Mass Audubon
Protecting the Nature of Massachusetts

LOSING GROUND

Planning for Resilience

Patterns of development and their impact on the nature of Massachusetts

Fifth Edition of the Losing Ground *Series*

June 2014

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Acknowledgements

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Introduction

The nature of Massachusetts is rooted in the land. From the shifting sands of the Cape and Islands to the ancient bedrock ridges of the Berkshires and Taconics, each of the plant and animal species that we strive to protect requires sufficient habitat to survive. While the hardworking conservation community continues to protect fields, forests, and wetlands, loss of habitat due to land conversion remains one of the top threats to the nature of Massachusetts. For the past 30 years, Mass Audubon's *Losing Ground* series has tracked and reported on patterns of development and land conservation in Massachusetts, providing an essential snapshot of a changing Commonwealth over time. This latest edition provides updated trends between 2005 and 2013.

Environmental protection ultimately rests on preservation of landscape functions. Seed dispersal, animal movement across the landscape, gene flow amongst a population, the meandering of a stream—each of these is an example of a natural process that requires a landscape of connected natural areas, unconstrained by artificial barriers, in which to operate. Human land use, especially our inclination to build long-lasting structures and to harden our investments against the vagaries of natural processes, tends to interrupt these natural processes and thus reduce overall habitat quality and function.

Development has reshaped the face of Massachusetts in the past 40 years. Earlier editions of *Losing Ground* calculated 775,000 acres of developed land in Massachusetts in 1971, or 15 percent of the state. We now estimate that 1.1 million acres are developed, representing 21 percent of the state. Most of this development has occurred in the eastern half of the state as wooded suburbs have been absorbed by urban expansion and the farm fields of formerly rural exurbs have "grown houses" to meet the demand for commuter housing. In Chapter 1 we report on recent patterns of development across the state.

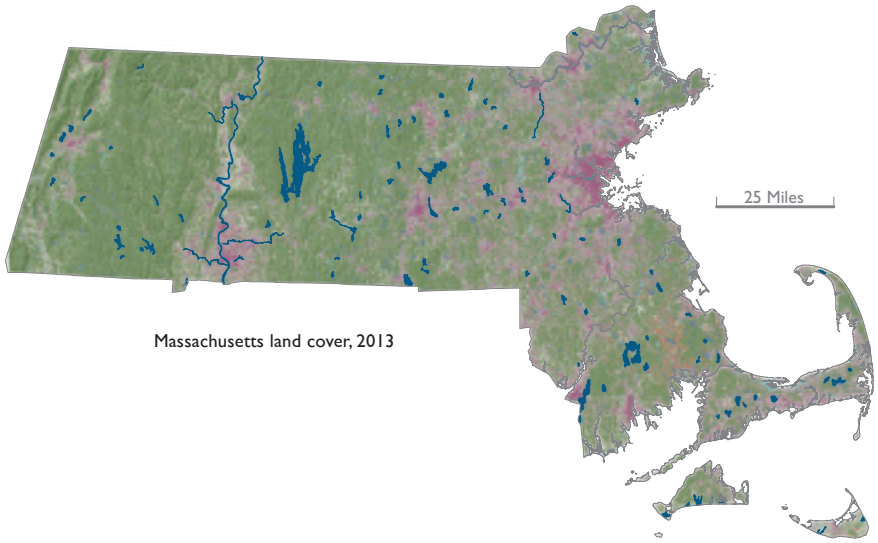
While the amount of developed land has increased, the amount of protected land has increased even more, especially in recent years. The second edition of *Losing Ground* concluded that 890,000 acres were permanently protected as wildlife habitat in 1997. We now estimate that 1,259,075 acres are permanently protected for all purposes. Chapter 2 analyzes the pace of land protection, where the land is being protected, by whom, and for what purposes.

For a glossary of terms, frequently asked questions, and technical report please visit www.massaudubon.org/losingground.

The amount and the location of both development and land protection influence habitat quality. Accordingly, it is critical to track how new development and land protection relate to our most important habitats. In Chapter 3 we look at development impacts on valuable habitat as determined in *BioMap2* and on resilient landscapes as determined by The Nature Conservancy (TNC). Chapter 3 also asks whether we are protecting the *right* land by providing an update on efforts to protect land identified in *BioMap2* and TNC's resilience analysis.

As natural lands are converted to development, it is ever more important to design our built environment to minimize effects on natural processes. Chapter 4 describes important planning tools and programs available to foster "green community" design in the Commonwealth to sustain our economy and environment. We also take an in-depth look at smart growth policies in 37 communities in the I-495 region, which continues to experience some of the highest development rates in the state.

Building activity was dramatically reduced in the period of our analysis, due to the Great Recession and resulting credit crunch; yet development pressure on the land is returning to levels seen in previous years. Recent catastrophic storms in our region have provided a sobering reminder that the era of climate change is upon us, and will require creative and proactive solutions. Planning and zoning for development must be modernized and the pace of land protection must increase even further if we are to maintain a Massachusetts with an interconnected mosaic of forests, fields, and wetlands, including the most valuable land for wildlife habitat and climate resilience.



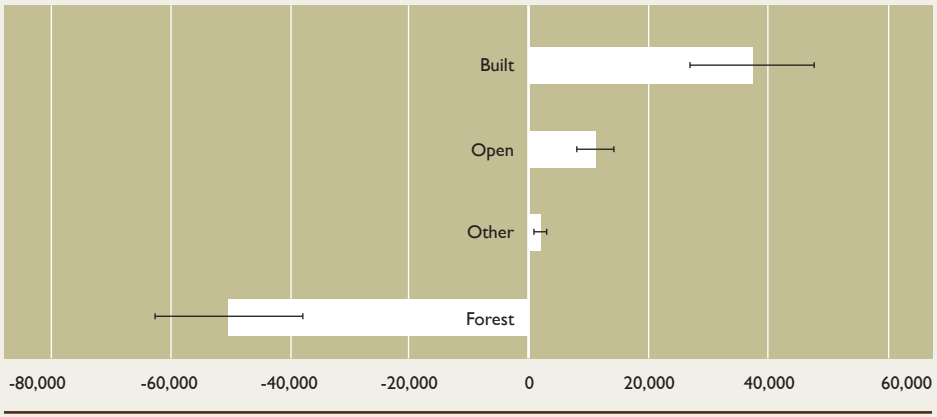
Massachusetts land cover, 2013

Chapter 1 / Land Use Changes in Massachusetts

Land use decisions in Massachusetts are typically made on a parcel-by-parcel basis, within the planning and regulatory frameworks established at the municipal and state levels. The local effects of these decisions may be obvious: businesses or residences spring up in former forest or farmland, for example, contributing to the economic and social capacity of the area. But the cumulative impacts of many such decisions are harder to discern, and questions of long-term community character, sustainability, and resilience come into play. To determine the patterns and trends of development over the period from April 2005 to April 2013, we analyzed a statewide land cover change dataset created by Boston University's Department of Earth & Environment.

From April 2005 to April 2013, approximately 38,000 acres of forest or other undeveloped land were converted to development in Massachusetts, translating to a pace of 13 acres per day through this 8-year period. Figure 1.1 shows that nearly 50,000 acres of forest were lost during this time period, and our "Open" category, consisting of bare land, low vegetation, and agriculture, increased by approximately 10,000 acres.

Figure 1.1: Land use change (acres) in Massachusetts, 2005-2013



LAND USE DATA SOURCES

Land use change analyses in past editions of *Losing Ground* were based on land use data provided by the Massachusetts Office of Geographic Information (MassGIS). Unfortunately, directly comparable, updated land use data were not available for use in this analysis. As an alternative, we turned to the Department of Earth & Environment at Boston University (BU) where researchers use Landsat satellite imagery to map land cover and monitor land cover changes. Landsat TM/ETM+ imagery has a 30-meter resolution, resulting in a land use mosaic consisting of approximately 0.22-acre pixels.

The BU team has developed a change detection and classification approach that accurately determines the timing and location of land cover changes based on changes in the surface reflectance characteristics of individual pixels.[1] This method utilizes all available Landsat TM/ETM+ data from 1985 to the present, and is relatively unaffected by clouds, shadows, satellite error, and other artifacts that challenge land cover analyses based on shorter observation periods. Mass Audubon has worked with the BU team to create and assess a custom, seven-class land cover product. The agreement among our land cover data and an internally generated reference dataset is approximately 86 percent.

Importantly, this new approach to mapping and monitoring land cover change allows us to estimate annual rates of development during the period of our analysis. This information was not available in previous editions of *Losing Ground* and represents a powerful new way to look at changes in the rate of development within our analysis window.

The estimated daily rate of development is markedly lower than the rate reported in previous editions of *Losing Ground*. This is good news from a conservation perspective, yet it is critical to remember that this time period includes the most dramatic and sustained slowdown in building activity to affect Massachusetts in decades. The 2007 global economic crisis and ensuing Great Recession hit Massachusetts' construction sector particularly hard, but the economy and construction are rebounding. Figure 1.2 shows the estimated annual rate of development since 2005 along with permitted housing units in Massachusetts according to the U.S. Census Bureau.[2] While our Landsat-derived development estimates show the economic slowdown, our model captures trends only through April 2013, limiting our ability

to effectively determine the subsequent rebound in development. The housing start data, which is available through 2013, clearly shows that the number of residential units produced per year is trending toward its previous rate. Furthermore, the state passed a law automatically extending for four years all valid state, regional, and local land use-related permits in existence between August 15, 2008, and August 15, 2012. Many projects permitted during this term can simply begin construction without further review, even if local land use rules have changed in the interim. It will be good news if the rate of land lost to development stays low while the number of units produced rises.

Figure 1.2: New development and permitted housing units in Massachusetts

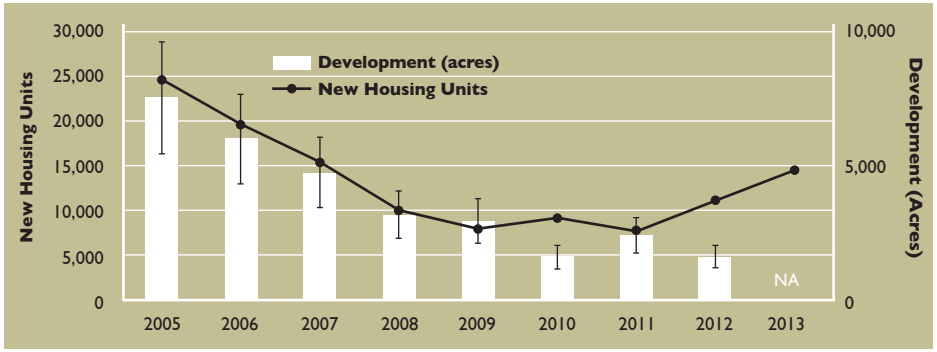
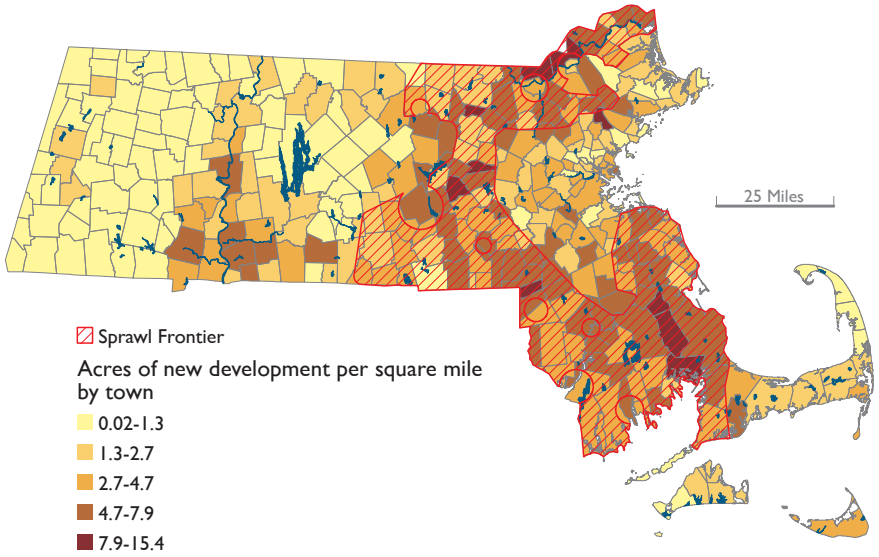


Figure 1.3: Recent development trends in Massachusetts, 2005-2013



The Sprawl Frontier & Danger Zone: How far has it spread?

The reduction in the pace of development since 2005 has mostly affected those communities where high development rates have been previously documented. This makes sense because communities that were experiencing little development pressure before the downturn (such as in the Berkshire highlands) have in general continued to experience little loss of natural land, while those with high development pressure (such as in the Blackstone Valley) generally have declining development rates. A consequence of this statewide slowdown in building activity has been that two development areas identified in previous *Losing Ground* reports, the Sprawl Frontier and the Sprawl Danger Zone, remain substantially similar to their 2005 extents[3] (Figure 1.3).

Most of the towns experiencing the highest rates of development in Massachusetts—the Sprawl Frontier—are within 10 miles of I-495, with an additional cluster in the southern Connecticut River Valley. Within the I-495 zone, municipalities with the highest rates (between approximately 8 and 16 acres of new development per square mile of land area) are located near Plymouth (Plympton, Carver, and Wareham), scattered east of Worcester (Northborough, Hudson, Grafton, and Milford), or along the Merrimack River (Tyngsborough, Dracut, and Methuen), with a few other communities (including Ayer, Lynnfield, and Plainville) also occurring in this class. It is notable that many of these communities include or are near the ends of the MBTA commuter rail system branches (Figure 1.4).

Many towns on the Worcester Plateau and in the Connecticut and Housatonic River valleys were characterized in the previous edition of *Losing Ground* as being in the Sprawl Danger Zone: areas where an increase in development pressure could lead to significant changes in community character and ecological function. The economic downturn has relieved development pressure throughout much of the Sprawl Danger Zone; this situation represents an extended opportunity for land conservation.

COMPARING COMMUNITIES

Massachusetts' 351 municipalities vary greatly in size, from the smallest (Nahant, at 1 square mile of land) to the largest (Plymouth, at nearly 100 square miles of land), so it would not always be meaningful to compare the absolute acreage of development across towns. To provide a common basis for comparison in this report, the area of new development in each town between 2005 and 2013 has been normalized by the town's area, giving a development rate of acres per square mile.

Figure 1.4: Hot spots of development—20 towns with the highest development rates in Massachusetts

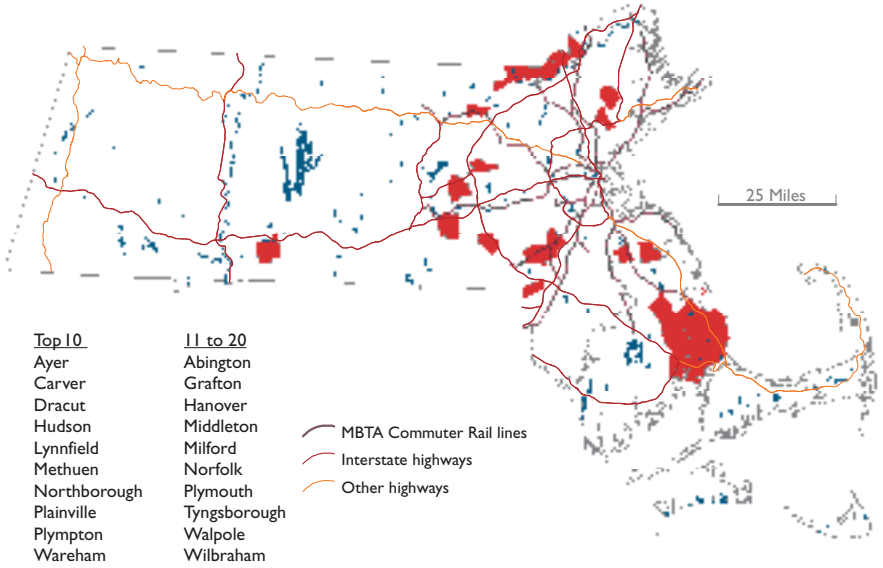
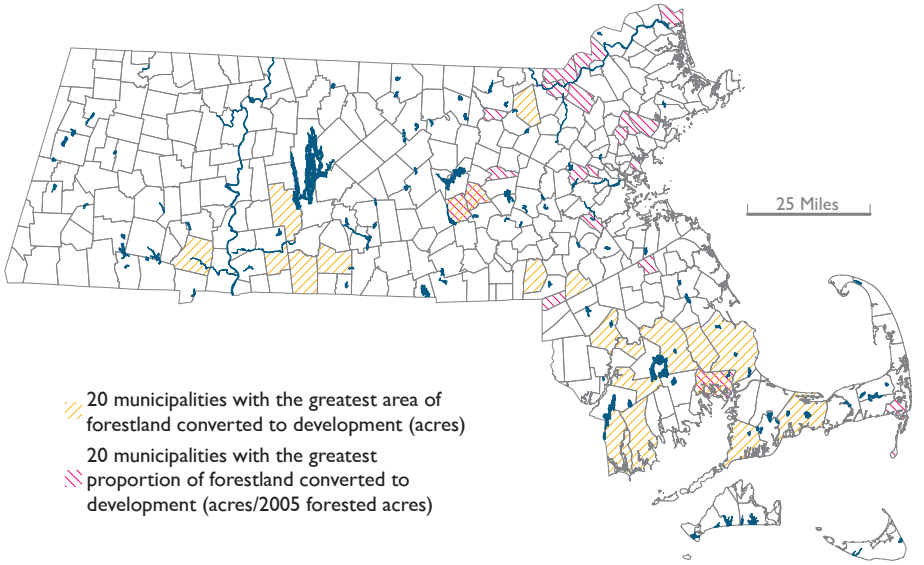


Figure 1.5: Forest conversion in Massachusetts, 2005-2013



What types of land are being developed in Massachusetts?

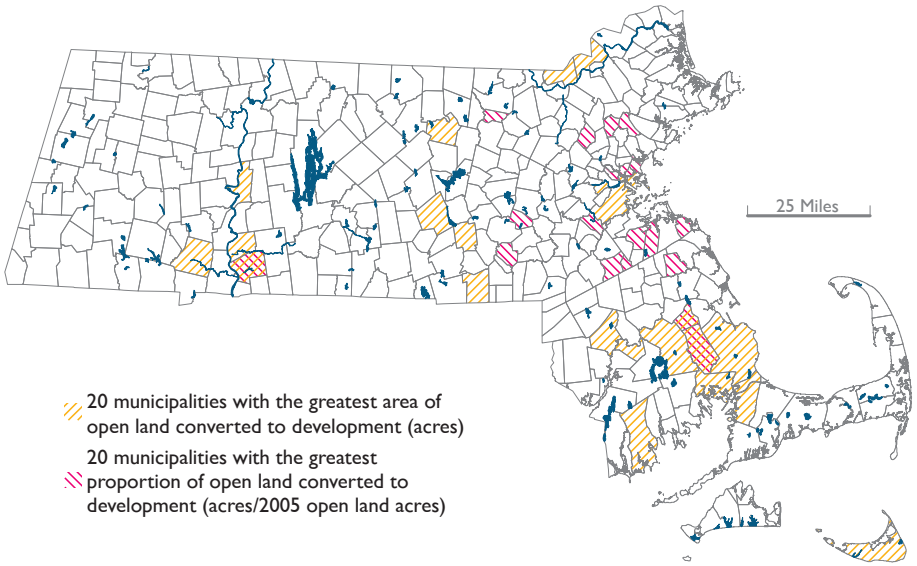
In *Losing Ground* we are primarily addressing the issues surrounding *new* development—the conversion of a previously undeveloped area to residential, commercial, industrial, or other built land uses—rather than changes in use on previously developed sites (e.g., brownfield redevelopment). The conversion of forestland to low-density residential housing accounts for the great majority of land development in Massachusetts between 2005 and 2013; conversion of open land to other types of housing and/or commercial development is also substantial.

Figure 1.5 shows the 20 municipalities with the greatest amount of forest conversion to development between 2005 and 2013, both as absolute area and relative to the amount of forest in each town present in 2005; three municipalities are in the top 20 of both categories. Regions experiencing the greatest area of forest conversion include southeastern Massachusetts and the inner Cape, as well as a cluster of towns south of the Quabbin Reservoir. Each town in the top 20 of forest conversion has lost more than 100 acres of forest to development between 2005 and 2013; Plymouth, at number one, has lost more than 400 acres of forest.

In contrast, most of the towns developing the greatest proportion of 2005 forest area are in the greater Boston area or the Merrimack River valley. It is important to consider that in communities such as Revere, Belmont, Lowell, and Wakefield—the top four communities in the latter class, which each have less than 1,000 acres of forest (and Revere has less than 100 acres)—even a relatively small development can impact a large proportion of the community's forest area, dramatically altering neighborhood character and local ecological function.

Forest, including forested wetland, remains Massachusetts' primary land cover type, occurring on more than 3.2 million acres (more than 60 percent) of the state and forming the matrix in which all other land uses occur. In addition to its aesthetic, recreational, and wildlife habitat values, this forest cover provides crucial ecosystem services, including filtering water and air, sequestering carbon, and buffering the effects of severe storms; forestland also supports the state's economy as a source of renewable fuel, food, and fiber. Maintaining the integrity of this forested matrix is critical for the long-term well-being of both human and natural systems.

Figure 1.6: Open land conversion in Massachusetts, 2005-2013



DATA LIMITATIONS

Landsat-derived land cover classification offers many advantages, including its continual and frequent updating (new images of Massachusetts are acquired approximately every 16 days), but existing methods for analyzing these data are challenged to accurately classify some important land use/land cover types. Agricultural areas in particular, with somewhat irregular patterns (both spatially and through time) of field preparation, crop production, and fallowness, do not fit neatly into a single classification label as readily as a stable forest, for example. Within a single growing season, a cropland area could be classified as bare soil, row crops, and herbaceous growth/pasture, sometimes multiple times. Due to the high incidence of categorization error among nonforested, undeveloped land use types, we decided to aggregate these categories into a single "Open Land" class. The tradeoff, however, is that all open lands, including quarries, beaches, urban vacant lots, and forests cleared for development but not yet developed, are also within the Open Land class, limiting our ability to draw from these data specific conclusions regarding agricultural land.

Figure 1.6 shows the 20 municipalities with the greatest amount of open land conversion to development between 2005 and 2013, both as absolute area and relative to the amount of open land in each town present in 2005; three municipalities occur in the top 20 of both categories. The open land class includes cropland, pasture, and hayfields, as well as areas of bare soil, low woody vegetation, and recreational fields; importantly, this class also includes areas that have been cleared in preparation for development. As such, this map should not be interpreted as representing conversion of agricultural land alone. (See box on Landsat data limitations.)

The broad geographic pattern of the municipalities experiencing the greatest absolute areas of open land conversion to development is similar to those experiencing forest conversion: a cluster of southeastern/inner Cape municipalities, several municipalities in the southern Connecticut River valley, and more scattered around Worcester. These top 20 communities also include Nantucket and, surprisingly, Boston. Approximately 100 acres or more of open land have been converted to development between 2005 and 2013 in each of the top 20 communities, with Plymouth again placing first at more than 300 acres.

The top 20 municipalities with the greatest proportion of 2005 open land area converted to development are mostly concentrated in the greater Boston area, with a few towns near I-495, and the city of Springfield. In general, the proportion of open land conversion in these communities is high because they had relatively small areas of open land in 2005.

The maintenance of agricultural capacity has been an important economic, social, and conservation goal in Massachusetts for many years. A preliminary report released in February 2014 by the USDA National Agricultural Statistics Service indicates that the number of farms and acreage of farmland in Massachusetts increased modestly between 2007 and 2012, to nearly 7,800 farms and over 520,000 farm acres (farm acres in this tally includes buildings and noncultivated areas of a farmed parcel, such as forest or wetlands; the actual area in active agricultural use is substantially smaller).[4]