning.

As the data inputs used in this analysis are not the same as those used by the Massachusetts Estuaries Project, the current and future growth are not expected to be identical.

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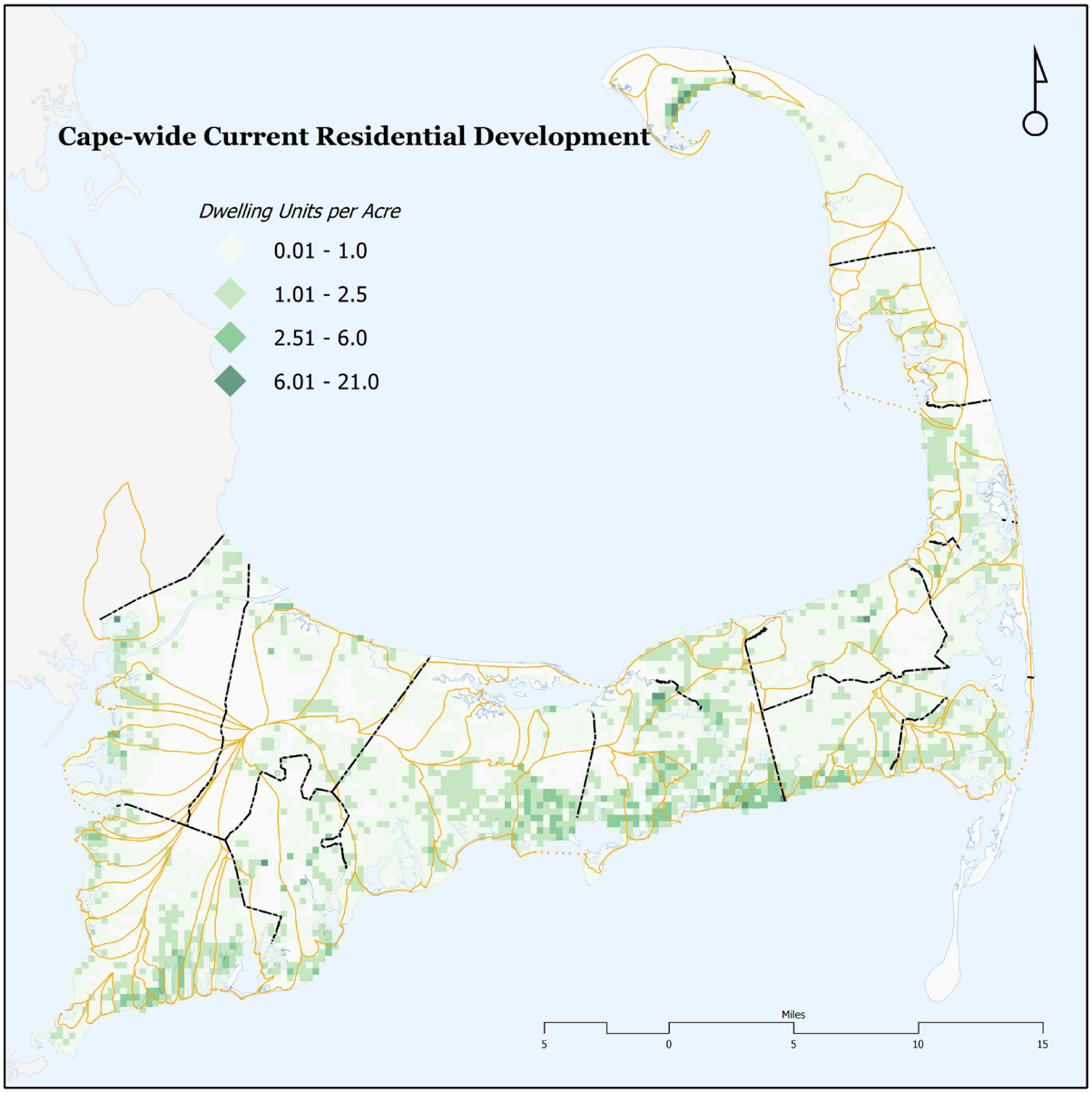
FIGURE EAL-7: Density of Current Dwelling Units

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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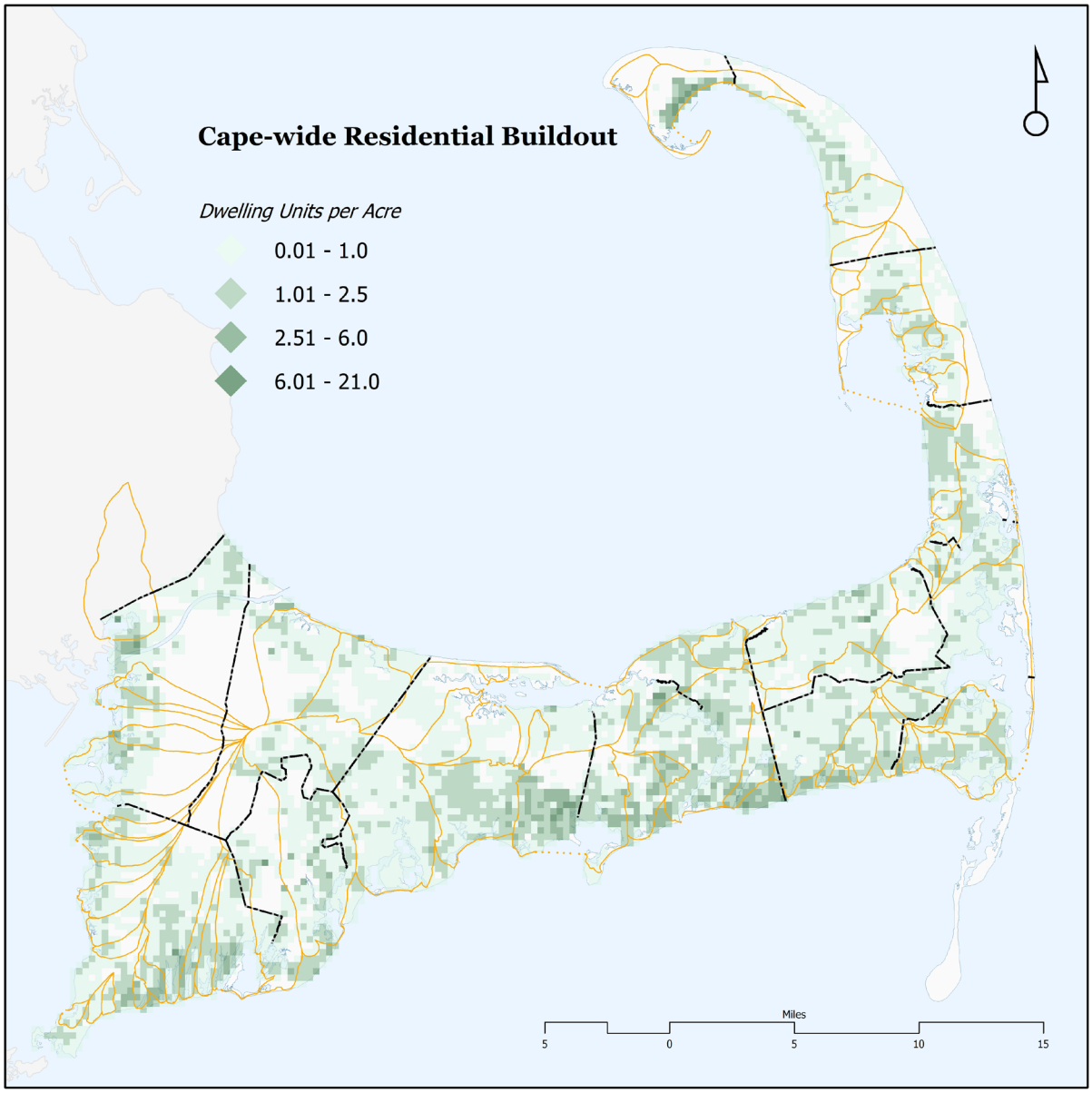
FIGURE EAL-8: Potential Density of Dwelling Units at Buildout

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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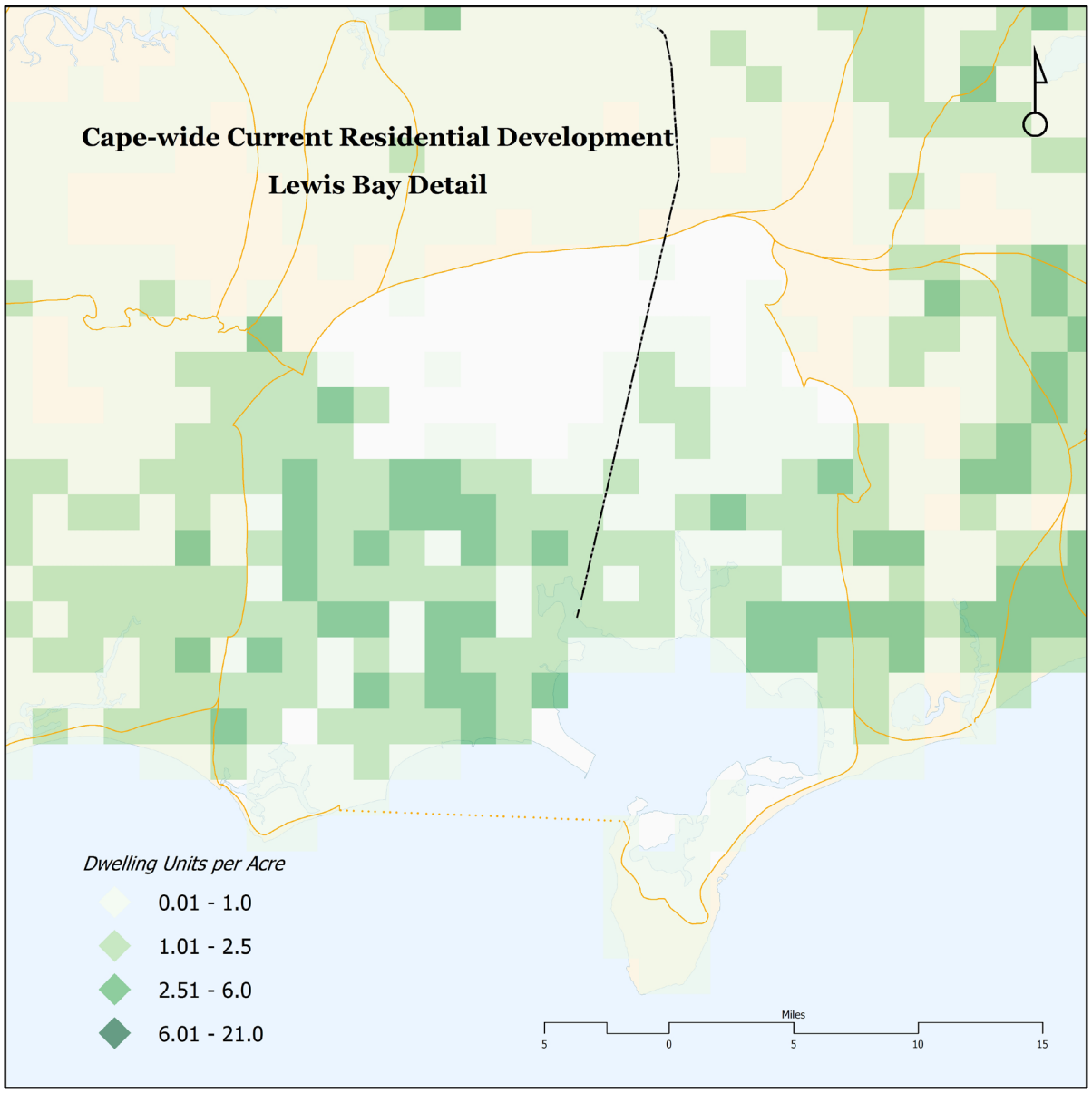
FIGURE EAL-9: Density of Current Dwelling Units in the Lewis Bay Watershed

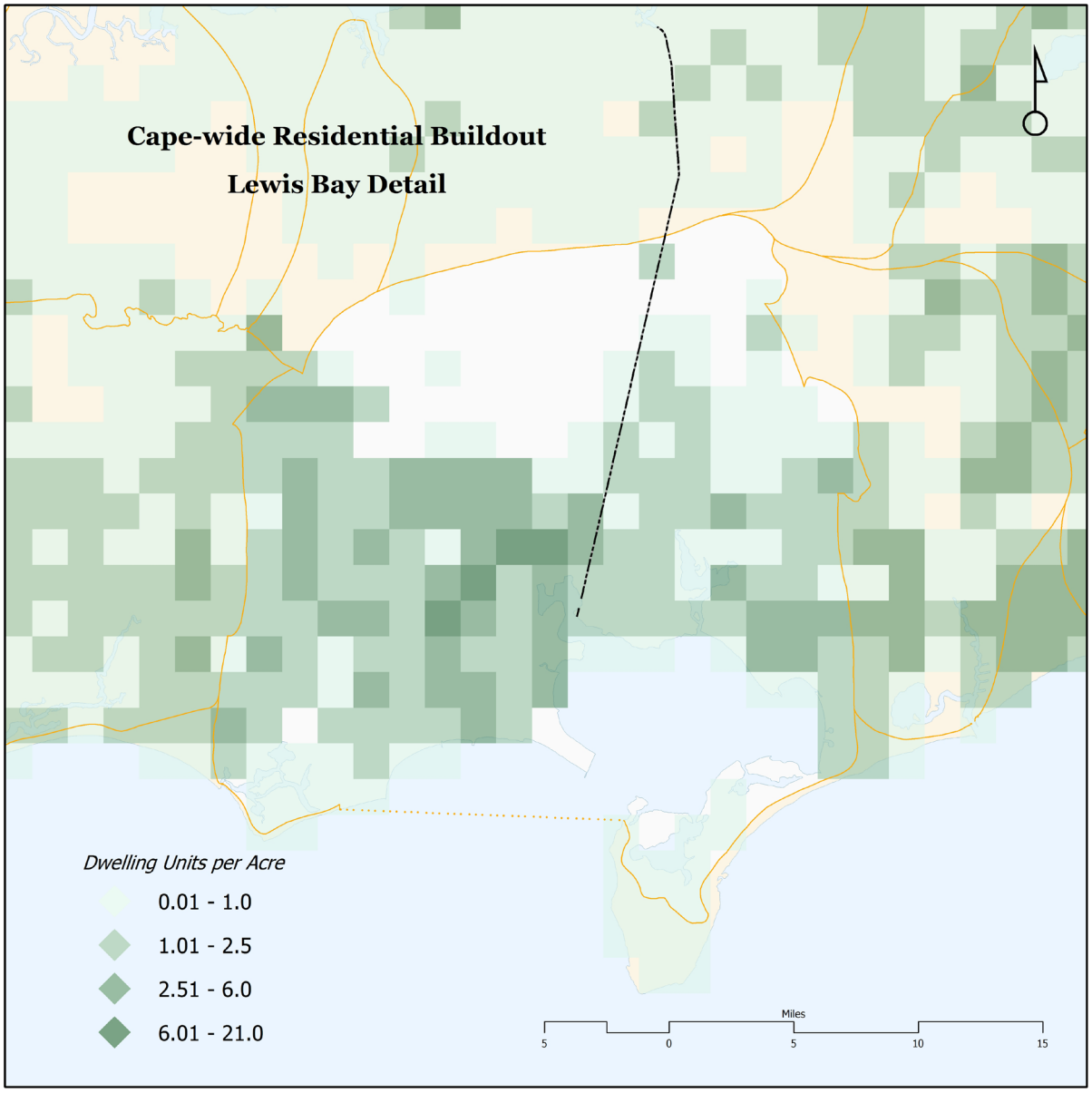
Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

FIGURE EAL-10: Potential Density of Dwelling Units at Buildout in the Lewis Bay Watershed

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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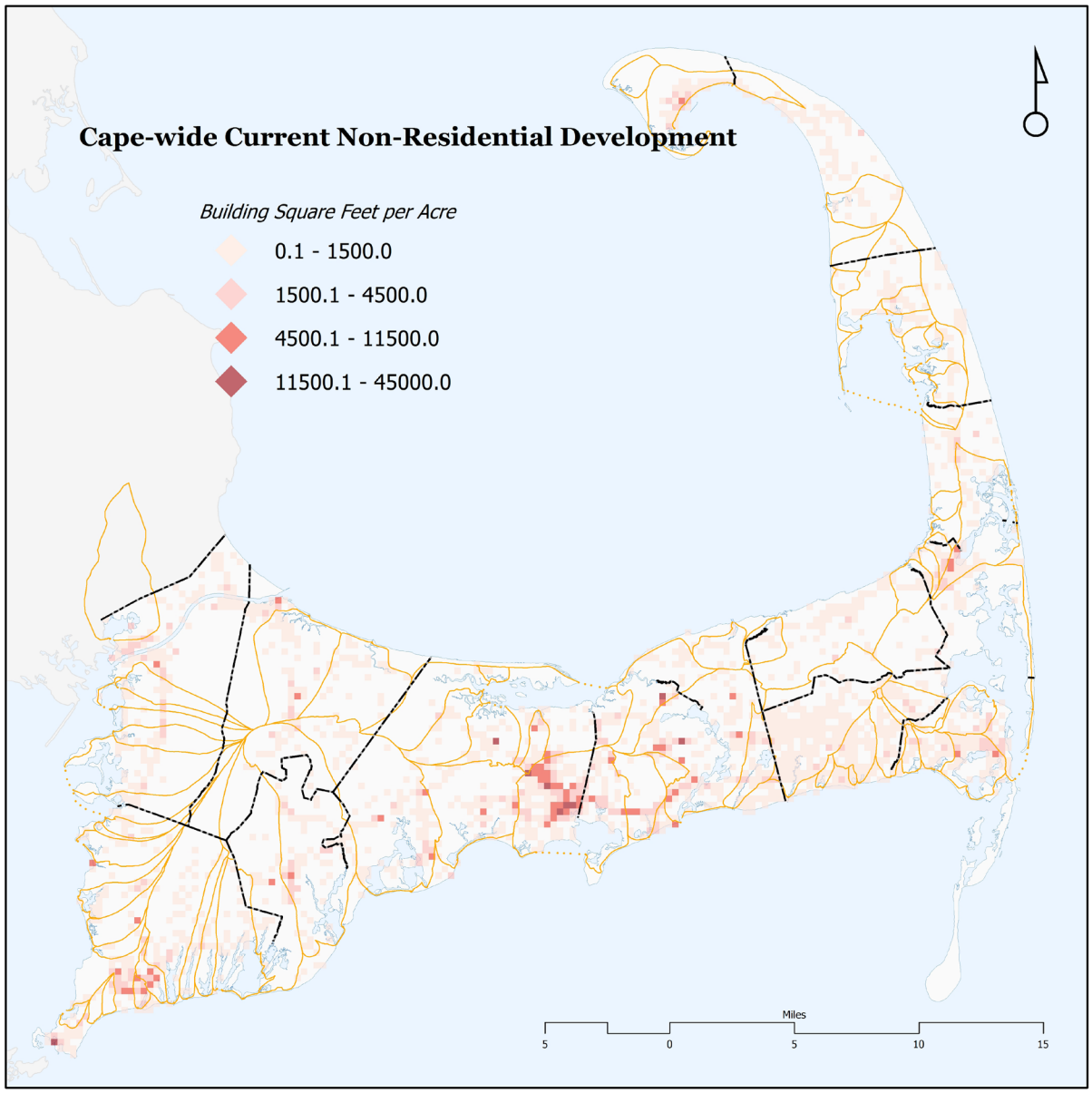
FIGURE EAL-11: Density of Current Non-Residential Development

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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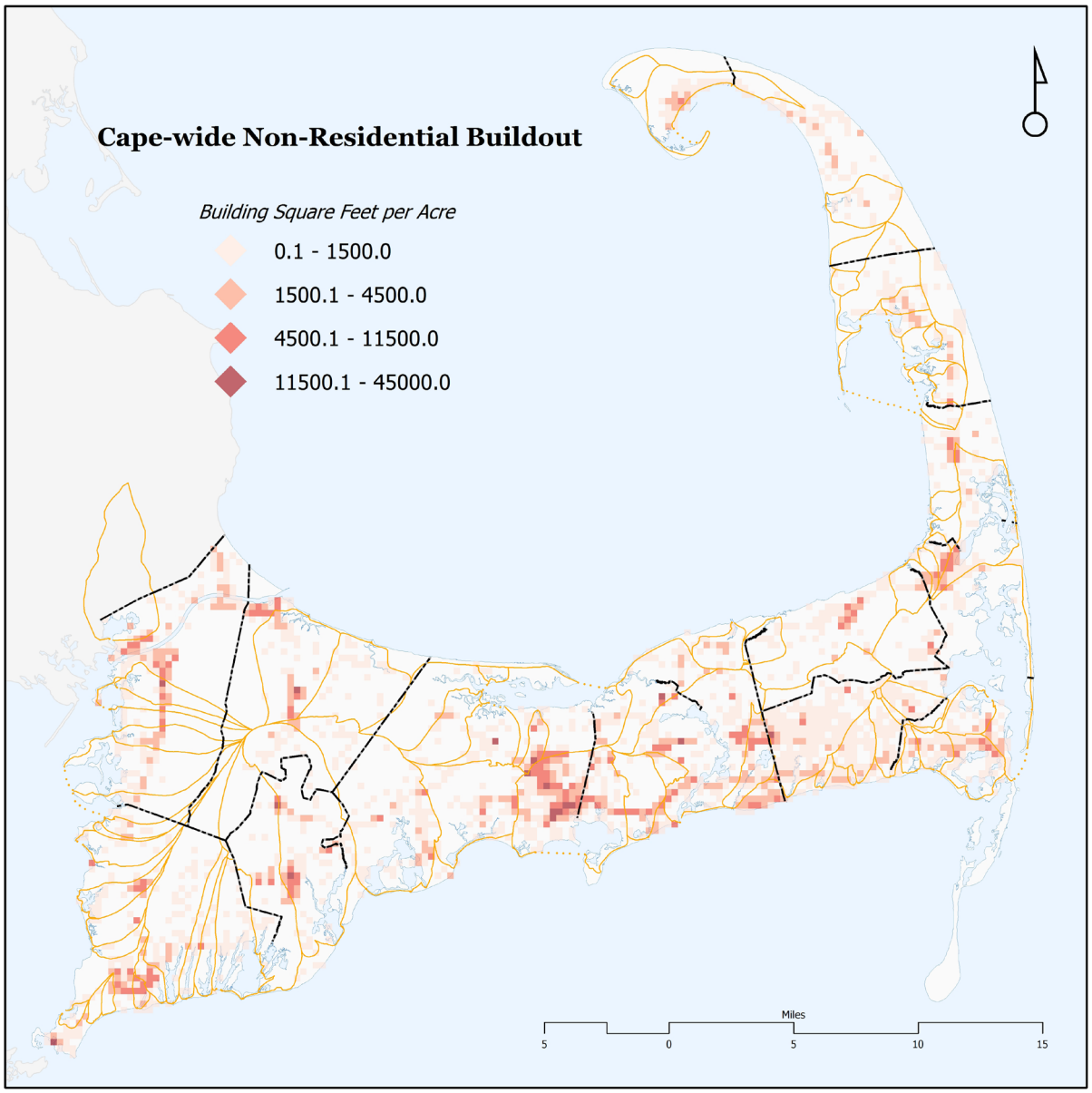
FIGURE EAL-12: Potential Density of Non-Residential Development at Buildout

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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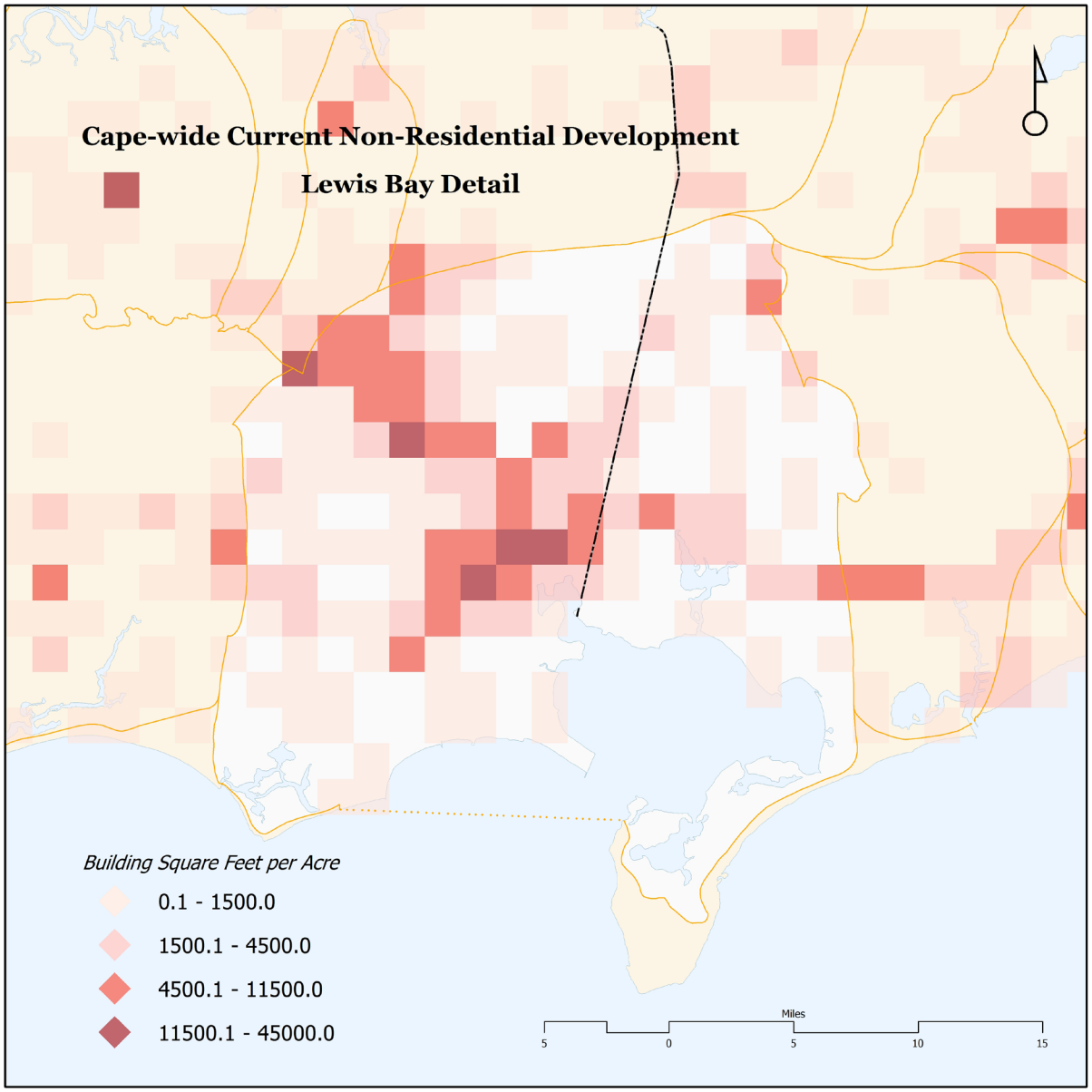
FIGURE EAL-13: Density of Current Non-Residential Development in the Lewis Bay Watershed

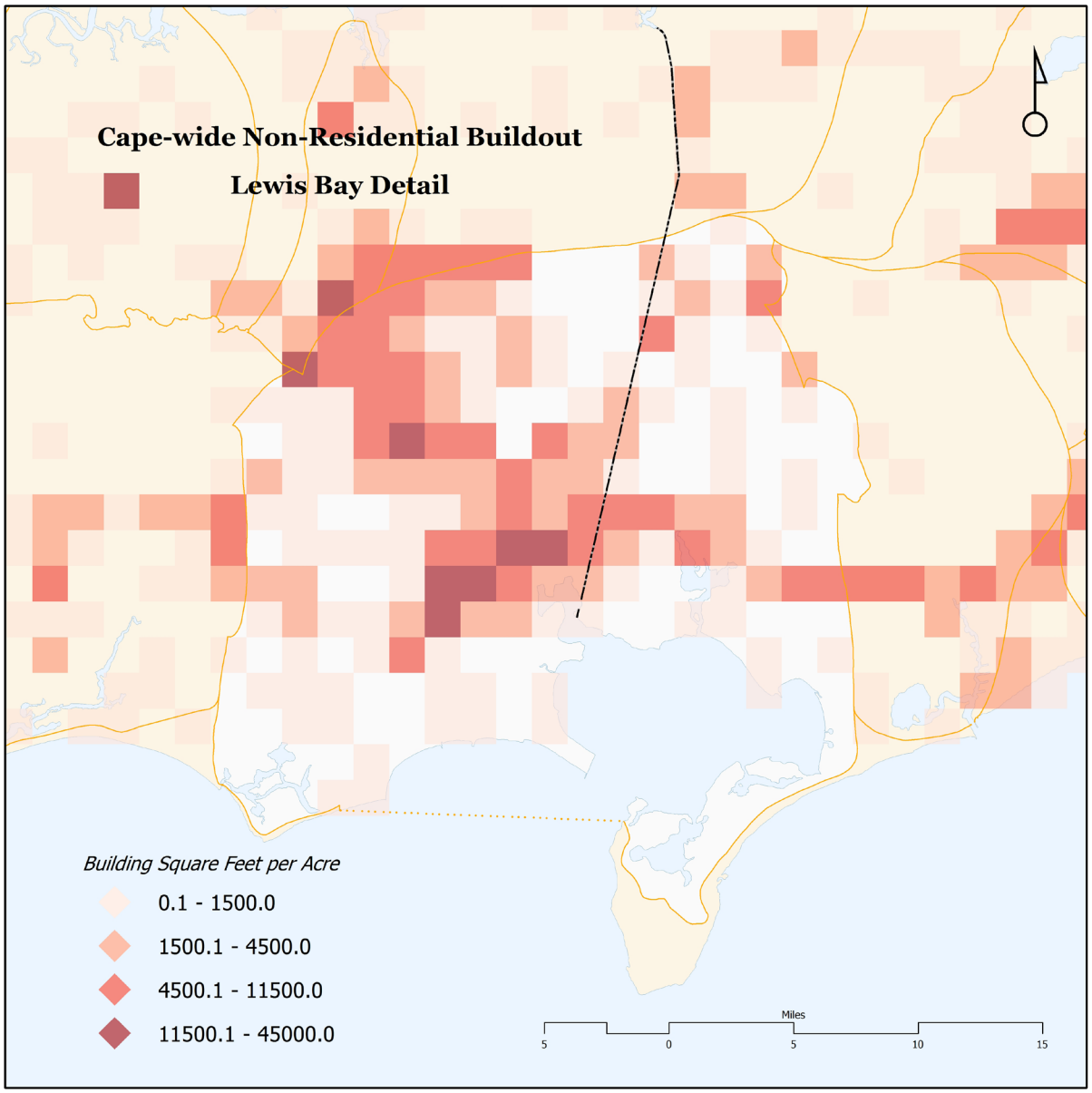
Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

FIGURE EAL-14: Potential Density of Non-Residential Development at Buildout in the Lewis Bay Watershed

Map displays development on a quarter-mile grid cell.
Watersheds to coastal embayments are outlined in yellow.



SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012

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TABLE EAL-3: Current and Potential Number of Dwelling Units and of Non-Residential Square Footage by Watershed to Coastal Embayments

WATERSHED	DWELLINGS ALL LAND USE CODES			NON-RESIDENTIAL SQUARE FOOTAGE LAND USE CODES 013, 031, 300–999		
	EXISTING	ADDITIONAL	% CHANGE	EXISTING	ADDITIONAL	% CHANGE
Back River/ Eel Pond	777	197	25	206,180	1,203,488	584
Phinneys Harbor	744	28	4	86,605	69,527	80
West Falmouth Harbor	728	147	20	504,416	1,084,028	215
Oyster Pond	213	27	13	0	0	0
Little Pond	1,242	138	11	1,160,523	380,512	33
Great Pond	4,543	800	18	558,422	281,011	50
Green Pond	1,356	177	13	151,319	39,980	26
Bournes Pond	1,105	239	22	120,540	65,083	54
Waquoit Bay East	3,854	617	16	504,594	1,615,510	320
Popponesset Bay	7,399	1,590	21	2,081,492	2,383,796	115
Rushy Marsh Pond	8	1	13	0	0	0
Three Bay	7,002	902	13	2,043,921	441,248	22
Centerville River	7,026	425	6	1,879,125	161,167	9
Lewis Bay	10,231	2,526	25	14,322,583	3,366,068	24
Parkers River	3,409	124	4	1,217,964	301,474	25
Bass River	11,207	806	7	5,129,297	1,942,023	38

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TABLE EAL-3 (continued)

WATERSHED	DWELLINGS ALL LAND USE CODES			NON-RESIDENTIAL SQUARE FOOTAGE LAND USE CODES 013, 031, 300–999		
	EXISTING	ADDITIONAL	% CHANGE	EXISTING	ADDITIONAL	% CHANGE
Allen Harbor	314	70	22	60,393	11,980	20
Wychmere Harbor	160	4	3	31,384	0	0
Saquatucket Harbor	1,182	196	17	237,287	28,548	12
Taylors Pond/ Mill Creek	690	79	11	233,541	135,115	58
Sulfur Springs/ Bucks Creek	1,065	110	10	331,874	304,539	92
Stage Harbor	1,829	260	14	1,468,610	222,509	15
Muddy Creek	1,182	209	18	143,496	22,510	16
Bassing Harbor/ Ryders Cove	1,155	135	12	435,823	118,244	27
Pleasant Bay	4,869	1,171	24	99,346	467,050	47
Rock Harbor	598	49	8	304,727	331,882	109
Little Nam-skaket Creek	407	38	9	247,514	264,917	107
Namskaket Creek	592	103	17	232,716	291,276	125
TOTAL:	74,887	11,168	15	34,693,690	15,533,488	45

SOURCE: CCC GIS, using MassGIS parcel boundaries and assessing data, 2010–2012