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Cape Cod Pesticide and Fertilizer Use Inventory

September 17, 2013 Draft for Public Comment

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EXECUTIVE SUMMARY

Due to the potential threat pesticides and fertilizers pose to the environment and public health, these products have been a major topic of discussion on Cape Cod among regulators, industry, environmental groups, and the public. Pesticides are used to prevent, destroy, or repel living organisms when and where they are not wanted. Fertilizers are added to soil to promote plant growth by providing supplemental nutrients to plants, including nitrogen, phosphorous, and potassium. A portion of pesticides and fertilizers applied to fields, lawns, and other areas makes its way to surface waters through stormwater runoff, to groundwater by leaching through the soil, and to other areas by volatilization into the atmosphere from which it is redistributed by precipitation.

Pesticides can pose a threat to drinking water, and are considered contaminants of emerging concern by the U.S. Environmental Protection Agency (EPA). In addition to being a potential threat to human health, pesticides can be toxic to aquatic ecosystems and can accumulate in sediments. Once introduced into the water, pesticides are difficult to remove, and most water utilities do not test drinking water for the presence of pesticides.

The primary pollutants of concern in to fertilizer are nutrients (nitrogen and phosphorous). Nitrogen can pose a threat to public health once introduced into drinking water supplies. Nitrogen and phosphorous are the limiting nutrients in coastal and fresh water systems, respectively. A limiting nutrient acts like a fertilizer and its presence or absence controls the extent of plant and algae growth. If too much of a limiting nutrient is present, it promotes excess growth of nuisance plants and algae, a process known as eutrophication.

The goal of this project was to better understand the extent of pesticide and fertilizer use on Cape Cod, particularly the relative application on different land uses in the region (e.g., residential, commercial, municipal). In addition, recommended best management practices (BMPs) for these products to reduce their potential impact to water resources are identified. This knowledge will allow Barnstable County and other stakeholders to identify and implement appropriate strategies to reduce pesticide and fertilizer use impacts to protect the Cape's water resources.

Using past studies and data collected by the Cape Cod Commission (the Commission) and others, the Horsley Witten Group, Inc. (HW) quantified relative use of pesticides and fertilizers by different user categories, and recommended BMPs for improved management of these products. The largest user category of both pesticides and fertilizers is residential use, whether residents apply the products to their property themselves, or whether the products are applied to their properties by commercial applicators. Figure 1 shows the relative use of pesticides by various user categories, and Figure 2 shows relative fertilizer use.

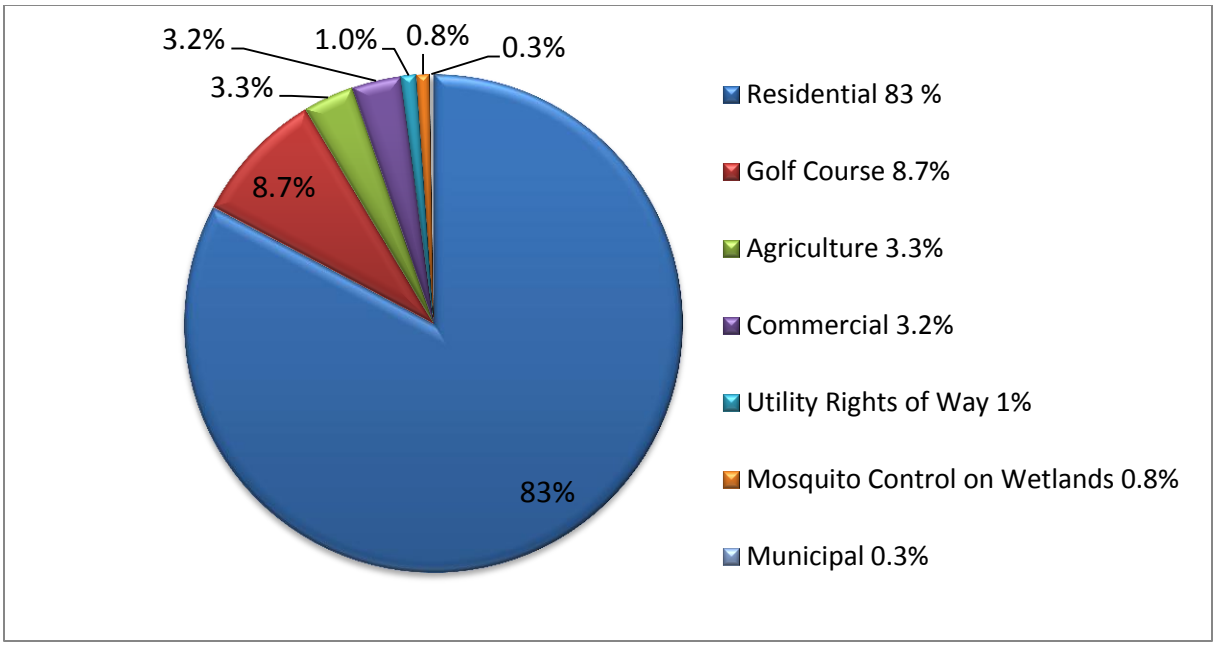

Figure 1. Relative Pesticide Use by Different User Types

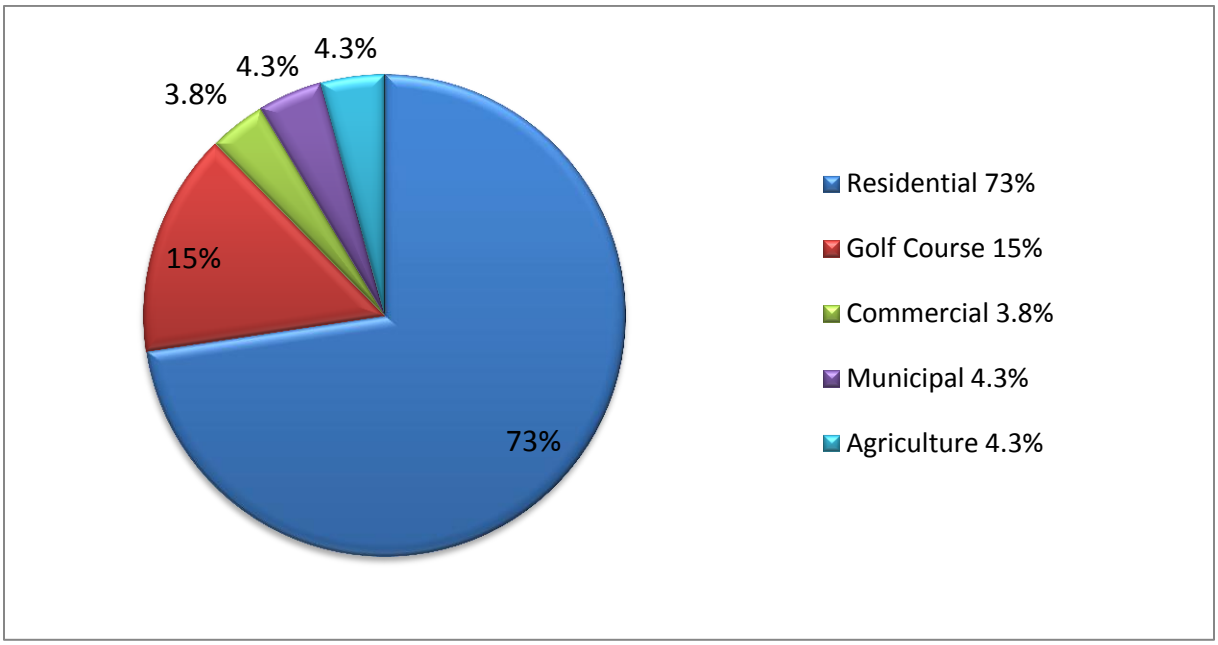

Figure 2. Relative Fertilizer Use by Different User Types

HW identified BMPs intended to maximize the benefits of vegetated areas, whether they are turf, landscaped areas or agricultural areas, while minimizing the potential for environmental impact that can happen as a result of inefficient, incorrect or irresponsible application practices. HW focused on general BMPs, applicable to most land uses, but also provided resources for industry-specific BMPs. HW identified BMPs in the following three broad categories: planning and education, integrated pest management; and use of native/naturalized vegetation.

1.0 INTRODUCTION

The use of pesticides and fertilizers on Cape Cod has been a major topic of discussion among regulators, industry, environmental groups, and the public. This is due to the potential threat these products pose to the environment and public health. Pesticides encompass a wide variety of chemicals used to prevent, destroy, or repel living organisms when and where they are not wanted. Pesticides are often referred to according to the type of pest they control, such as insecticides, rodenticides, and fungicides. Fertilizers are added to soil to promote plant growth by providing supplemental nutrients to plants, including nitrogen, phosphorous, and potassium.

Pesticides can pose a threat to drinking water, and are considered contaminants of emerging concern by the U.S. Environmental Protection Agency (EPA). According to the EPA, laboratory studies show that pesticides can cause health problems such as birth defects, nerve damage, cancer, and other effects that might occur over a long period of time, and that the effects depend on the toxicity of the pesticide and the amounts consumed. Some pesticides also pose unique health risks to children. Often, a portion of the pesticides applied to fields, lawns, and other areas makes its way to surface waters through stormwater runoff, to groundwater by leaching through the soil, and to other areas by volatilization into the atmosphere followed by precipitation. Once introduced into the water, pesticides are difficult to remove, and most water utilities do not test drinking water for the presence of pesticides. In addition to being a potential threat to human health, pesticides can be toxic to aquatic ecosystems and can accumulate in sediments.

The primary pollutants of concern related to fertilizer use are nutrients (nitrogen and phosphorous). The EPA established a maximum contaminant limit (MCL) for nitrate of 10 parts per million (ppm), or 10 milligrams per liter (mg/L) for drinking water. The Cape Cod Regional Policy Plan recommends a nitrogen loading standard of 5 mg/L to ensure that nitrate levels in drinking water are well below the federal standard. Excess nitrate in drinking water can pose health risks, particularly to young infants, as it can result in restriction of oxygen transport in the bloodstream. Infants under the age of four months lack the enzyme necessary to correct this condition, also known as the blue baby syndrome. Recent research (Ward et al., 2010) also indicates that nitrate levels above 5 mg/L may lead to increased cancer risks in certain populations. Public drinking water quality on Cape Cod is generally very good, but the Cape Cod Commission (the Commission) identified a recent trend toward some degradation.

In addition to being drinking water contaminants, nitrogen and phosphorous are the limiting nutrients in coastal and fresh water systems, respectively. A limiting nutrient acts like a fertilizer and its presence or absence controls the extent of plant and algae growth. If too much of a limiting nutrient is present, it promotes excess growth of nuisance plants and algae, a process known as eutrophication.

Figure 3 shows the average managed areas across Cape Cod by land use type. These areas are assumed to be lawns, and were derived by the Cape Cod Commission's Geographic Information System (GIS) team. Details on the development of these layers are provided in Appendix A of this report. This Figure provides a visual representation of the relative managed areas for various land uses.

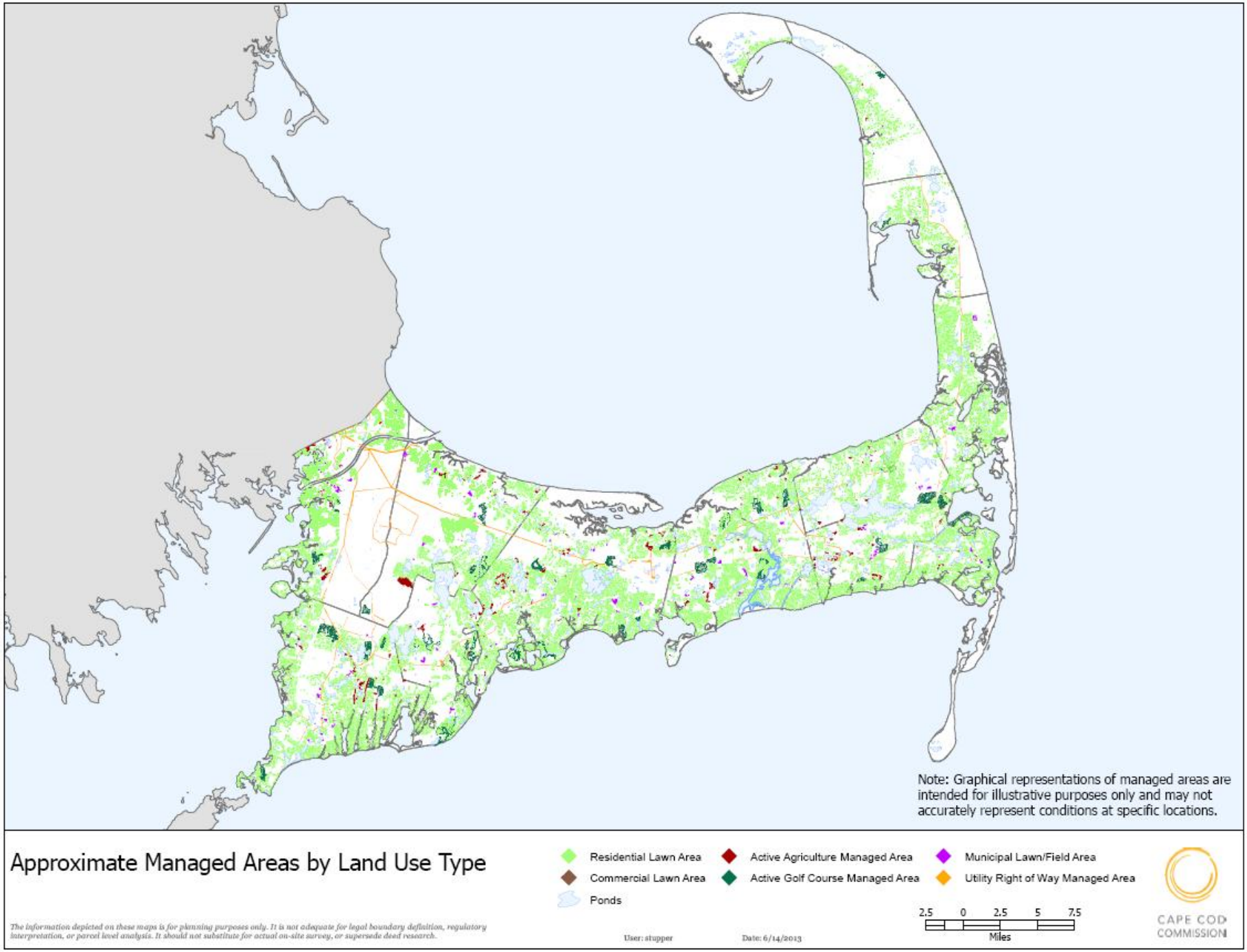

Figure 3. Approximate Managed Areas by Land Use Type

The goal of this project is to better understand the extent of pesticide and fertilizer use on Cape Cod, particularly the relative use among different land uses in the region (e.g., residential, commercial, municipal), and to recommend best management practices (BMPs) for these products to reduce their potential impact to water resources. This understanding will allow Barnstable County and other stakeholders to identify and implement appropriate strategies to reduce pesticide and fertilizer use impacts in order to protect the Cape's water resources.

Certain categories of users have already implemented BMPs, and are more educated about pesticides and fertilizers than other users. For example, golf courses and the agricultural industry have a financial incentive to reduce their pesticide and fertilizer use. These products get expensive when applied in large quantities, and savings can be achieved by applying them more efficiently. While the same economic incentive applies to other users such as home-owners, the incentive is not as great when overall quantities purchased by an individual are much smaller. In addition, all pesticide applicators except individual home-owners must be licensed. Obtaining and maintaining a valid license requires a certain amount of upfront and regular education that unlicensed applicators (e.g., home-owners) are not required to have.

This report summarizes data collected by the Commission and the Horsley Witten Group, Inc. (HW), and analyzes these data to determine the relative contributions of pesticides and fertilizers by different land use categories. This study builds upon an initial round of data collection managed by the Commission, including a phone survey of local residents to understand and quantify pesticide and fertilizer use on their properties, both by themselves and by outside contractors (Cape Cod Commission, 2012). The following projects and resources were also evaluated as part of this analysis:

- The Pleasant Bay Fertilizer Management Plan prepared by HW for the Pleasant Bay Alliance. This project identified a series of fertilizer reduction strategies for the Pleasant Bay watershed that have potential application across the entire Cape;
- A survey of residential fertilizer use in Orleans conducted by the University of Massachusetts School of Marine Science and Technology (SMAST);
- The Massachusetts Estuaries Project Reports prepared for various watersheds across the Cape that contain fertilizer application data for residential and commercial properties based, in part, on land area;
- Recent legislation signed by Governor Patrick that limits applications of phosphorus fertilizers throughout the state; and
- A recent pesticide use analysis conducted by the Massachusetts Department of Agricultural Resources (MDAR) that evaluated relative pesticide use based on land use type.

2.0 PESTICIDE USE

This section describes HW's methodology for quantifying pesticide use on Cape Cod, and provides detailed results by land use type.

2.1 Methodology

HW worked with Commission staff to gather information related to pesticide use on Cape Cod. Data were collected from a variety of sources, including MDAR, personal communications with a number of pesticide users and applicators, published literature, and garden centers, among others. Table 2-1 summarizes the pesticide use data sources for each land use category. These data were then analyzed to quantify total annual pesticide use (pounds per year) for each land use category. Using spatial data provided by the Cape Cod Commission, HW also estimated average annual pesticide application rates for each land use category (pounds per acre per year).

Most of the detailed pesticide use data came from a database developed by the Commission using 2010 MDAR data (the Commission's MDAR database). This database provides total pesticide use (by total product and active ingredient) as reported by licensed applicators or businesses on Cape Cod. It should be noted that individual homeowners are not required to report their personal pesticide use to MDAR when they purchase and apply pesticides themselves. The stores where they purchase those pesticides are also not required to report sales to MDAR. Businesses reporting to MDAR and included in the Commission's MDAR database range from golf courses to landscape companies to cranberry bogs and towns, and are categorized in the following user groups in the database:

- Agriculture;
- Golf Course;
- Municipal;
- Commercial; and
- Unknown.

This study focuses on quantifying pesticide and fertilizer use for the following user categories: residential, commercial, golf courses, agriculture, municipalities, utility rights of way, and mosquito control operations. While the reporting categories in the Commission's MDAR database do not exactly match the land use categories analyzed in this study, HW was able to include most of the data in the analysis.

Table 2-1. Pesticide Use Data Sources

Land Use Category	Pesticide Use Data Sources
General	• Personal communication with Ridley and Associates, Inc. • Personal communication with Green Cape • Personal communication with Sarah Little, Ph.D., Toxics Use Reduction Consultant

Land Use Category	Pesticide Use Data Sources
Residential	• Cape Cod Commission 2010 MDAR Pesticide Use Database • Results from the July 2012 Survey of Residential Fertilizer and Pesticide Use on Cape Cod • 2012 pesticide and fertilizer sales records for several Cape Cod garden centers • Product labels for most commonly used pesticides and fertilizers • Cape Cod Commission GIS data (see Appendix A)
Commercial	• Cape Cod Commission 2010 MDAR Pesticide Use Database • 2012 pesticide and fertilizer sales records for several Cape Cod garden centers • Personal communication with several commercial applicators • Cape Cod Commission GIS land use data (see Appendix A)
Golf Courses	• Cape Cod Commission 2010 MDAR Pesticide Use Database • Cape Cod Commission GIS land use data (see Appendix A) • Personal communication with Cape Cod golf course personnel • Individual golf course MDAR Pesticide Use Reports for several Cape Cod golf courses between the years of 2007 – 2012
Municipalities	• Cape Cod Commission 2010 MDAR Pesticide Use Database • Personal communication with town staff from public works, schools, recreation, and other municipal departments in seven towns across the Cape
Utility Rights-of-Way	• 2008 – 2009 NSTAR pesticide use data for Cape Cod provided by MDAR • Wijnja, Hotze. January, 2011. Estimated Pesticide Use on Cape Cod for Vegetation Management (for total utility rights-of-way acreage) • NSTAR Five-Year Vegetation Management Plan (2008 – 2012) • NSTAR Proposed Five-Year Vegetation Management Plan (2013 – 2017) • Cape Cod Commission GIS land use data (see Appendix A)
Wetland areas receiving mosquito control applications	• Cape Cod Commission 2010 Massachusetts Department of Agricultural Resources Pesticide Use Database • Personal communication with Cape Cod Mosquito Control Project • Cape Cod Mosquito Control Project 2011 Annual Operations Report • Cape Cod Mosquito Control Project NPDES Permit (for cumulative wetlands acreage)
Agricultural areas	• Cape Cod Commission 2010 Massachusetts Department of Agricultural Resources Pesticide Use Database • Cape Cod Commission GIS land use data (see Appendix A) • Personal communication with Cape Cod Cooperative Extension • Personal communication with UMass Extension Landscape and Agriculture Program, Cranberry Team

Pesticide active ingredients are the chemical compounds contained within a pesticide product that are toxic to the target organism for which the pesticide is intended. Most pesticide products are not composed of active ingredients exclusively. However, sometimes the "inactive" or

"inert" ingredients contained within the product are also toxic (Cox et al., 2006), and they are usually added to the pesticide product to enhance its effectiveness. For example, inert ingredients may serve as a solvent, allowing the pesticide's active ingredient to penetrate a plant's outer surface. Despite their potential toxicity, federal law does not require that these inactive ingredients be identified by name or percentage on the label (EPA, 2013). Therefore, for purposes of quantifying pesticide use, HW conducted its analysis based on the total amount of product applied rather than on active ingredients only.

Pesticides are available in a wide variety of forms and concentrations. Some pesticides are added to fertilizers, such that when users apply the fertilizer to their properties, they are also applying pesticides. While the primary purpose of the product is to fertilize, pesticide-fertilizer combination products are reported to MDAR by applicators, and are sold by retail stores. HW used the MDAR database to compare active ingredient concentrations in straight pesticides with those in combination pesticide/fertilizer products (Section 2.2.1). This enabled HW to account for both the pesticide and fertilizer contents of these products.

Pesticide use is reported by companies using a number of different units, which include liquid units (e.g., gallon, quart) as well as solid units (e.g., pound, ton). To provide a total amount of pesticide per company and land use category, all units were converted to pounds. While it is understood that liquid and solid concentrations for pesticides can vary, in an effort to avoid discounting the inert ingredients, liquid measurements were converted to pounds using the density factor for water (e.g., one gallon of pesticide is equivalent to 8.35 pounds of pesticide).

Many variables affect pesticide use from year-to-year, such as climate, weather, and disease outbreaks. Since data from the Commission's MDAR database represented a single year of data, it does not account for fluctuations in weather and other factors. Therefore, as much as possible, HW used other data sources to provide context to the 2010 data. For example, HW contacted several Cape Cod golf courses and reviewed several individual Pesticide Use Reports over the last five or six years to quantify the variation in pesticide use from year-to-year. Based on the data, it appeared that pesticide use could vary by up to about 50%. The fluctuations could be the result of changes in climatic or weather conditions, disease outbreaks, economic factors, change in pesticide product (e.g., concentration), or other variables. Based on personal communication with a number of golf course managers, 50% variation in pesticide use from year-to-year is atypical, and generally the amount of fluctuation from one year to the next is more constant. Additional details on how pesticide use was quantified for each land use category are provided below.

2.1.1 MDAR Data Analysis

As previously discussed, individual home-owners who purchase and apply pesticides to their property do not report their use to MDAR. So while the Commission's MDAR database does not include all pesticide user categories, it provides detailed information about the regulated users. HW analyzed the Commission's MDAR database to quantify pesticide use for regulated users, compare straight pesticides with combination pesticide/fertilizer products, and identify the top 10 active ingredients used across the Cape by total weight.

2.1.2 Residential and Commercial Pesticide Use

Lawns and landscaped areas on residential and commercial properties can be managed by a number of entities, including the home or business owner, a landlord, a commercial landscaper or applicator, or a property management company, among others. Pesticide use from these various entities was obtained from different sources. Since the data sources for both residential and commercial properties are the same, and the data and methodology used for these two land use categories are very similar, they are summarized below. HW then made a number of assumptions to separate the two categories, and provide an estimate of pesticide use for each.

Estimating Total Pesticide Use for Residential and Commercial Properties

The Commission's MDAR database provides quantities and types of pesticides applied by licensed applicators from companies labeled as "commercial" in the database. These "commercial" companies are all located on or near Cape Cod, and are assumed to apply most of their reported pesticides on the Cape. It is possible that some off-Cape applicators conduct business on the Cape, but HW assumed that those would be balanced with on-Cape applicators conducting some part of their business off-Cape.

The "commercial" category of the Commission's MDAR database includes landscaping, pest control, and property management companies, as well as a few other private entities. However, the database does not specify the type of property (i.e., commercial or residential) to which the licensed applicators applied the pesticides. In an effort to separate residential from commercial use, and to provide some context to the 2010 data "snapshot," HW reached out to commercial applicators and landscapers. HW initially asked a number of Cape Cod companies to complete an online survey on the types and quantities of pesticides they apply on an annual basis, the number of acres they manage, and how much of their business is for residential, commercial, and/or industrial customers. Six applicators provided incomplete surveys with limited responses to questions. HW followed up with the commercial applicators and landscapers by phone with a smaller set of questions, but they were reluctant to provide detailed information. Therefore, pesticide use quantities derived from the Commission's MDAR database are difficult to distribute between residential and commercial properties. HW first estimated total use for both categories combined before separating them.

Some home and business owners may apply the pesticides themselves without the need for an applicator license, therefore without any reporting to MDAR. To quantify pesticide use from these users, HW reached out to garden centers and other potential suppliers, and requested recent sales records for pesticides. HW obtained 2012 sales records from four garden centers distributed across Cape Cod in Sandwich, Hyannis, Dennisport, and Truro. Similar to the Commission's MDAR database, the quantities purchased from these garden centers are difficult to distribute between residential and commercial properties as this information is not tracked by the garden centers. However, based on conversations with one of the Garden Centers, it could be assumed that most of these sales were made to residential users.

HW reviewed the Cape Cod Commission's *Residential Fertilizer and Pesticide Use on Cape Cod* report that provides results and a summary of the Commission's summer 2012 survey of

pesticide and fertilizer use on Cape Cod. A number of the assumptions made to quantify pesticide and fertilizer use are taken from results of this survey.

Using the Commission's MDAR database, HW calculated the total amount of pesticides reported to MDAR in the database as either straight pesticides, or a combination of pesticide and fertilizer when the name of the product indicated that it was a combination of pesticide and fertilizer. This total amount of pesticides is assumed to be applied by "commercial applicators."

In addition, HW used a combination of the sales records and the survey results to extrapolate the amounts sold at these retail stores and estimated a total amount of pesticide applied by individuals across the Cape. The survey provides the following statistics:

- 57% of residents apply fertilizer on their property, either themselves or through a contractor;
- 62% of those who fertilize apply the fertilizers themselves;
- 24% of those who apply fertilizers themselves purchased them from a nursery or garden store (as opposed to a home supply store, a hardware store, or a discount store);
- The average property owner who fertilizes applies approximately 59 pounds (lbs) of fertilizer to his/her property annually;
- 51% of residents apply pesticides on their property, either themselves or through a contractor;
- 67% of those who apply pesticides purchased the products themselves; and
- 15% of those who apply pesticides themselves purchased them from a nursery or garden store.

After estimating the total amount of both pesticides and fertilizers sold by the surveyed garden stores, HW applied the survey statistics above to estimate the amount of pesticides applied by an individual resident.

The total amount of pesticides applied on residential and commercial properties was estimated as the sum of the total pesticides reported in the MDAR database by "commercial" entities, and the estimated amount of pesticides purchased by individual customers for their own application.

Comparing Results to National Data on Pesticide Use

For verification purposes, and to confirm the order of magnitude of the application rate, HW researched other estimated pesticide application rates for homeowners, and found an EPA estimate of total residential pesticide use expressed in terms of active ingredients.

EPA's *1996-1997 Pesticide Market Estimates*, and *2006-2007 Pesticide Market Estimates* web pages (http://www.epa.gov/pesticides/pestsales/index.htm) discuss pesticide use and trends for the US, and estimate that homeowner applications of conventional pesticides totaled approximately 76 million pounds of active ingredients in 1997, excluding "commercial applications to homes and gardens, including lawns." Homeowner pesticide use was 71 million pounds of active ingredients in 2006, and 66 million pounds in 2007. According to census projections (Bureau of the Census, 1996), there were approximately 100 million households in

the U.S. in 1997, and 110 million and 111 million in 2006 and 2007, respectively. Using the same statistics as in the survey, (i.e., 51% of household apply pesticides, of which 67% apply it themselves), approximately 34 million households applied 76 million lbs of pesticides in 1997. Similarly, approximately 38 million households applied 71 and 66 million pounds of pesticides in 2006 and 2007, respectively. This is equivalent to each household applying 2.2, 1.9, and 1.7 lbs of active ingredients to their properties in 1997, 2006, and 2007, respectively.

The household pesticides most mentioned in the Commission's survey of pesticide and fertilizer use (i.e., Dimension™, Ortho™ weed-b-gone, Round-up™ weed killer, and Spectracide™) contain at most 5% active ingredients, with most products containing closer to 1% or less. Therefore, the 1.7 to 2.2 lbs of active pesticide ingredients applied by the average American household corresponds to approximately 34 to 44 lbs of total pesticides. HW then compared this national average to the estimated use on Cape Cod.

Separating Residential from Commercial Pesticide Use

Based on conversations with pest control companies and landscapers, HW determined that most of their customers are residential users. The proportion of commercial customers for pest companies was estimated by these businesses as approximately 1% for pest companies, and 5 to 15% for landscape and lawn care companies. In addition, garden centers indicated that most, if not all, of their customers are home-owners. In order to separate pesticides applied on residential properties from the amounts applied on commercial properties, HW assumed the following:

- Approximately 90% of the pesticides applied by commercial applicators are for residential customers, with the remaining 10% used for applications on commercial properties; and
- All sales from garden centers are made to customers who will apply the products on residential properties.

2.1.3 Golf Course Pesticide Use

Pesticide use on golf courses was primarily calculated using data provided in the Commission's MDAR database. There were a total of 27 golf courses with pesticide use data entered into the database with a total managed land use area of about 2,000 acres. This area includes those areas of the golf course that are managed and where pesticides and fertilizers may be applied. Often times, at least half of a golf course's property is left in its natural condition. There are estimated to be about 38 active golf courses on Cape Cod with a total managed land area of about 2,500 acres. The total amount of pesticide product used by the 27 golf courses contained in the database for 2010 was summed and converted to total pounds. Using the GIS data provided by the Commission, which estimated total managed acreage for the 27 golf courses, HW determined an average pesticide product application rate (pounds per year). HW then applied this application rate across the total golf course managed area on Cape Cod to determine a total pesticide use.

2.1.4 Municipal Pesticide Use

The Commission's MDAR database and personal communications with town staff responsible for managing municipal properties were the two main sources of data for quantifying pesticide

use by municipalities. The Commission's MDAR database categorizes certain applicators as "municipal," including four individual towns or town departments, a high school, and two county properties. During communications with town staff across the Cape, it became clear that the municipal category in the database does not account for all municipal activities on the Cape. Some towns apply pesticides on their golf courses, which are reported as golf properties rather than municipal properties, while other towns hire pesticide applicators, at least one of which does not appear in the database. In addition, towns manage a variety of properties with very specific uses and pesticide needs, which cannot be easily grouped into the single "municipal" category. HW contacted seven towns distributed across the Cape to get a better understanding of the pesticide applications on the following types of properties:

- Cemeteries;
- Roads;
- Parks and ball fields; and
- Schools.

Town highway departments or departments of public works (DPWs) frequently manage the cemeteries and roads. Schools are usually managed by a separate entity from the DPWs. Parks and some ball fields can be maintained either by DPWs, the schools, or the golf departments. Not all town departments from the seven towns contacted by HW provided information on their properties.

HW summarized the information for each type of municipal property listed above, and estimated an amount of pesticide applied to each type of property for towns that use pesticides. The total amount of pesticides used on municipal properties was then estimated for the entire Cape by averaging the estimated use across all towns with data, and applying that average to all Cape towns.

2.1.5 Agricultural Pesticide Use

Pesticide use for agriculture was primarily calculated using data provided in the Commission's MDAR database. There were a total of 19 agricultural properties (at least half of which are cranberry bogs) with pesticide use data entered into the database. Based on GIS data provided by the Commission, the total managed area on Cape Cod devoted to agriculture is estimated to be 1,800 acres. The total amount of pesticide product used by the 19 agricultural properties contained in the database for 2010 was summed and converted to total pounds. Using the GIS data provided by the Commission, which estimated total managed property acreage for the agricultural properties, HW determined an average pesticide product application rate (pounds per year) for agriculture. HW then applied this application rate across the total agriculture area on Cape Cod (1,800 acres) to determine a total pesticide use. Through discussions with the Cape Cod Cooperative Extension and UMass Extension Landscape and Agriculture Program - Cranberry Team, the variation in pesticide application for agriculture uses from year-to-year can be dramatic, based on weather conditions, disease outbreaks and other factors.

2.1.6 Utility Rights of Way Pesticide Use

Pesticide use by NSTAR electric and gas on their utility rights of way on Cape Cod was calculated using data provided by MDAR for the years 2008 and 2009. According to MDAR representatives, NSTAR has not applied pesticides to their utility rights of way since 2009. The data were provided by MDAR as a Microsoft™ Excel™ summary table. HW used these data to calculate a total average pesticide product use.

Based on GIS data provided by the Commission, NSTAR's managed utility rights of way area is estimated to be 1,900 acres. Using the GIS data provided by the Commission, HW determined an average pesticide product application rate (pounds per year) for the utility rights of way. HW then applied this application rate across the total NSTAR utility rights of way on Cape Cod (1,900 acres) to determine a total pesticide use.

2.1.7 Mosquito Control Pesticide Use

The Cape Cod Mosquito Control Project (CCMCP) is charged with controlling mosquito populations on Cape Cod. In an effort to use the most effective, yet least environmentally invasive mosquito control techniques, the CCMCP follows an Integrated Pest Management program to apply a combination of mechanical, cultural, and biological controls to keep pest populations low enough to prevent intolerable damage or annoyance.

Pesticide use by CCMCP for mosquito control on Cape Cod was primarily calculated using data provided in the Commission MDAR database. The total amount of pesticide product used by the CCMCP contained in the database for 2010 was summed and converted to total pounds. HW then used data from the CCMCP National Pollutant Discharge Elimination System (NPDES) annual reports for 2011 and 2012 to determine how much variation was experienced in pesticide application from year-to-year.

The NPDES annual reports also provided a total size of treatment area of 300,000 acres. This area mostly represents the wetland resource areas where mosquito control may be applied in any given year. Using data (total pesticide applied per product and application rates per product) provided in the annual reports, it was calculated that the actual treatment area was at least two orders of magnitude smaller than this. HW calculated a conservative treatment area of 4,000 acres. The actual treatment area is likely smaller than this, since some pesticides are applied more than once to the same area, and generally more than one pesticide is applied to each area. However, HW used this conservative treatment area of 4,000 acres as the land use area for mosquito control on wetland areas. Using the total pesticide use data and this land use area, HW was able to calculate an average annual application rate for mosquito control pesticides within wetland resource areas on Cape Cod.

2.2 Results

Results from the pesticide use analysis are summarized in Table 2-2 by land use category, and are provided as a total amount of pesticide in lbs per year, as well as an estimated application rate in lbs/acre. Pesticides are applied to turf, but also to trees, shrubberies, and buildings (e.g.,

pest control). Therefore, the estimated application rate and managed areas for residential and commercial properties assumes that pesticides are applied to an entire property, rather than solely to its lawns. The Cape Cod Commission's *Residential Fertilizer and Pesticide Use on Cape Cod* report suggests that 51% of residents use pesticides. The residential "managed" area is estimated at 51% of the total residential area. Figure 3 provides a graph of total pesticide use by land use category. Details about the results for each type of land use are provided in sub-sections below.

Table 2-2. Pesticide Use by Land Use Category

Land Use Category	Total Managed Area (acres)	Number of Parcels	Estimated Average Pesticide Application Rate On Properties where Pesticides Are Applied (lbs/acre/year)	Total Pesticide Use (lbs/year)
Residential	45,750[1]	128,500	24[2]	1.1 million
Commercial	3,850[1]	4,000	11[2]	41,800
Golf Course	2,500	N/A	45	113,000
Municipal	N/A	423	2 – 3.75	3,300[3]
Agriculture	1,800	N/A	24[4]	43,200
Utility Rights of Way	1,900	N/A	7	13,300
Mosquito Control on Wetlands	4,000[5]	N/A	2.7	10,800

[1] *This managed area is assumed to be 51% of the total area, as approximately 51% of homeowners apply, or have others apply pesticides on their property. A similar percentage of applications is assumed for commercial properties.*
[2] *These application rates are for properties where pesticides are being applied (i.e., about half the residential and commercial properties on the Cape). It should be noted that pesticides may be applied only to a portion of each property, so the actual application rate per acre may be higher.*
[3] *This amount is applied to town parks and ball fields only.*
[4] *Pesticide application rate is based on the 15 agricultural properties for which acreage was provided.*
[5] *This is a conservative estimate of the average annual treatment area.*

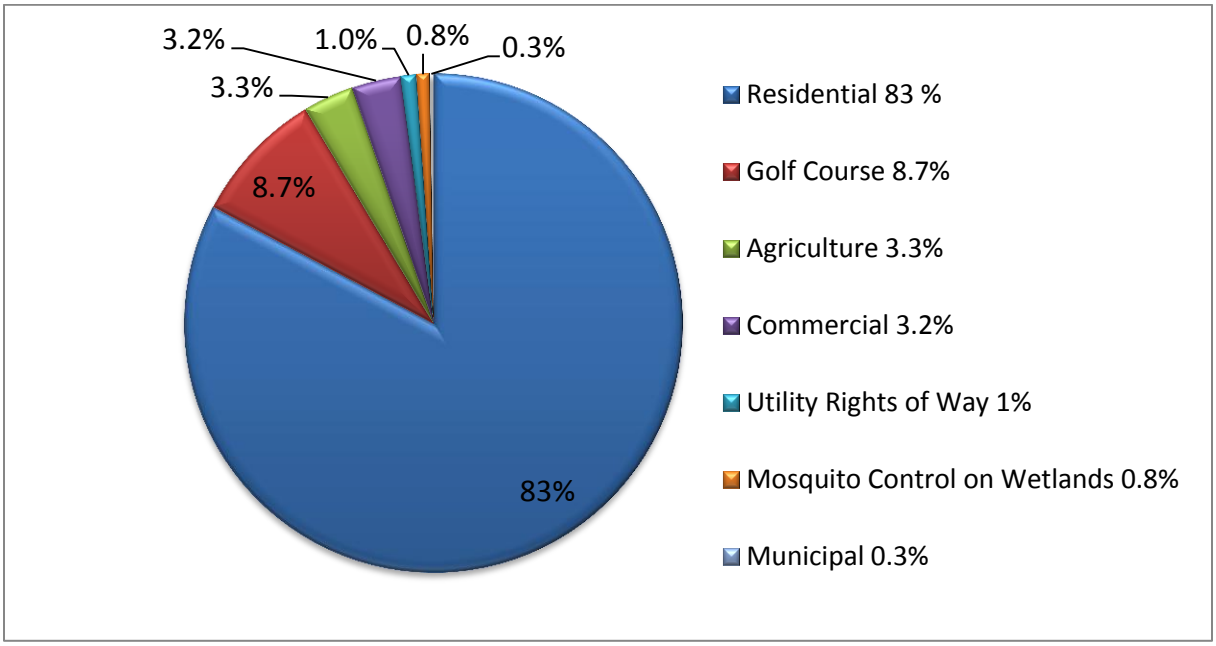

Figure 4. Pesticide Use by Land Use Category

2.2.1 MDAR Data Results

The amounts of pesticides applied by each type of regulated user are detailed in each section below. HW also used the Commission's MDAR database to quantify the top pesticides used on the Cape. Due to the wide variety of pesticide products, brands, active ingredient concentrations, and reporting to MDAR, there are over 900 different products among the 2,000+ entries in the Commission's MDAR database. Therefore, HW compared pesticide quantities using the approximately 200 active ingredients from the database, rather than individual products. HW quantified pesticide use by weight of active ingredients, and identified the top 10 active ingredients used across the Cape by total weight. Table 2-3 provides the list of those active ingredients, their total weight, and the range of their concentrations in the reported products, as well as the types of crops or sites where the pesticides are applied.

Table 2-3. Top 10 Pesticide Products by Weight of Active Ingredients

Active Ingredient	Weight Applied (lbs of active ingredients)	Range of Active Ingredient Content (%)	Main Types of Crops or Sites Pesticides Are Applied to
Mineral oil	19,793	97-98.8%	Turf, trees, and shrubberies
Chlorothalonil	13,179	29.9-90%	Turf and cranberry bogs
Spinosad	8,449	11.6-80%	Cranberry bogs, trees, and shrubberies
Aliphatic petroleum solvent	3,336	80-98.8%	Trees, shrubberies, and bluberries

Active Ingredient	Weight Applied (lbs of active ingredients)	Range of Active Ingredient Content (%)	Main Types of Crops or Sites Pesticides Are Applied to
Iprodione	2,813	1-50%	Turf
Fosetyl-Al	2,701	70-80%	Turf
POE isooctadecanol	2,329	100%	Mosquito control
Mancozeb	2,183	15-80%	Turf, cranberry bogs, trees, and shrubberies
Boron sodium oxide	1,953	6-98%	Structures (pest control)
Glyphosate-isopropylammonium	1,875	2-58%	Turf, cranberry bogs, trees, and shrubberies

These top 10 active ingredients are only applied as straight pesticides in relatively high concentrations, such that the active ingredient makes up most of the contents of the pesticides applied. The products that contain these active ingredients may not represent the greatest application rate by total weight.

Finally, HW compared pesticide contents in straight pesticides to the contents in combination pesticide/fertilizer products. HW sorted products into two categories: straight pesticides, and combination pesticide/fertilizer products. For each category, HW identified unique combinations of active ingredient and concentration. HW then averaged the concentration across those products. Straight pesticides averaged approximately 22% in active ingredients, while combination products averaged approximately 1.8%. This indicates that straight pesticides are a little over 10 times more concentrated than pesticide/fertilizer combination products. To account for this in the rest of the study, HW assumed that combination products provide approximately 10% of the pesticide content compared to straight pesticide products.

2.2.2 Residential Pesticide Use

As previously discussed in the methodology section above, residential use is divided between residents who purchase and apply pesticides themselves, and those who rely on professional licensed applicators. The total amount of pesticides applied on residential properties is the sum of the total use by each category of users.

Use by Residents Who Apply Their Own Pesticides

According to the four garden centers' sales records, the following quantities of pesticides were sold by those centers:

- Straight pesticides: 42,800 lbs;
- Combination pesticide/fertilizer products: 29,100 lbs, which is assumed to be equivalent to 2,910 lbs of straight pesticide;
- Total amount of pesticides: 45,700 lbs.

These four garden centers only represent a portion of the pesticide sales to individuals across the Cape. Using the assumptions described in the methodology, and derived from the Commission's 2012 survey of pesticide and fertilizer use, HW estimated that an average total of 16 lbs of pesticides are purchased by individuals who apply pesticides or combined fertilizer-pesticides to their property.

As discussed in the methodology, for verification purposes, and to confirm the order of magnitude of the application rate, HW researched other estimated pesticide application rates for homeowners. According to EPA estimates, residential homeowners across the country applying their own pesticides use an average of 34 to 44 lbs of pesticides annually. EPA numbers across the country are higher than HW's estimate of 16 lbs of pesticides applied by Cape Cod homeowners, but the order of magnitude is the same.

The Commission's survey on pesticide and fertilizer use indicates that 34% of residents apply pesticides to their own property (i.e., 51% of residents apply pesticides, and 67% of those residents purchase the pesticides themselves). According to GIS data analyzed by the Commission, there are approximately 128,500 residential properties on the Cape, totaling about 89,700 total acres. Based on the number of residential properties, and the estimates above, residential users apply approximately 702,500 lbs of pesticides on their own properties.

Use by Residents Who Hire Applicators

According to the Commission's MDAR database, in 2010, the following quantities of pesticides were applied by licensed applicators:

- Straight pesticides: 354,400 lbs;
- Combination pesticide/fertilizer products: 631,200 lbs;
- Total amount of pesticides: 417,500 lbs.

Assuming that 90% of these applications are made on residential properties, a total of 375,800 lbs of pesticides are applied by commercial applicators to residential properties.

Total Residential Use

Based on the results discussed above, residential users apply approximately 702,500 lbs of pesticides to their own properties, and an additional 375,800 lbs of pesticides are applied to residential properties by commercial applicators. These amounts result in a total of approximately 1.1 million lbs of pesticides applied to residential properties annually. Given that there are approximately 89,700 acres of residential properties on the Cape, this pesticide load corresponds to approximately 12 lbs/acre of residential property including all residential properties. However, according to the Commission's survey results, only about half the households apply pesticides, so the application rate is likely closer to 24 lbs/acre on properties that apply these products.

2.2.3 Commercial Pesticide Use

The Commission's MDAR database indicates that the following quantities of pesticides were applied by licensed applicators in 2010:

- Straight pesticides: 354,400 lbs,
- Combination pesticide/fertilizer products: 631,200 lbs, which is assumed to be equivalent to 63,120 lbs of straight pesticide;
- Total amount of pesticides: 417,600 lbs.

Assuming that 10% of these applications are made to commercial properties, a total of 41,800 lbs of pesticides are applied by commercial applicators to commercial properties. According to GIS data analyzed by the Commission, there are approximately 4,000 commercial properties on the Cape, totaling about 7,550 acres. Not all commercial properties apply pesticides. Assuming the same percentage of businesses use pesticides on the Cape as homeowners (i.e., 51%), the 41,800 lbs of pesticides applied to commercial properties corresponds to an application rate of about 11 lbs/acre across 51% of the 7,550 acres of commercial properties (i.e., 3,850 acres). This application rate is most likely higher because while pesticides can be applied to buildings (e.g., pest control) and areas other than lawns (e.g., shrubberies and other landscaped areas), they are unlikely to be applied across an entire property.

2.2.4 Golf Course Pesticide Use

Golf courses, including those on Cape Cod, have been under scrutiny over the years for pesticide use. This outside pressure, along with many golf courses' own aspiration to reduce pesticide use, has led to an industry-wide shift toward "greener" landscaping practices on golf courses. Many golf courses on Cape Cod have implemented plans and policies to reduce pesticide use, which are discussed further in Section 4.2.3.

In 2010, the estimated average pesticide application rate on the managed areas of golf courses on Cape Cod was 45 lbs/ac/yr. By applying this application rate across the total managed land area devoted to golf courses on the Cape (2,500 acres), the estimated total amount of pesticides applied in 2010 was 113,000 pounds.

2.2.5 Municipal Pesticide Use

Most municipalities apply small amounts of pesticides, if any, to their properties. Some towns limit use as a matter of policy, while others mention limited funding or the use of an organic care program that does not involve pesticides.

Cemeteries

No pesticides are applied to cemeteries in the six towns from which HW obtained data. Therefore, HW estimates that no pesticides are being applied to cemeteries across the Cape.

Roads

No pesticides are applied to roads and their rights of way in the five towns from which HW obtained data. Some towns reported using mechanical weeding. Therefore, HW estimates that no pesticides are applied to town-maintained roads across the Cape.

Parks and Ball Fields

Of the six towns that provided data to HW on their pesticide use, four towns do not apply pesticides to their parks and ball fields for the following reason: town policy, the location of the ball fields near the town's public drinking water supplies, or the town's implementation of an organic care program.

The fifth town had applied no pesticides over the past three years to its parks and ball fields while it was implementing an organic program. However, the town experienced an increase in labor needs to properly maintain the properties under the organic program compared to its previous program, and will be reverting some of the properties back to non-organic care. Based on discussions with the town, HW estimates that approximately 6,800 lbs of a combination product of fertilizer with pesticide will be applied to 34 acres of this town's parks and ball fields for an application rate of 200 lbs/acre. While the fertilizers used contain some pesticides, their primary purpose is to fertilize the turf, and the 6,800 lbs of the combined pesticide/fertilizer product is equivalent to approximately 680 lbs of pesticide product.

The sixth town does not apply pesticides to its parks, but applies a combination of fertilizer with pesticides to its ballfields. In the past five years, the town has applied approximately 3,750 lbs of fertilizer-pesticide combination over 10 acres at a rate of 375 lbs/acre, representing approximately 37.5 lbs of pesticide product per acre. Applications will increase this year to approximately 6,400 lbs of fertilizer-pesticide combination, representing approximately 640 lbs of pesticide product as the total acreage of managed ball fields has increased from 10 to 17 acres.

Four of the six towns apply no pesticides on their parks and ball fields, and the remaining two apply on average about 6,600 lbs of a combined fertilizer-pesticide product, with a range of application rates from 200 to 375 lbs/acre. While the size of recreational areas varies across towns across the Cape, it is probable that similar budgets are being spent on pesticides by these towns. The exact acreage and application rates are not known for all towns, and it is possible that some towns will apply more than the average of 2,200 lbs per town, while others will apply less. Therefore, HW's best estimate is that approximately 33,000 lbs of combined fertilizer-pesticide product are applied to parks and ball fields across the 15 Cape Cod municipalities, which is equivalent to approximately 3,300 lbs of pesticide product.

Schools

While some towns mentioned using pesticides on school grounds on an irregular basis to address specific pest issues (e.g., hornets' nest), no pesticides are applied regularly at schools in the three towns from which HW obtained data. This is likely due to the Massachusetts Children and Families Protection Act that prohibits schools and child care facilities from using pesticides on school grounds unless an Integrated Pest Management (IPM) Plan has been written and submitted to the MDAR[1]. Therefore, HW estimates that no pesticides are being applied to schools across the Cape.

[1] These IPMs are available online (http://massnrc.org/ipm/).

Total Use

Total municipal pesticide use across the Cape is the same as the pesticide use for parks and ball fields: on average 220 lbs of pesticide product per town, for a total of approximately 3,300 lbs across the 15 Cape Cod municipalities.

2.2.6 Agricultural Pesticide Use

The proportion of agricultural land use compared to other land uses on Cape Cod is relatively small (0.2% of Barnstable County's acreage is considered agricultural). Of this agricultural land, about 2/3 is devoted to cranberry production. The estimated average pesticide application rate for managed agricultural land on Cape Cod in 2010 was 24 lbs/ac/yr. By applying this application rate across the total managed land area devoted to agriculture on the Cape (1,800 acres), the estimated total amount of pesticides applied in 2010 was 43,200 pounds.

2.2.7 Pesticide Use on Utility Rights of Way

In order to avoid interruptions in electric service that overgrown or fallen vegetation can cause, utility companies use various methods to control or remove vegetation within their utility rights-of-way, including the use of pesticides.

The estimated average pesticide application rate for utility rights of way when pesticides were being applied was 7 pounds per acre. This rate was calculated by taking the total pesticide use and dividing it over the total utility right of way area, which is estimated to be 1,900 acres. The estimated total annual pesticide use for utility rights of way when pesticides were being applied was 13,300 lbs/yr. However, MDAR communicated to HW that due to public opposition to the use of pesticides on utility rights of way, NSTAR has not applied pesticides on its Cape Cod rights of way since 2009.

2.2.8 Pesticide Use for Mosquito Control

Pesticide use by the CCMCP for mosquito control was also quantified. As described in Section 2.1.6, the CCMCP is charged with controlling mosquito populations on Cape Cod. Along with mechanical, cultural, and biological controls, the CCMCP also uses insecticides to keep pest populations low enough to prevent intolerable damage or annoyance.

The land use area for this category was calculated as 4,000 acres, which represents a conservative estimate of the total acreage where pesticides are applied. The average annual total pesticide use for the CCMCP is 10,800 lbs/yr. By dividing this total over the total treatment area, the average annual application rate is 2.7 lbs/ac/yr. Since the land use area is likely an over-estimate, the pesticide application rate is likely higher.

3.0 FERTILIZER USE

This section describes HW's methodology for quantifying fertilizer use on Cape Cod, and provides detailed results by land use type. It should be noted that the fertilizers applied by most users will be absorbed by plants and soils, such that only a portion of the applied fertilizers

leaches into the groundwater. The MEP model assumes approximately 20% leaching of fertilizers applied to turf. HW researched existing scientific literature and available data on behalf of the Massachusetts Department of Environmental Protection, and concluded that 20% leaching was a reasonable rate for Cape Cod soil conditions (HW, June 2009). In addition, the amount of available nitrogen in fertilizers varies across products. Assuming that an average fertilizer is composed approximately of 25% nitrogen, the application of 100 lbs of that fertilizer is equivalent to 25 lbs of nitrogen, of which approximately 5 lbs (i.e., 20%) will leach into the groundwater.

3.1 Methodology

Fertilizer use data were collected from a variety of sources. Table 3-1 summarizes the fertilizer use data sources for each land use category. These data were then analyzed to determine an estimated average annual total fertilizer use (pounds per year) for each land use category. Using spatial data provided by the Cape Cod Commission, HW then estimated average annual fertilizer application rates for each land use category (pounds per acre per year).

Table 3-1. Fertilizer Use Data Sources

Land Use Category	Fertilizer Use Data Sources
General	• Personal communication with Ridley and Associates, Inc. • Personal communication with Green Cape • Personal communication with Sarah Little, Ph.D., Toxics Use Reduction Consultant
Residential	• Cape Cod Commission 2010 MDAR Pesticide Use Database • Results from the July 2012 Survey of Residential Fertilizer and Pesticide Use on Cape Cod • 2012 pesticide and fertilizer sales records for several Cape Cod garden centers • Product labels for most commonly used pesticides and fertilizers • Cape Cod Commission GIS data (see Appendix A)
Commercial	• Cape Cod Commission 2010 MDAR Pesticide Use Database • 2012 pesticide and fertilizer sales records for several Cape Cod garden centers • Personal communication with several commercial applicators • Cape Cod Commission GIS data (see Appendix A)
Golf Courses	• Personal communication with Cape Cod golf course personnel • Cape Cod Commission GIS data (see Appendix A) • Pleasant Bay Fertilizer Management Plan
Municipalities	• Cape Cod Commission 2010 MDAR Pesticide Use Database • Personal communication with town staff from public works, schools, recreation, and other municipal departments in seven towns across the Cape

Land Use Category	Fertilizer Use Data Sources
Agricultural areas	• Personal communication with Cape Cod Cooperative Extension • Personal communication with UMass Extension Landscape and Agriculture Program, Cranberry Team • Cape Cod Commission GIS data (see Appendix A)

Fertilizer products are usually a combination of nutrients, primarily nitrogen, phosphorous, and potassium. Each pound of fertilizer applied only contains a certain percentage of nitrogen. HW received some data in units of total pounds of fertilizer, while other information was provided in pounds of nitrogen. However, when calculating fertilizer use, all nutrients should be included. Therefore, HW assumed that on average, fertilizers provide approximately 25% nitrogen in weight, which means that each pound of fertilizer applied provides approximately 0.25 lbs of nitrogen.

Fertilizers can be purchased in a variety of forms (e.g., liquid, granular) and quantities. Some are already dissolved in water, or easily soluble, and are considered "quick" release, while others take longer to dissolve and are labeled "slow," or "controlled" release. Certain types of fertilizers are organic, while others are synthetic. In an effort to provide a total amount of fertilizers across the Cape, HW made assumptions such as treating all fertilizers equally, regardless of their solubility and composition. Additional details on how fertilizer use was calculated for each land use category are provided below.

3.1.1 Residential Fertilizer Use

Residential fertilizer users either purchase and apply fertilizer themselves, or have another party apply the fertilizer, such as a landscaping company, or a landlord or property management company. HW estimated fertilizer use for residents who apply it themselves (direct users), and for residents who have others apply the fertilizers (i.e., indirect users).

According to the Commission's survey of residential pesticide and fertilizer use, 57% of residents use fertilizers, of which 62% purchase the fertilizer themselves. The survey also indicates that residents who apply fertilizer themselves use on average 59 lbs of fertilizer annually. The main brand name/lawn care program cited by survey participants was Scotts. Scotts' 4-step lawn program represents approximately 53 lbs of fertilizer for an average 5,000 square foot (ft^2) lawn.

Application rates from the Commission's survey are slightly higher than results from the Massachusetts Estuaries Project (MEP) 2005 homeowner survey for fertilizer applications (Howes & White, 2005). This survey showed that homeowners who applied fertilizers to their lawns themselves applied an average of 0.75 lbs of nitrogen per 1,000 ft^2, with an average of 2.16 applications per year. This represents a total of 1.6 lbs of nitrogen/1,000 ft^2, or about 32 lbs of fertilizer for a 5,000 ft^2 lawn across all homeowners. However, the Howes and White survey also showed that across all homeowners applying fertilizers (i.e., either themselves or through a lawn care company) an average of 0.86 lbs of nitrogen was applied per 1,000 ft^2, with

approximately 2.93 applications per year. This represents a total of 2.5 lbs of nitrogen/1,000 ft^2, or about 50 lbs of fertilizer for a 5,000 ft^2 lawn across all homeowners.

Although HW had conversations with landscaping and lawn care companies, these companies did not wish to provide estimates of the average fertilizer amount used on a typical lawn, or of their application rates. While some fertilizer products are reported to MDAR, these are only the ones that include pesticides. Therefore, the database does not provide estimates of fertilizers used by lawn care companies. Therefore, HW assumed that landscaping and lawn care companies apply the same amount of fertilizer as individual homeowners (i.e., 59 lbs per property).

HW used the following assumptions to estimate total residential fertilizer use, based on the number of parcels/properties estimated by the Commission's GIS team:

- 57% of residential properties use an average of 59 lbs of fertilizer annually; and
- The remaining 43% of residential properties use no fertilizer.

An average managed area for each property is needed to convert the total residential use into an application rate. In its estuary studies across the Cape, MEP estimates lawn sizes to be approximately 5,000 square feet, which is based on the 2005 homeowner survey for fertilizer applications (Howes & White, 2005). The Cape Cod Commission's *Nitrogen Loading* Technical Bulletin (Cape Cod Commission, 1991) for estimating nitrogen loading also assumes an average 5,000 square foot lawn, citing the Cape Cod Planning and Economic Development Commission's 5,000 square foot estimate (CCPEDC, 1979), and results from a survey conducted for the *Yarmouth Water Resources Protection Study* (IEP, 1988). Therefore, HW assumed that fertilizers are applied to an average 5,000 ft^2 area on each residential property. This may be variable across various types of development, with potentially smaller managed areas in denser areas of the Cape, and larger managed areas in more rural settings.

3.1.2 Commercial Fertilizer Use

As discussed under the residential use methodology, landscaping and lawn care companies did not wish to share their application rates. HW assumed the same application rate for commercial properties as for residential properties for those that fertilize (See Section 3.2.1 results). In order to estimate the average managed area on each commercial property, the Commission selected a dozen parcels across nine towns representing a wide-range of commercial activities (e.g., restaurant, bank, retail, industrial, gas station, small and large shopping plazas). Across those properties, lawns represented approximately 10% of the lot size on average. HW used 10% of the lot size as an approximation for lawn size across all commercial properties on the Cape. HW then applied the application rate and lot coverage assumptions to the Commission GIS team's estimate of commercial acreage across the Cape to determine total fertilizer use.

3.1.3 Golf course Fertilizer Use

Golf course fertilizer use was calculated using estimates provided by individual golf courses as well as rates provided by several golf courses in the Pleasant Bay Fertilizer Management Plan. Application rates were provided as pounds of nitrogen per 1,000 square feet per year for roughs, greens, tees and fairways. These rates were multiplied by the total acreage of roughs, greens,

tees and fairways to determine an application rate for the managed area of each golf course. This rate was then applied to the total managed areas of the golf course to determine a total application rate for each golf course. These rates were averaged to determine an overall average application rate for golf course land use on Cape Cod in pounds of nitrogen per acre per year.

HW then applied the assumption that fertilizer products generally contain 25% nitrogen to determine a total fertilizer product use. The total application rates (in pounds nitrogen per acre and pounds fertilizer product per acre) were then applied to the golf course land use area provided by the Commission to determine a total fertilizer use (in total nitrogen and fertilizer product) for golf course land use.

3.1.4 Municipal Fertilizer Use

As mentioned under the pesticide methodology, towns manage a variety of properties with very specific uses and fertilizer needs, which cannot be easily grouped into the single "municipal" category. HW contacted seven towns distributed across the Cape to get a better understanding of the fertilizer applications on the following types of properties:

- Cemeteries;
- Roads;
- Parks and ball fields; and
- Schools.

Town highway departments or departments of public works (DPWs) frequently manage the cemeteries and roads. Schools are usually managed by a separate entity from the DPWs. Parks and some ball fields can be maintained either under the DPWs, the schools, or the golf departments. Not all town departments from the seven towns contacted by HW provided information on fertilizer use for their properties.

HW summarized the information for each type of municipal property listed above, and estimated an amount of fertilizer applied to each type of property for towns that use fertilizers. The total amount of fertilizers used on municipal properties was then estimated for the entire Cape by averaging the estimated use across all towns with data, and applying that average to all Cape towns.

3.1.5 Agricultural Fertilizer Use

The University of Massachusetts Extension Landscape and Agriculture Program, Cranberry Team provided average fertilizer application rates for cranberry bogs as pounds of nitrogen per acre. HW used the average fertilizer application rate (pounds nitrogen per acre) and applied the assumption that fertilizer products generally contain 25% nitrogen to determine a total fertilizer product use. The total application rates (in pounds nitrogen per acre and pounds fertilizer product per acre) were then applied to the agriculture land use area provided by the Commission to determine a total fertilizer use (in total nitrogen and fertilizer product) for agriculture land use.

Based on estimates provided by the Marine Biological Laboratory (MBL), the fertilizer application rate used here is conservative, and is similar to that used for "other agriculture"

(MBL, 2013). Therefore, this application rate was applied to all agricultural land use areas despite the fact that there is a portion of agricultural land use on Cape Cod that is not made up of cranberry bogs.

3.2 Results

Results from the fertilizer use analysis are summarized in Table 3-2 by land use category, and are provided as a total amount of pesticide in lbs per year, as well as an estimated application rate in lbs/acre. In Table 3-2, the number of parcels is provided for reference only. The residential, commercial, and municipal parcel estimates include all parcels of each type across the Cape, regardless of whether they fertilize. The golf courses, and agriculture estimates account for individual golf courses or agricultural entities. Figure 4 provides a graph of total pesticide use by land use category. Details about the results for each type of land use are provided in sub-sections below.

Table 3-2. Fertilizer Use by Land Use Category

Land Use Category	Managed Area (acres)	Number of Parcels	Average Fertilizer Application Rate On Managed Areas (lbs/acre/year)	Total Fertilizer Use (lbs/year)
Residential	8,407	128,500	514[1]	4.3 million
Commercial	430	4,000	514[1]	225,000
Golf Course	2,500	N/A	354	885,000
Municipal	N/A	423	43.5 to 760	257,000
Agriculture	1,800[2]	N/A	140	252,000

[1] *The residential application rate assumes that residents of Cape Cod apply fertilizer to approximately 5,000 square feet of lawn. The commercial rate uses the same application rate.*
[2] *Acreage only included for 15 of the 19 agricultural properties.*

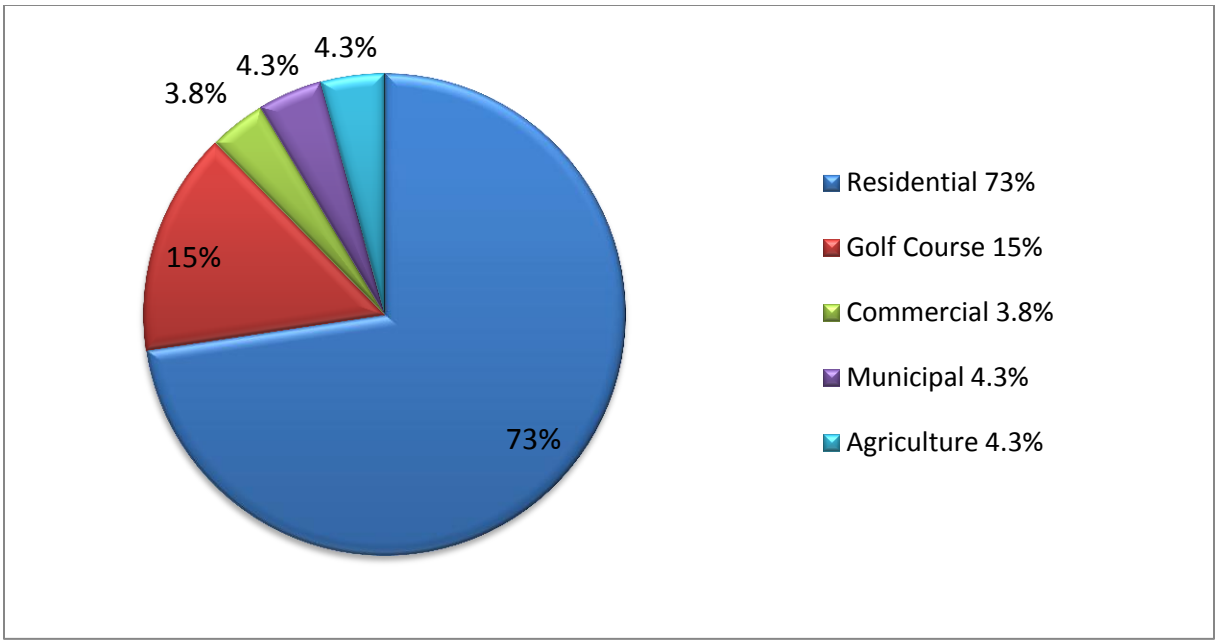

Figure 5. Fertilizer Use by Land Use Category

3.2.1 Residential Fertilizer Use

According to data received from the Commission's GIS team, there are approximately 128,500 residential parcels across Cape Cod. Using the assumptions described in the methodology section, HW estimates that approximately 4.3 million lbs of fertilizer are applied to residential properties on an annual basis. Assuming that 57% of residents on the Cape fertilize, and that the average managed area on their property is 5,000 square feet, approximately 8,400 residential acres receive fertilizer. This translates into an application rate of around 514 lbs/acre, or 12 lbs/1,000 square feet. This result is consistent with the Commission's nitrogen loading model (CCC, 1991), which assumes the typical fertilizer application rate on the Cape is 3 lbs N/1,000 square feet, or 12 lbs fertilizer assuming a 25% nitrogen content in the fertilizer applied.

3.2.2 Commercial Fertilizer Use

The Cape includes approximately 7,554 acres of commercial properties. As described in the methodology, approximately 10% of the total commercial acreage (i.e., 755 acres) is assumed to represent lawns on these properties. If approximately 12 lbs of fertilizer are applied annually for each 1,000 square feet of managed area, and 57% of properties fertilize, HW estimates that commercial properties use a total of 225,000 lbs of fertilizer across the Cape.

3.2.3 Golf course Fertilizer Use

Based on fertilizer use data provided by golf courses, total fertilizer use on golf courses is about 885,000 pounds per year across the 2,500 acres of managed golf course land. The application rate on managed areas is about 354 lbs/ac. The table below summarizes fertilizer use for various managed turf areas on Cape Cod golf courses.

Table 3-3. Average Fertilizer Use by Cape Cod Golf Courses by Turf Type

Golf Course Turf Type	Fertilizer Use (lbs N / 1,000 ft^2)	Fertilizer Use (lbs fertilizer / acre)
Rough	1-2	174 – 348
Green	3 – 4.5	523 – 784
Tee	2.25 – 4.5	392 – 784
Fairway	1.75 - 3	305 – 523

3.2.4 Municipal Fertilizer Use

Most municipalities apply limited amounts of fertilizers, if any, to their properties. Some towns do so as a matter of policy, while others mention limited funding.

Cemeteries

No fertilizers are applied to cemeteries in five of the six towns from which HW obtained data. The sixth town applies fertilizer to about 60 acres of property two to three times per year at an annual rate of 43.5 lbs/acre, for a total of 2,600 lbs/year. Assuming that one in every six towns on the Cape applies fertilizers to their cemeteries, a total of 6,500 lbs of fertilizers are being applied by municipalities to cemeteries. It should be noted that this does not include privately-owned cemeteries, or cemeteries maintained by churches or other entities.

Roads

Almost no fertilizers are applied to roads and their rights of way in the five towns from which HW obtained data. One town applies some starter fertilizer in areas where roadwork has been completed and new plantings have been made, and another town applies a total of 17 lbs of fertilizers to a half acre of islands. This limited amount of fertilizer use is difficult to quantify precisely for new roadwork, and overall amounts are likely to be very limited throughout the entire Cape. Therefore, HW estimates that no fertilizers are being applied to town-maintained roads across the Cape.

Parks and Ball Fields

The five towns that provided fertilizer use data to HW apply fertilizers mainly to their ball fields, with almost no fertilizer being applied to parks. This is either due to town policy, or the location of the ball fields near the town's public drinking water supplies. Three of the five towns apply no fertilizer to their ball fields. The fourth town applies 3 lbs of nitrogen per 1,000 square feet of managed area over 44 acres, which totals approximately 23,000 lbs of fertilizer assuming a 25% nitrogen concentration. The fifth town has been applying about 7,600 lbs of fertilizer over 10 acres for the past five years, but recently increased fertilizer use to 15,200 lbs over a greater managed area of 17 acres.

Three of the five towns apply no fertilizers to their parks and ball fields, and the remaining two apply a total of 38,200 lbs of fertilizer, with a range of application rates from 520 to 760 lbs/acre.

This represents on average 9,500 lbs per town, which adds up to approximately 142,500 lbs of fertilizer being applied to parks and ball fields across the 15 Cape Cod municipalities.

Schools

The three school systems that provided fertilizer information to HW showed a wide range of practices, from no fertilizer application beyond leaving the turf clippings on the lawns after each mowing, to fertilizer application rates between 125 and 560 lbs/acre. While grass clippings are technically a form of fertilizer, many entities across the Cape use this practice, and estimating the amount of grass clippings returned to the managed areas as fertilizer is beyond the scope of this study. HW assumed that the school using this practice does not use fertilizers. The second school applies 140 lbs/acre four times a year to 19 to 26 acres of school grounds, depending on need, which is equivalent to an average of 12,600 lbs of fertilizer annually. The third school applies approximately 9,000 lbs to 72 managed acres of school grounds.

One school system applies no fertilizers to their grounds, and the remaining two school systems apply a combined 21,600 lbs of fertilizer, with a range of application rates from 125 to 560 lbs/acre. This represents on average 7,200 lbs per town, which adds up to approximately 108,000 lbs of fertilizer being applied to school grounds across the 15 Cape Cod municipalities.

Total Use

Total municipal fertilizer use across the Cape is the sum of the use for cemeteries, parks and ball fields, and schools, which totals approximately 257,000 lbs across the 15 Cape Cod municipalities.

3.2.5 Agriculture Fertilizer Use

Total fertilizer use for the agricultural sector on Cape Cod was estimated to be 252,000 lbs/yr. The application rate on managed areas is about 140 lbs/ac.

4.0 RECOMMENDED BEST MANAGEMENT PRACTICES

4.1 Introduction

The results of this study indicate that among the sectors assessed, residential pesticide and fertilizer use accounts for over 80% of the total pesticides and 70% of total fertilizers used on Cape Cod. The following include some Best Management Practices (BMPs) recommended for the residential sector, which are intended to maximize the benefits of residential turf and landscaped areas, while minimizing the potential for public health and environmental impacts that can happen as a result of inefficient, incorrect or irresponsible management practices.

The University of Massachusetts (UMass) Cooperative Extension has recently developed a comprehensive manual of Best Management Practices (BMPs) for lawn and landscape turf, which is available for download on their website (http://extension.umass.edu/turf/publications-resources/best-management-practices) as well as the Massachusetts Department of Agriculture Agricultural BMPs website

(http://www.mass.gov/eea/agencies/agr/about/divisions/massachusetts-agricultural-best-management-practices.html). The guide was used as a resource for the following section. Recommended BMPs that are specific to sectors other than the residential sector, such as golf courses and cranberry bogs may be found on the Massachusetts Department of Agriculture Agricultural BMPs website (http://www.mass.gov/eea/agencies/agr/about/divisions/massachusetts-agricultural-best-management-practices.html).

4.1.1 Integrated Pest Management

The BMPs described in this report are focused on Integrated Pest Management (IPM) as an approach to manage lawns and landscaped areas. IPM is an approach to turf and vegetation management that involves the use of ecologically-based, common sense methods to maintain healthy landscapes. In contrast to conventional practices that lead to the routine application of pesticides whether or not they are needed, IPM focuses on maintaining landscapes in a way that prevents and minimizes pest problems and uses environmentally responsible controls when pest problems occur (MDAR, 2006).

A sound IPM program has the potential to reduce reliance on pesticides because applications are made only when all other options to maintain the quality and integrity of the vegetation have been exhausted (MDAR, UMass, 2010). The use of cultural practices, or methods that make it hard for pests to survive, are fundamental to IPM. The key steps in developing a complete IPM program, include:

1. Assess site conditions and history;
2. Determine client and customer expectations;
3. Determine pest action levels;
4. Establish a monitoring (scouting) program;
5. Identify the pest/problem;
6. Implement a management decision;
7. Keep accurate records and evaluation program; and
8. Communicate.

Organic IPM

IPM allows the use of pesticides, fertilizers and other materials made from synthetic materials when necessary. Organic IPM takes IPM one step further to manage pests by integrating organically-approved biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. For a practice to be organically-approved largely means that products are restricted to those made from natural materials. It is important to note that pesticides used in organic programs can still have harmful effects on humans, animals and the environment, and must be used carefully and only when needed.

4.2 Residential BMPs for the Reduction of Pesticides and Fertilizers

4.2.1 Pre-Management BMPs

There are a number of BMPs that should be implemented prior to planting and managing land areas. These are centered around gathering information and data, assessing local site conditions and identifying management areas. The best way to reduce pesticide and fertilizer use is to minimize the size of managed areas in the first place. There are a host of other benefits associated with minimizing managed areas, and maintaining natural areas to the greatest extent possible, such as wildlife habitat protection and preservation of natural hydrology.

Once management areas have been identified, the use of native and naturalized vegetation should be used to the greatest extent possible within these areas. These species are more tolerant to local conditions, and often require less maintenance, including the use of pesticides, fertilizers and watering. Since conventional lawn areas tend to have high maintenance needs, including the use of pesticides and fertilizers, they should be avoided where possible. It is important to note that often times this requires a shift in public attitude toward what is considered aesthetically pleasing and important to homeowners. Where turf areas are created and managed, there are BMPs that can be used to minimize the use of fertilizers and pesticides in these areas. These are discussed in Section 4.2.2.

BMP-1. Knowledge Development

A background knowledge about the issues, regulations and management strategies related to pesticides and fertilizers is important to the success of any vegetative management program. It is important for homeowners and land managers to be educated on correct fertilizer and pest management practices and the newest methods, approaches and products. This includes learning about pest identification and biology to effectively implement pest management strategies as well as creating and maintaining current files for key pests.

BMP-2. Limit Size of Managed Area

Many land managers (e.g., golf courses, homeowners, businesses) have decreased the amount of managed areas of their property in an effort to reduce pesticide and fertilizer use. This also reduces costs associated with maintenance of these areas, and increases habitat for wildlife and endangered species. Homeowners should take the same approach and reduce managed areas to the greatest extent possible. Preservation of natural areas, particularly at the borders of the property, can also provide additional privacy and sound abatement.

BMP-3. Alternative Landscapes and Native Species Selection

A variety of native ground covers, or low-growing plants, can be used as an alternative to turf grass. Using native or naturalized vegetation typically requires less fertilizers and pesticides, because these species grow more readily than non-native species. These species can also often still afford the same values as turf grass. Selecting which types of plants are appropriate for you depends on a variety of factors (e.g., location within your yard, soil conditions).

4.2.2 Turf Management BMPs

As described in Section 4.2.1, ideally turf areas should be minimized to the greatest extent possible in order to reduce dependence on fertilizers and pesticides. However, where turf areas are provided, there are a series of BMPs that can be utilized to limit fertilizer and pesticide needs.

BMP-4. Smart Grass Selection

Grass seeds should be selected that are most suited to local site conditions, including soil characteristics, light, use, and desired level of maintenance. In the northeast, a mixture of cool-season grasses is recommended. Seed products labeled "endophytic" tend to be tolerant of environmental stresses and are resistant to some of the more common insect pests, including billbugs, chinch bugs and sod webworms (MDAR, 2006). Grasses should also be selected that are drought-tolerant, requiring less watering. A good resource for selecting the appropriate grass species to suit local conditions is the "Grass Variety Chart" provided in "A Homeowner's Guide to Environmentally Sound Lawncare," provided by MDAR and available at http://www.mass.gov/eea/docs/agr/pesticides/publications/ipm-lawn-guide-1a-1.pdf. This document is also included in the Resources section at the end of this report.

BMP-5. Smart Soil Preparation and Management

Maintaining proper soil conditions is integral to maintaining a healthy lawn. Enriched soil will provide the necessary nutrients to the turf so that it may out-compete weeds and resist other pest problems. However, conventional "step programs" offered by some lawncare companies should be avoided. Instead, a program that is suited to site-specific conditions should be developed and implements. Although this requires the collection of site specific information, the results will be worth the up-front data collection efforts. The following activities should be conducted for smart soil preparation and management:

- Soil testing: A soil test is key to understanding your soil's nutrient levels and fertilizer needs. A soil test will also report on pH levels. The Master Gardeners offer soil testing clinics throughout the spring. They can be contacted at the Cape Cod Extension Office (508-375-6690). Samples can also be brought to the Cape Cod Extension Office for testing year-round (Town of Falmouth, 2004).
- Liming: The soil pH should be 6.5 – 7.0 (Town of Falmouth, 2004). Since most soil in New England is acidic, it is common to have to raise the pH of soils in order to provide good conditions for growing lawn. Lime is a calcium based compound that can be added to soils that are too acidic in order to raise the pH. Lime is generally applied to lawns at a rate of 50 pounds per 1,000 square feet, but the rate should be based on the pH reported as part of the soil test. If you fertilize a lawn with a low pH, the nitrogen in the fertilizer won't be absorbed by the grass, and instead will be diverted into leaching and runoff.
- Fertilizing: Recycled grass clippings and atmospheric deposition are natural sources of nitrogen. In many cases this is all an established lawn needs. However, if homeowners decide to fertilize their lawn, it should be used conservatively. Of the various nutrients contained in fertilizer (nitrogen, phosphorous and potassium), nitrogen is the most important for promoting lawn growth. However, in excessive amounts it can increase

disease problems, reduce a lawn's tolerance to high and low temperatures, and cause moisture stress due to overstimulation of growth.

- Type of fertilizer: Homeowners should ensure that they purchase fertilizer products that contain the appropriate level of nitrogen for their lawn. There are two basic forms of nitrogen contained in fertilizers: fast acting or Water Soluble Nitrogen (WSN) and slow-acting or Water Insoluble Nitrogen (WIN). Because of the high permeability of most soils on Cape Cod, most homeowners should use a fertilizer that has a higher proportion of slow-acting or WIN nitrogen. This will be verified by the soil test results. An application rate of 1 – 2 pounds of nitrogen per 1,000 square feet of lawn per year will help protect Cape Cod's receiving waters.
- Timing and rate of fertilizer application: Fertilizers should be applied at a time and rate to maximize plant uptake of the fertilizer and avoid nitrogen being leached directly to groundwater. This is important to ensure the effectiveness of the fertilizer product as well as to avoid the environmental impacts associated with leached nitrogen in groundwater. Recent research suggests a partial application of fertilizer in the spring, followed by small applications as needed to improve nitrogen uptake and reduce leaching (EPA, 2010). If using a slow-acting or WIN fertilizer, it can be applied less frequently (MDAR, 2006). It is also important to apply fertilizers during appropriate weather conditions and to adjust irrigation needs to accommodate maximum fertilizer uptake and avoid nitrogen leaching. In a study conducted by Bowman et al., 1998, researchers demonstrated that delayed irrigation after fertilization (1, 3, and 5 days) decreased nitrogen leaching, and greater irrigation resulted in greater leaching for both shallow- and deep- rooted turfgrass.

BMP-6. Smart Mowing

The following recommendations provide an effective approach to maintaining a healthy lawn:

- Height: Lawns should be mowed high in order to encourage dense, well-rooted turf which will tolerate environmental stress, including pests, as well as reduce the need for fertilizer and pesticides. The ideal grass height for most lawns is 2 – 3 inches.
- Frequency: Grass height should be reduced by 1/3 at a time to avoid stress on the grass. This may require more frequent mowing in the spring and fall when grass is growing more quickly.
- Timing: Lawns should be mowed when the lawn is dry to minimize the chances of spreading disease.
- Equipment: Mower blades should be kept sharp to minimize stress on the turf.
- Clippings: Unless there is an excessive amount, clippings should not be removed, since they provide a good source of nutrients for the soil (MDAR, 2006).

BMP-7. Smart Watering

Efficient use of water is important to encourage deep-routed turf. There is generally sufficient rainfall on Cape Cod so that watering of lawns is not necessary most of the year. If homeowners wish to maintain their lawn's green appearance during hot, dry times of the summer season, watering may be necessary. It is important to concentrate watering only on managed lawn areas

in order to conserve water and avoid runoff of fertilizer and associated nitrogen from lawn areas to impervious surfaces and receiving waters. The following should be considered for smart watering practices:

- Timing: Lawns should only be watered when necessary and never during precipitation events. Lawns should be watered just before they begin to wilt. Watering at this time will prevent permanent injury to the lawn. Watering should also be conducted early in the morning to minimize the spread of disease and evaporation into the air. Excessive watering during humid conditions can promote disease, such as the growth of certain fungi.
- Frequency: Frequency of watering depends on many factors, such as the type of soil, weather conditions, type of grass and extent of the root system. Drought-tolerant grass species should be selected (see BMP-6) in order to reduce the frequency of watering. One inch per week of water is generally enough for most lawns
- Amount: Lawns should be watered deeply in order to encourage deep roots which can take up water on their own. Approximately one inch of water should be used to wet the soil to a depth of 4 – 6 inches. It is important not to over-water lawns, since over-watered lawns restrict rooting. Also, since most homeowners use drinking water to water their lawns, and tend to water more during dry periods, this can unnecessarily waste precious drinking water supplies when they are at their lowest levels (MDAR, 2006).

BMP-8. Smart Waste Management and Composting

Composting is a way to eliminate most crop and weed residues around the landscape and to control pests that may harbor in the residues. The compost may then be used as a mulch or incorporated into soil to add to organic matter. Composting must be done correctly to assure the destruction of many serious plant pathogens and weed seeds. If followed correctly, the composting method will control all insect pests, nematodes, most pathogens (UCANR, 2013).

Composting can also help reduce total nitrogen on a watershed scale. Although synthetic and organic fertilizers generally have the same amount of nitrogen, if you use compost from composted leaves on-site or within the watershed then no net additional nitrogen is imported onto the site or within the watershed. If synthetic fertilizers are used, then nitrogen is being imported to the site or watershed (S. Little, personal communication, April 2, 2013).

More information on composting may be found either through the UMass Extension program (http://extension.umass.edu/cdle/fact-sheets/waste-management-and-composting) or the Massachusetts Department of Environmental Protection (http://www.mass.gov/eea/agencies/massdep/recycle/reduce/home-composting-and-green-landscaping.html#1). The Cape Cod Cooperative Extension can also be a resource (http://www.capecodextension.org/horticulture-entomology-ticks/).

4.2.3 Pest Control BMPs

BMP-9. Pest Identification

In order to effectively control pests, homeowners or land managers need to be able to correctly identify them. Homeowners should learn to identify the main pests that appear in their yard and

become familiar with their life cycles. For example, control measures for dandelions will be very different from those for grubs (MDAR, 2006).

BMP-10. Monitoring

Homeowners should monitor their lawns for the presence of pests and note any changes in pest populations and problem areas. The simple presence of a pest does not mean a treatment needs to be made. There may be a level of damage which is tolerable and not worth using pesticide for control (MDAR, 2006). The document, "A Homeowner's Guide to Environmentally Sound Lawncare," provided by MDAR provides more information on monitoring and is available at http://www.mass.gov/eea/docs/agr/pesticides/publications/ipm-lawn-guide-1a-1.pdf. This document is also included in the Resources section at the end of this report.

BMP-11. Mechanical Controls

Manual or mechanical controls offer a non-chemical approach to correct pest problems. For example, mechanical interventions may include the use of a weed-wacker to manage weeds, or the use of insect traps. The effectiveness of manual and/or mechanical controls depend on the type and number of pests occurring in the managed lawn area (MDAR, 2006).

BMP-12. Biological Controls

Similar to mechanical controls, biological controls offer an alternative to chemical controls to manage pests. Biological controls may involve the use of the following:

- Beneficial insects: Many insects occur naturally in yards have the potential to keep low-to-mid size populations of a pest in check. For example, the big-eyed bug is considered a beneficial insect, and is a natural predator of the chinch bug, which is considered a pest. It is important to note that beneficial insects are very susceptible to pesticides. Broad-spectrum insecticides affect more than just the pest, and homeowners should be aware that the use of these pesticides may eliminate natural controls along with the pest.
- Biological control products: An increasing number of pest control products are being marketed which contain living organisms that act against pests. Biological controls contain beneficial insects, pest diseases, and parasites of pests which are released or applied in order to control target pests. These products often work only during certain life stages of the pest, or under certain environmental conditions. While many biological controls pose fewer risks to the environment than chemical pesticides, their use may require more planning (MDAR, 2006).

BMP-13. Chemical Controls

Chemical controls, or pesticides, are toxic by design and are used to repel, mitigate or kill pests. They should be used only as a last resort, and should be applied carefully and strictly according to label instructions. If pesticides are used, the chemical that poses the lowest risk to public health and the environment should be selected (MDAR, 2006).

5.0 CONCLUSIONS

A number of assumptions were required to estimate total use of pesticides and fertilizers on all types of land use, and estimates could be refined with additional information (e.g., average fertilizer applications by commercial applicators). However, the largest users of both pesticides and fertilizers are individual homeowners, by far, as they represent over 70% of pesticide use, and over 80% of fertilizer use. This is consistent with the proportion of total land use considered residential, compare to other land uses. Figure 3 in Section 1 provides a visual representation of the managed areas by various land uses, and is dominated by the light green representative of residential lawns. Developed residential areas represent almost 90,000 acres, whereas golf courses, the second largest users of pesticides (8.7%) and fertilizers (15%), represent less than 8,000 acres, or less than 9% of the total residential area. It should be noted that most pesticide users other than residential (e.g., golf, agriculture) are regulated, such that pesticide applications can only be conducted by certified professionals who are educated in the use of pesticides. These entities also have a financial incentive to minimize both their pesticide and fertilizer use. The same does not apply to residential users. Therefore reduction in total use and improved management practices should focus on residential users.

6.0 AREAS FOR FURTHER STUDY

Although this study strived to capture the majority of pesticide and fertilizer use on Cape Cod, some land uses were not included in the study. For example, pesticide use for vegetative maintenance on state highways and railroad rights of way were not included in this study. However, this contribution is likely to be limited, if existent at all. State Highway pest management plans indicate that the State manages rights of way using mechanical cutting and mowing methods and therefore presently do not apply pesticides (or fertilizers) to their rights-of-way.

Aquatic vegetation management practices were also not assessed in this study. However, aquatic herbicide applications are heavily regulated by the State Department of Environmental Protection, Bureau of Resource Protection, Wetland/Waterway Program, and have not been used significantly on Cape Cod. Additional information on aquatic vegetation management is provided in the Massachusetts Department of Environmental Protection's *Guidance for Aquatic Plant Management in Lakes and Ponds – As It Relates to the Wetlands Protection Act* (available online at: http://www.mass.gov/dep/water/laws/alkguide.pdf).

In addition, this study is aimed to quantify the total amount of pesticide products being applied from some of the major land uses on Cape Cod. This study did not examine the degree of toxicity among the various types of pesticides being applied nor did it evaluate toxicity as part of the analysis.

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8.0 ADDITIONAL RESOURCES

Pesticides

Pesticide Regulations	
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	http://www.epa.gov/agriculture/lfra.html
Pesticide Regulation in Massachusetts: the Massachusetts Pesticide Control Act	http://www.mass.gov/eea/agencies/agr/pesticides/pesticide-regulation-in-massachusetts.html
Federal and State Pesticide Program Websites	
US EPA Pesticides Program	http://www.epa.gov/pesticides/
EPA New England Pesticide Program	http://www.epa.gov/region1/eco/pest/
Massachusetts Department of Agricultural Resources Pesticide Program	http://www.mass.gov/eea/agencies/agr/pesticides/
Local Pesticide Program Websites	
Wellesley Pesticide Awareness Campaign	http://home.comcast.net/~little.sarah/
Carlisle Pesticide Awareness Group	https://home.comcast.net/~carlislepag/
Other Pesticide Resources	
UMass Extension Pesticide Education Program	http://www.umass.edu/pested/
Agricultural Best Management Practices provided by the Massachusetts Department of Agricultural Resources	http://www.mass.gov/eea/agencies/agr/about/divisions/massachusetts-agricultural-best-management-practices.html
Cape Alliance for Pesticide Education	http://www.greencape.org/
Massachusetts Natural Resources Collaborations: School IPM and Pest Reporting	http://massnrc.org/
UMass Lowell Toxics Use Reduction Institute	http://www.turi.org/
Grassroots Environmental	http://www.grassrootsinfo.org/index.html

Education	
A Homeowner's Guide to Environmentally Sound Lawncare published by the Massachusetts Department of Food and Agriculture	http://www.mass.gov/eea/docs/agr/pesticides/publications/ipm-lawn-guide-1a-1.pdf
North and South Rivers Watershed Association Greenscapes Program	http://greenscapes.org/
Beyond Pesticides	http://www.beyondpesticides.org/
Alliance for a Healthy Tomorrow	http://www.healthytomorrow.org/
Toxics Action Center	http://www.toxicsaction.org/

Fertilizers

Fertilizer Regulations	
Massachusetts State Law	https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXIX/Chapter128
Massachusetts State Regulations	http://www.mass.gov/eea/docs/agr/legal/regs/330-cmr-15-00.pdf
Federal and State Fertilizer Program Websites	
EPA's Nutrient Management and Fertilizer Website	http://www.epa.gov/agriculture/tfer.html
Massachusetts Department of Agricultural Resources Fertilizer and Lime Registration Website	http://www.mass.gov/eea/agencies/agr/farm-products/fertilizer/
Other Fertilizer Resources	
Agricultural Best Management Practices provided by the Massachusetts Department of Agricultural Resources	http://www.mass.gov/eea/agencies/agr/about/divisions/massachusetts-agricultural-best-management-practices.html
A Homeowner's Guide to Environmentally Sound Lawncare published by the Massachusetts	http://www.mass.gov/eea/docs/agr/pesticides/publications/ipm-lawn-guide-1a-1.pdf

Department of Food and Agriculture	
North and South Rivers Watershed Association Greenscapes Program	http://greenscapes.org/
Don't Trash Grass, published by the Massachusetts Department of Environmental Protection	http://www.mass.gov/dep/recycle/reduce/dtg.pdf
UMass Extension Agriculture and Green Industry Program	http://ag.umass.edu/agriculture-and-green-industry
MA DEP Model Groundwater Protection District Bylaw/Ordinance	http://www.mass.gov/dep/water/gwpmod.pdf

APPENDIX A – CAPE COD COMMISSION GIS DATA DEVELOPMENT DETAILS

Active Barnstable County (Cape Cod) Golf Course Areas
File Geodatabase Feature Class

Tags

Golf Course, Land Use, Recreation, Planning

Summary

The source of this feature class was likely a digitization project by the Cape Cod Commission (CCC). The existing feature class was used by CCC and updated in June, 2013 using orthoimagery.

Description

The feature class comprises the managed areas of the golf courses of Barnstable County (Cape Cod) as of May, 2013.

Credits

CCC

Use limitations

There are no access and use limitations for this item.

Extent

There is no extent for this item.

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Managed Barnstable County (Cape Cod) Utility ROW Areas
Shapefile

Tags

utilities, land use, land cover, planning, ROW, right of way, fertilizer, pesticide

Summary

MassGIS Data - Land Use (2005): To provide a statewide dataset representing land use for use by MassGIS and its stakeholders. The dataset is also intended to be incorporated into the MassGIS data holdings and distributed for use based on data policies at MassGIS. Land Use Code 24 Powerline/Utility: Powerline and other maintained public utility corridors and associated facilities, including power plants and their parking areas. The feature class comprising the Land Use Code 24 Powerline/Utility was used, edited and updated by the Cape Cod Commission (CCC) in May, 2013 using orthoimagery.

Description

MassGIS Data - Land Use (2005): This is a statewide, seamless digital dataset of land use / land cover for the State of Massachusetts derived using semi-automated methods and based on digital imagery captured in 2005 with 0.5 m pixel resolution. The project area encompasses the State of Massachusetts. The minimum mapping unit (MMU) for this dataset is 1 acre overall for the dataset. However, there are some exceptions: a MMU of 0.5 acre has been used for rural areas where there may be isolated residential, commercial, or industrial structures. In such cases, areas less than 1 acre and more than about 0.5 acre are mapped. In urban areas, the MMU is 1 acre. This implies that a water tower or a communication tower in the middle of a residential or commercial area may not be mapped out separately if it occupies less than 1 acre of land. In areas where assessor parcel data was available, Multi-family Residential, Commercial, and Industrial areas may be as small as 0.25 acre. The land use classification scheme used for these data is based on a coding schema used in previous land use datasets in Massachusetts with some modifications for the 2005 classification.

Credits

Preparation: Sanborn, Obtained from: MassGIS, Edits/Updates: CCC

Use limitations

None, per MassGIS

Extent

There is no extent for this item.

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Active Barnstable County (Cape Cod) Agricultural Areas
File Geodatabase Feature Class

Tags

Agricultural, Agriculture, Cropland, Orchard, Land use, Land cover, Planning

Summary

MassGIS Data - Land Use (2005): To provide a statewide dataset representing land use for use by MassGIS and its stakeholders. The dataset is also intended to be incorporated into the MassGIS data holdings and distributed for use based on data policies at MassGIS. Land Use Codes 1 (Cropland) and 35 (Orchard): (LU Code 1) Generally tilled land used to grow row crops. Boundaries follow the shape of the fields and include associated buildings (e.g., barns). This category also includes turf farms that grow sod. (LU Code 35) Fruit farms and associated facilities. The feature class comprising these land use categories was updated using orthoimagery and the list of farms and farmstands on http://www.buyfreshbuylocalcapecod.org/ by the Cape Cod Commission (CCC) in May, 2013.

Description

MassGIS Data - Land Use (2005): This is a statewide, seamless digital dataset of land use / land cover for the State of Massachusetts derived using semi-automated methods and based on digital imagery captured in 2005 with 0.5 m pixel resolution. The project area encompasses the State of Massachusetts. The minimum mapping unit (MMU) for this dataset is 1 acre overall for the dataset. However, there are some exceptions: a MMU of 0.5 acre has been used for rural areas where there may be isolated residential, commercial, or industrial structures. In such cases, areas less than 1 acre and more than about 0.5 acre are mapped. In urban areas, the MMU is 1 acre. This implies that a water tower or a communication tower in the middle of a residential or commercial area may not be mapped out separately if it occupies less than 1 acre of land. In areas where assessor parcel data was available, Multi-family Residential, Commercial, and Industrial areas may be as small as 0.25 acre. The land use classification scheme used for these data is based on a coding schema used in previous land use datasets in Massachusetts with some modifications for the 2005 classification.

Credits

Preparation: Sanborn, Obtained from: MassGIS, Edits/Updates: CCC

Use limitations

None, per MassGIS

Extent

There is no extent for this item.

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Managed Municipal Barnstable County (Cape Cod) Areas
File Geodatabase Feature Class

Tags

lawn, municipal, land use, land cover, planning, municipal

Summary

This feature class originated as the "MassGIS Data - Land Use (2005)", Land Use Code: 7, Land Use Description: Participation Recreation subset and includes edits, omissions of non-municipally-owned areas and additional municipally-owned lawn layers on the subset. The Summary (Purpose) of the parent feature class according to MassGIS is: "To provide a statewide dataset representing land use for use by MassGIS and its stakeholders. The dataset is also intended to be incorporated into the MassGIS data holdings and distributed for use based on data policies at MassGIS."

Description

The parent feature class "MassGIS Data - Land Use (2005)" subset of the Land Use Code: 7, Land Use Description: Participation Recreation was edited to omit non-municipally owned areas, areas covering impermeable features and addditional municapply-owned areas were added by the CCC. Below is the "Description (Abstract)" provided by MassGISfor the parent feature class. Per MassGIS on the parent feature class: "This is a statewide, seamless digital dataset of land use / land cover for the State of Massachusetts derived using semi-automated methods and based on digital imagery captured in 2005 with 0.5 m pixel resolution. The project area encompasses the State of Massachusetts. The minimum mapping unit (MMU) for this dataset is 1 acre overall for the dataset. However, there are some exceptions: a MMU of 0.5 acre has been used for rural areas where there may be isolated residential, commercial, or industrial structures. In such cases, areas less than 1 acre and more than about 0.5 acre are mapped. In urban areas, the MMU is 1 acre. This implies that a water tower or a communication tower in the middle of a residential or commercial area may not be mapped out separately if it occupies less than 1 acre of land. In areas where assessor parcel data was available, Multi-family Residential, Commercial, and Industrial areas may be as small as 0.25 acre. The land use classification scheme used for these data is based on a coding schema used in previous land use datasets in Massachusetts with some modifications for the 2005 classification."

Credits

MassGIS (parent feature class), CCC (this layer)

Use limitations

None

Extent

West -70.688071 East -69.918715
North 42.087024 South 41.506889

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

APPENDIX B – RESIDENTIAL FERTILIZER AND PESTICIDE USE ON CAPE COD: RESULTS OF RESIDENTIAL PHONE SURVEY, UNIVERSITY OF MASSACHUSETTS DARTMOUTH CENTER FOR POLICY ANALYSIS, JUNE 2012

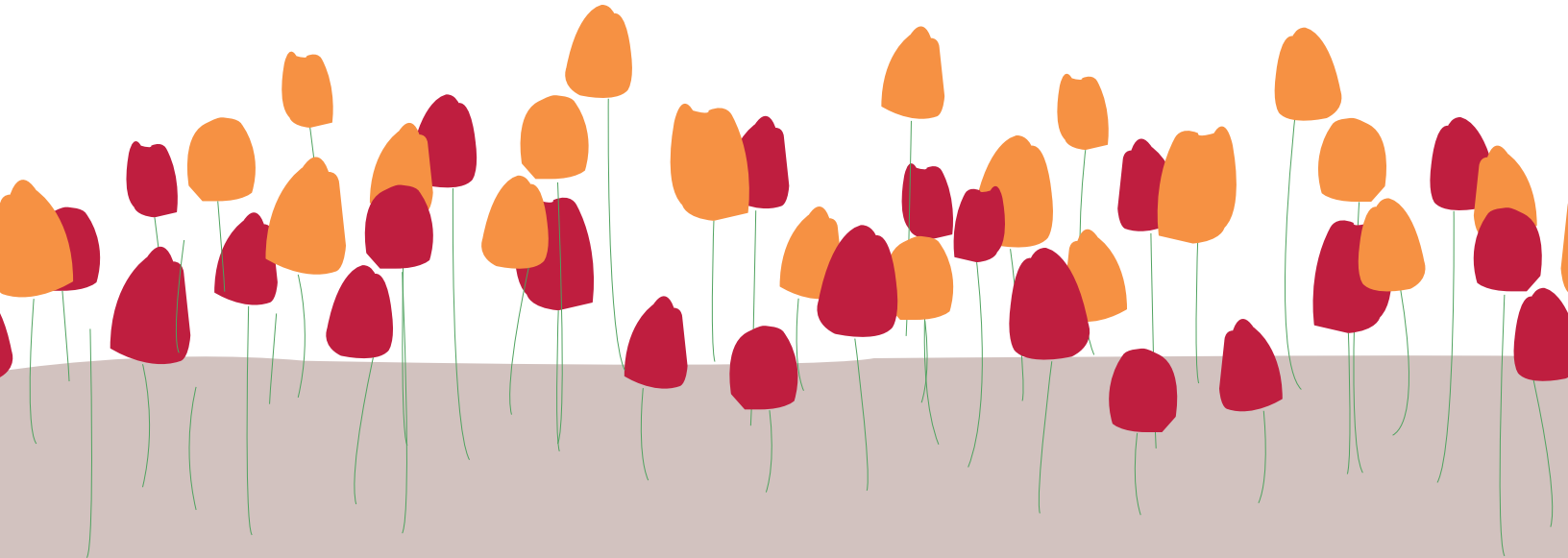
Residential Fertilizer and Pesticide Use On Cape Cod

Results of Residential Phone Survey

Prepared By:

CENTER FOR POLICY ANALYSIS
UNIVERSITY OF MASSACHUSETTS
DARTMOUTH

Prepared for the Cape Cod Commission
July 2012



UNIVERSITY OF MASSACHUSETTS DARTMOUTH
CENTER FOR POLICY ANALYSIS

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Polling and Program Evaluation Research Series No. 104

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EXECUTIVE SUMMARY

A random sample telephone survey of Cape Cod residents was conducted by the Center for Policy Analysis to measure attitudes and behaviors regarding outdoor fertilizer and pesticide use. The survey is part of a larger project being conducted by the Cape Cod Commission, with the support of the Barnstable County Commissioners, which seeks to quantify pesticide and fertilizer use on Cape Cod. This information will provide the basis for establishing goals to reduce pesticide and fertilizer use throughout the region and will also support a separate public education and outreach program to promote best management practices.

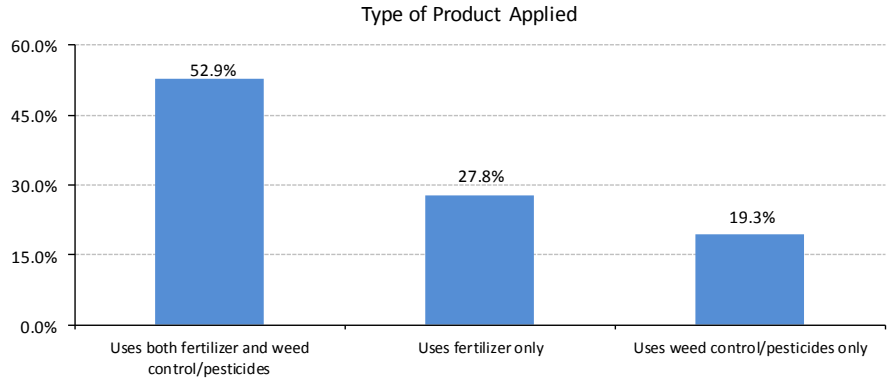
The survey measures residents' self-reported behaviors and attitudes about outdoor fertilizer and pesticide use over the past 12 months. A total of 550 telephone interviews were conducted from June 27 through July 6, 2012 using a questionnaire developed by the Cape Cod Commission and the Center for Policy Analysis. The telephone interview was conducted with the member of the household, age 18 and older, who primarily makes decisions regarding lawn fertilizer use.

Topline Results

Overall, attitudinal and behavioral differentiation among respondents demonstrates that tailored management and education strategies will be needed to address specific populations. That is, there is no one size fits all solution that will effectively change residential fertilizer and pesticide use behaviors.

Nearly seven-in-ten respondents (69.6%) report that a lawn fertilizer, a weed control product, and/or a pesticide have been applied on their property in the past 12 months. Among these respondents, 52.9% report that both a fertilizer and weed control/pesticide was applied, while 27.8% applied lawn fertilizer only and 19.3% applied weed or pest control products only (see Figure 1).

Figure 1



The survey results highlight one overarching conclusion; many Cape residents are uncertain about the products they use, the form of product that is applied (e.g. granular, liquid), and the frequency of application. This is particularly true among respondents who contract with a lawn care or pest control company, although many respondents who apply the products themselves are also unable to provide specific product name and usage data.

This may be partly due to a recollection issue and the seasonality of fertilizer use, that is, respondents simply cannot remember these facts because the product was applied several months past.[1] In addition, respondents who contract with a lawn care or pest control company are more hands off than respondents who self-apply. These users

[1] There was no optimal time of year to conduct the survey to avoid recollection issues. The decision was made to administer the survey in the summer because fertilizer and pesticide products were likely applied in the spring/summer maintenance cycle.

rely on a systematic approach where the lawn company or landscaper makes most of the decisions about what will be applied and when. For example, one respondent stated "How would I know [how often the product is applied]? I just pay the bill."

However, this does not fully explain respondents' lack of knowledge about the fertilizers and pesticides they are using on their property. For example, in most cases, respondents are at least able to remember the purpose for which they used the product, its form, and/or the frequency of application, although less than half can name all three. Thus, it is likely that uncertainty among respondents is a combination of all these factors, but that in general, many respondents are simply not paying much attention to the specific details of the product being used and the way in which it is applied.

Despite respondent ambiguity, there are significant differences among respondents in terms of usage and a respondent's sex, age, education, income, and the region of the Cape in which they reside. Moreover, homeowners who apply the products themselves differ in usage patterns from those who hire a lawn care, landscape or pest control company or who have a landlord or condo management apply the products at their home. Due to these differentiations, fertilizer and weed and pest control users were combined into two groups for some analyses in this report:

- Internal User: A person within the household applies the fertilizer, weed control, or pesticide product.
- External User: A person outside the household applies the fertilizer, weed control, or pesticide product. This group primarily consists of respondents who contract with a lawn care or pest control company, but also includes respondents who have these products applied by a landlord, condo association management, or a friend.

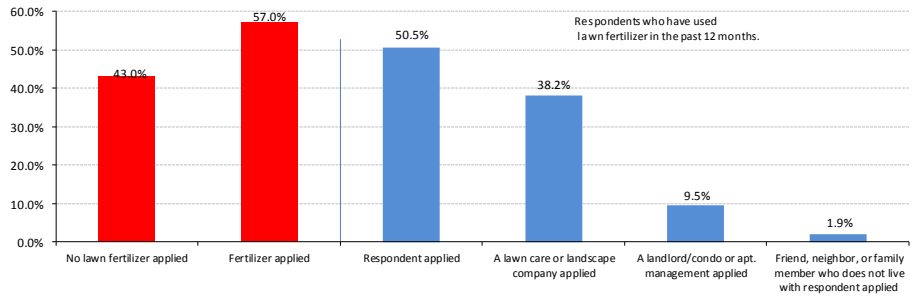
Lawn Fertilizer Use

Respondents were asked a series of questions regarding outdoor lawn fertilizer use, including who applies the product, the name of the product used, what the product is used to treat, the frequency in which it is applied, in which form the product is applied, and the type of store from which the product is purchased. Respondents were allowed to provide this data for up to 6 products.

- Fifty-seven percent of respondents (57.0%) report that they used lawn fertilizer in the past 12 months.[2] Just over half (50.5%) of these respondents applied the product themselves (see Figure 2). The majority of respondents (53.6%) used only one product, although they may be using the product to treat more than one issue (fertilize grass, kill weeds, etc.) and using it more than one time per year.

Figure 2

Can You Please Tell Me If You, Someone In Your Household, Or a Yard Care Professional Used Fertilizer On Your Lawn In the Past 12 Months?



[2] Because fertilizing and pest control are usually done seasonally, it is likely that many respondents were thinking about the current calendar year when providing usage data.

Respondents were asked to indicate the specific brand and product name of the fertilizer that was used on their lawn. Many are unable to name the product used; among respondents who had fertilizer applied in the past 12 months, 42.9% don't know or remember what product was applied – neither the company that makes the product (e.g. Scotts, Pennington) or the specific product name (e.g. Weed & Feed, Step 1, Crabgrass Killer, etc.).[3] The majority of these respondents contract with a lawn care or landscape company ((81.7% don't know/remember) or have fertilizer applied by a landlord or condo/apartment management (100.0% don't know/remember), although 8.5% of respondents who applied the fertilizer themselves don't know or remember the specific product name (see Table 1).

In addition, a significant number of respondents are able to identify the company that makes the product but not the specific product name. For example, many respondents simply answer "Scotts" but are unable to provide more detailed information about the product. The products most named by respondents include Scotts (no specific product) (N=46), Scotts 4 step (N=30), Organic (N=11), Pennington (N=8), Scotts Turf Builder (N=8), Lime (N=6), Scotts Step 1 (N=6), and Trugreen (N=6).

Table 1

Who Applies?	% "Don't Know/ Remember" Product Name
Respondent	8.5%
A lawn care or landscape company	81.7%
A landlord/condo or apt. management	100.0%
Friend, neighbor, or family member who does not live with respondent	0.0%

Lawn Fertilizer Application

Respondents cite a variety of reasons for applying lawn fertilizer with the majority not surprisingly using the products to fertilize grass (62.4%). Smaller percentages use the products to kill weeds (20.0%), kill grubs (4.0%), fertilize flowers and shrubs (3.3%), fertilize vegetables (3.1%), fertilize fruit trees (0.4%), and other reasons (0.4%). Just over 6 percent of respondents (6.2%) don't know what the product was used for and these respondents are all external users.

Products are applied primarily in dry granular form 83.5%, while 10.6% are a ready to use spray or liquid fertilizer, 3.5% are in another form, and 0.8% are in a concentrated spray, with 1.6% who don't remember. There were also a significant number of respondents who did not know the form because a lawn care/landscape company or landlord/condo management applied the product (not included in these results).

Respondents primarily fertilize between 1 to 4 times per year: 3.9% of respondents fertilize less than 1 time per year, 44.1% fertilize 1 to 2 times per year, 32.6% fertilize 3-4 times per year, 7.3% fertilize 4 to 5 times per year, 0.3% fertilize more than 5 times per year, 9.4% don't know because someone else applies the fertilizer, and 2.4% don't know. In terms of how respondents determine the amount of lawn fertilizer to apply, 47.5% let the lawn company decide. When these respondents are excluded from the data, 71.3% of respondents report that they determine the amount by using the directions on the bag, while 11.0% guess/estimate, 9.8% use past experience, 6.1% don't know or remember, 1.2% use the amount that fits in the spreader, and 0.6% use a store's recommendation.

Lastly, just over thirty-eight percent of respondents (38.1%) purchased their fertilizer through a lawn care professional. When these respondents are excluded from the data, respondents primarily purchased their fertilizer at a home supply store (31.3%), a nursery (23.7%), a hardware store (17.2%), and a discount department store (5.6%).

[3] The telephone interviewers were instructed to ask for the specific product name.

Crosstabulations

Crosstabulations were run for lawn fertilizer-related questions by the following variables: sex, education, age, household income, internal/external users, and region. Statistically significant correlations follow.

Internal vs. External Users

External users are more passive in directing their lawn care practices in comparison to internal users. External users are less knowledgeable about what is being applied, in what form, and how often in comparison to respondents who self-apply. They rely more on a hands-off systematic program developed early in the season in conjunction with their lawn care or landscape company. In addition:

- Internal users fertilize less frequently than external users; while a higher percentage of internal users apply the product(s) 1 to 2 times per year (52.3% vs. 39.5%), they are less likely to apply 3 to 4 times per year (33.8% vs. 45.6%) and 4 to 5 times per year (4.6% vs. 14.9%) (see Table 2).[4] This is consistent with research that shows that the average application rate of fertilizer applied by lawn and landscape professionals is higher than the application rate of homeowners (Law et al, 2008; Souto et al, 2009).

Table 2

Frequency	Internal	External
Less than 1 time per year	8.6%	0.0%
1-2 times per year	52.3%	39.5%
3-4 times per year	33.8%	45.6%
4-5 times per year	4.6%	14.9%
More than 5 times per year	0.7%	0.0%

- A higher percentage of internal users apply dry granules in comparison to external users (89.8% vs. 73.5%), while a higher percentage of external users have a ready to use liquid or spray applied (26.5% vs. 1.9%).

Age

- Respondents 65 years of age and older are more likely to contract with a lawn care or landscape company in comparison to other age cohorts, while younger respondents are more likely to self-apply; 13.6% age 18 to 34, 18.2% age 35 to 49, 17.9% age 50 to 64, and 33.1% age 65 and older have their lawn fertilizer applied by an outside company. Conversely, 38.1% age 18 to 34, 29.1% age 35 to 49, 32.1% age 50 to 64, and 19.3% age 65+ self-apply lawn fertilizer.
- Respondents 65 years of age and older are the most likely age cohort to use a spray or ready to use liquid fertilizer; 0.0% age 18 to 24, 1.8% age 35 to 49, 7.1% age 50 to 64, and 14.7% age 65+ use a liquid fertilizer, primarily this is the group that is most likely to contact with a lawn care or landscape company.

Household Income

- Respondents with incomes above $100K are more likely to have applied fertilizer (67.4%) in comparison to respondents with incomes between $50K and $100K (57.0%) and less than $50K (45.0%).

[4] Note: This data does not include external users who "let their lawn or landscape company decide" the frequency of application as well as respondents who "don't know."

Region

- Respondents who reside in the Lower Cape are less likely to have applied lawn fertilizer (either internally or externally) than are respondents who reside in the Mid-Cape and Upper Cape; 50.0% of Lower Cape respondents did not apply fertilizer in the past 12 months, compared to 39.0% of Mid-Cape respondents and 42.0% of Upper Cape respondents.[5]

Education

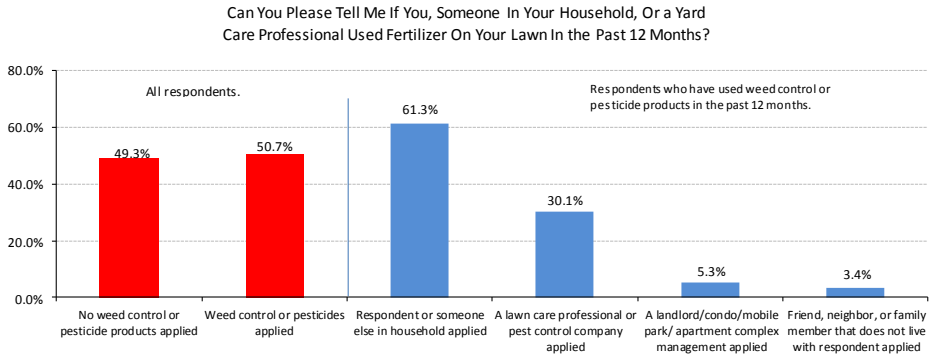
- Respondents with lower incomes and lower levels of education are more likely to have a landlord or apartment management apply fertilizer than are other respondents.

Weed & Pest Control

Respondents were asked several questions regarding outdoor weed and pest control product use, including who applies the product, the name of the product, the purpose for which they use the product, the frequency it is applied, in which form, and from which stores it is purchased.

Just over half of respondents (50.7%) report that they or someone else used weed or pest control products on their property in the past 12 months. Among these respondents, 61.3% applied the product themselves or it was applied by someone in the household, while 30.1% used a lawn care or pest control company, 5.3% had a landlord or condo/apartment management apply, and 3.4% had a friend or other person who does not live with them apply (see Figure 3). The majority of respondents (86.3%) used only one weed or pest control product in the past 12 months, although many are using the product to treat more than one issue (fertilize grass, kill weeds, etc.) and applying it more than one time per year.

Figure 3



Respondents were asked to provide the specific product name of the weed or pest control product that was used. Similar to the fertilizer use results, many respondents are unable to name the product used; among respondents who applied or had applied weed or pest control products in the past 12 months, 33.8% don't know or remember what product was applied – neither the company that makes the product (e.g. Ortho, Spectracide) or the specific product name (e.g. Cutter Yard Guard, Bayer Advanced, Ortho Weed-B-Gon, etc.).[6] The majority of these respondents contract with a lawn care or pest control company (85.0% don't know the product name) or who have these products applied by a landlord or condo/apartment management (100.0% don't know the product name) (see Table 3).

[5] Lower Cape is defined as the towns of Brewster, Chatham, Harwich, Eastham, Orleans, Provincetown, Truro, and Wellfleet. Mid Cape is defined as the towns of Barnstable, Dennis, and Yarmouth. Upper Cape is defined as the towns of Bourne, Falmouth, Mashpee, and Sandwich.

[6] The telephone interviewers were instructed to ask for the specific product name.

In addition, a significant number of respondents are only able to identify the company that makes the product. For example, many respondents answer "Ortho" but are unable to provide the specific product name. The products most named by respondents include Ortho Weed-B-Gon (N=22), Ortho (general) (N=21), Scotts (N=17), Roundup (N=15), Raid (N=12), Spectracide (N=11), Roundup Weed Killer (N=8), and Scotts Step 1 (N=7).

Table 3

Who Applies?	Number	Percent "Don't Know/Remember" Product Name
Respondent	5	3.1%
A lawn care or landscape company	68	85.0%
A landlord/condo or apt. management	14	100.0%
Friend, neighbor, or family member who does not live with respondent	3	33.3%

Weed and Pest Control Application

- Respondents manage many different types of weeds and insects, with over a quarter (26.6%) reporting that they manage "all types." In terms of specific insects and weeds, 16.6% use the products to manage ants, 11.3% for crabgrass, 10.0% for dandelions, 6.0% don't know, 4.7% for grubs, and 4.4% for grass, among others. Including only respondents who provided a specific weed or insect that they manage, 67.4% are using the products to manage weeds and 32.6% are using the project to manage insects.

- The majority of products used by respondents are ready to use sprays or liquids (43.4%), dry granules (20.7%), concentrated sprays (16.9%), and other forms (1.0%), while 3.8% of respondents don't know or remember. Just over fourteen percent of respondents (14.1%) don't know the product's form because they hire a lawn care or pest control company to apply the product, or a landlord, condo management, or a friend applies the product. When these external users are excluded from the data, just over half (50.6%) are using ready to spray liquid, followed by dry granules (24.1%), concentrated spray (19.7%), don't know/remember (4.4%), and other forms (1.2%).

- 11.1% apply the products less than 1 time per year, 38.8% apply them 1 to 2 times per year, 17.0% apply them 3-4 times per year, 9.0% use them 4 to 5 times per year, 4.2% use them more than 5 times per year, 11.1% don't know because their lawn or pest control company decides, and 9.0% don't know or remember. As one might expect, external users are less likely to know the frequency in which the product is applied in comparison to internal users.

- Just under a third of respondents (32.9%) report that someone else purchased their weed or pest control products, with the vast majority of these being external users. When these respondents are excluded from the data, 30.1% of respondents report that they purchased their weed or pest control products at a hardware store, 25.8% at a home supply store, 15.1% at a nursery, 7.0% at a discount department store, 6.5% at an "other" location, 2.7% at a grocery store, and 0.5% at a drug store. In addition, 12.4% of respondents don't remember where they purchased the product, most who are not the primary users of weed control and pesticides in the household.

Crosstabulations

Crosstabulations were run for weed and pest control-related all survey questions by the following variables: sex, education, age, household income, internal/external users, and region. There are only a small number of statistically significant correlations in comparison to fertilizer use and most of these are for external and internal users. For example:

- Internal users apply these products less frequently than do external users; while a higher percentage of internal users apply the product(s) 1 to 2 times per year (55.1% vs. 42.6%), they are less likely to apply 3 to 4 times per year (16.9% vs. 33.3%) and 4 to 5 times per year (9.0% vs. 18.5%) (see Table 4). As one might expect, respondents who are external users are less likely to know the frequency in which the product is applied in comparison to internal users.

Table 4

Frequency	Internal	External
Less than 1 time per year	11.2%	1.9%
1-2 times per year	55.1%	42.6%
3-4 times per year	16.9%	33.3%
4-5 times per year	9.0%	18.5%
More than 5 times per year	7.9%	3.7%

Note: This data does not include external users who "let their lawn or landscape company decide" the frequency of application and respondents who "don't know."

- Respondents who live in the Lower Cape use these products more frequently than respondents who reside in other regions; 44.9% of respondents who reside in the Lower Cape apply these products 3 or more times per year, which compares to only 21.9% who reside in the Upper Cape and 27.4% who reside in the Mid-Cape (see Table 5).

Table 5

Frequency	Upper	Mid	Lower
Less than 1 time per year	14.9%	7.1%	10.1%
1-2 times per year	40.4%	42.9%	30.4%
3-4 times per year	10.5%	13.1%	29.0%
4-5 times per year	7.0%	9.5%	13.0%
More than 5 times per year	4.4%	4.8%	2.9%
Don't know: company/ landlord/mngmnt. decides	11.4%	13.1%	8.7%
Don't know	11.4%	9.5%	5.8%

Alternative Lawn Care Practices

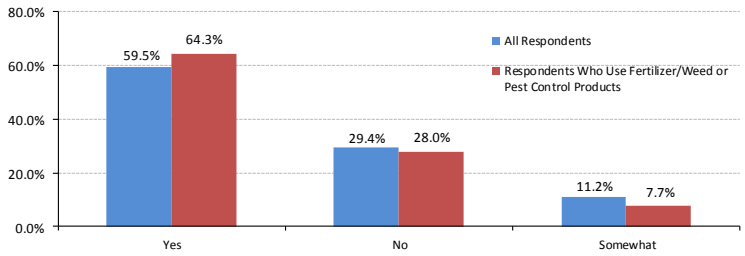
One of the project goals is to measure Cape Cod residents' awareness of organic land maintenance alternatives. To that end, respondents were asked several questions regarding alternative lawn care practices.

Awareness

In terms of respondent awareness of alternative lawn care practices aimed at eliminating or minimizing the use of conventional fertilizers and pesticides (e.g. top dressing, aeration, and organic products), 59.5% report that they are aware of these alternatives, while 11.2% are somewhat aware and 29.4% are not aware. Awareness increases slightly when respondents who don't use fertilizer, weed control, or pest control products are excluded from the data (see Figure 33). Among respondents who are at least somewhat aware of alternative lawn care practices, 44.7% report that they have used these alternatives, while 55.3% have not (see Figure 4).

Figure 4

Awareness of Alternative Lawn Care Practices



There are several statistically significant correlations in terms of respondent awareness of alternative lawn care practices:

- A higher percentage of females (64.0%) report that they are aware of alternative lawn care practices in comparison to males (54.4%).
- Respondents with a Bachelor's degree or higher are more aware of alternative lawn care practices (66.6%) in comparison to respondents with an Associate's degree/some college experience (48.4%) and respondents with a high school diploma or less (50.6%).
- Respondents with household income above $100K are more aware of alternative lawn care practices (71.1%) in comparison to respondents with household incomes between $50K and $100K (57.5%) and household incomes less than $50K (50.4%).

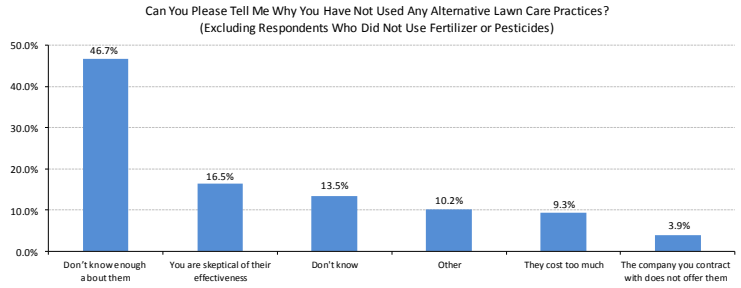
In terms of using these alternative practices:

- Respondents with a Bachelor's degree or higher are more likely to have used alternative lawn care practices (50.2%) in comparison to respondents with an Associate's degree/some college experience (40.8%) and respondents with a high school diploma or less (28.8%). This result is somewhat influenced by the fact that respondents with lower levels of education are more likely to have a landlord or condo management apply fertilizer or pesticides.
- Respondents with household incomes above $100K are more likely to have used alternative lawn care practices (58.3%) in comparison to respondents with household incomes between $50K and $100K (48.9%) and household incomes less than $50K (30.9%). This result is somewhat influenced by the fact that respondents with lower levels of education are more likely to rent and therefore have a landlord or condo management apply lawn fertilizer or pesticides.

Reasons for Not Using Alternative Lawn Care Practices

Respondents who have not used alternative lawn care practices were asked why they have not used them. Thirty-nine percent (39.0%) report that they don't use alternative lawn care practices because they don't know enough about them. This result includes respondents who do not use fertilizer or weed and pest control products. When these respondents are excluded from the results, 46.7% report that they do not use alternative lawn care practices because they don't know enough about them, while 16.5% indicate that they are skeptical of their effectiveness, 11.1% don't know why they don't use these products, 10.2% cite other reasons, 9.3% indicate that they cost too much, and 3.9% indicate that the company they contract with does not offer these types of products (see Figure 5).

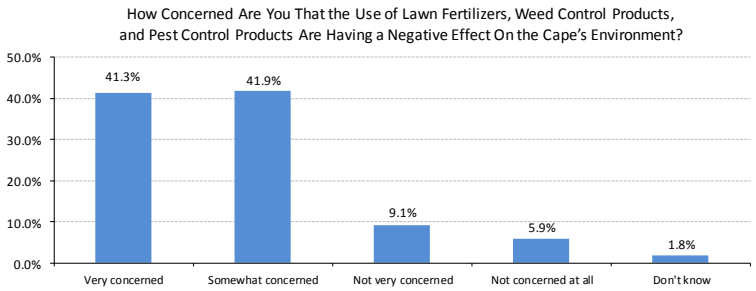
Figure 5



Level of Concern

Respondents were asked to indicate their level of concern about the impact that the use of lawn fertilizers, weed control products, and pest control products are having on the Cape's environment. More than forty-one percent (41.3%) report that they are very concerned that the use of these products are having a negative effect on the Cape's environment, while 41.9% are somewhat concerned, 9.1% are not very concerned, 5.9% are not concerned at all, and 1.8% don't know (see Figure 6).

Figure 6



There are several statistically significant correlations:

- Younger respondents are most likely to be very concerned that these products are having a negative effect on the Cape's environment; 49.2% in the 18 to 34 cohort, 40.0% in the 35 to 49 age cohort, 48.1% in the 50 to 64 age cohort, and 30.7% in the 65+ cohort, although the 65+ cohort is most likely to be somewhat concerned.
- A lower percentage of external users are very concerned that the use of these products is having a negative effect on the Cape's environment; 31.9% of external users are very concerned, compared to 46.8% of internal users, although external users are more likely to be somewhat concerned (47.8% vs. 39.4%).
- As one might expect, respondents who believe that the use of fertilizers, weed control products, and pest control products have a significantly negative effect on the environment have higher levels of concern about the negative impact that these products are having on Cape Cod's environment.

1.00 INTRODUCTION

The Cape Cod Commission, with the support of the Barnstable County Commissioners, is involved in a four-point plan to pursue pesticide concerns on Cape Cod. A major component of the plan is to initiate a Cape-wide study of fertilizer and pesticide use. The objective of the study is to quantify pesticide and fertilizer use in the Cape Cod region and to determine the relative contributions of pesticide and fertilizer use from major land use types. This information will provide the basis for establishing goals to reduce pesticide and fertilizer use throughout the region. It will also support a separate public education and outreach program to promote best management practices.

One task of the study is to measure attitudes and behaviors among Cape Cod residents regarding outdoor fertilizer and pesticide use, including the specific products used, what they are used to control, the frequency they are applied, and the amount applied. To this end, a random sample telephone survey of Cape Cod residents was conducted by the Center for Policy Analysis at UMass Dartmouth. The survey addresses the following needs:

- Portion of residences actively involved in land maintenance
- Portion of residences utilizing professional yard care services versus self-maintenance
- Quantity and type of fertilizers and pesticides used by residents
- Reasons for pesticide and fertilizer use
- Types of stores at which fertilizers and pesticides are purchased
- Perceptions of the effect of residential yard care on the environment
- Awareness of organic land maintenance alternatives

2.00 METHODOLOGY

A total of 550 telephone interviews were conducted with Cape Cod households from June 27, 2012 through July 6, 2012.[7] The overall margin of error for the poll is +/-4.2 percent for the complete set of data and the response rate for the survey is 15.1% (AAPOR#4).[8] Twenty test interviews were conducted before full implementation of the survey began.

The survey was conducted with the member of the household, age 18 and older, who primarily makes decisions regarding fertilizer use. Interviews were conducted between 3:00 pm and 8:00 pm on weekdays and 10:00 am and 4:00 pm on Saturday and Sunday. This range of hours provides the interviewers with an opportunity to contact hard to reach respondents, a procedure crucial to producing high quality survey data. Return calls were scheduled at the convenience of the respondents, primarily during the morning hours. Respondents were called a minimum of 5 times before they were determined to be unreachable.

A total of 17,568 dialings were made during the survey period. The average interview length was primarily dependent on whether the respondent applied fertilizer or pesticides and the number of products used. Overall, interviews averaged 7.4 minutes, with the shortest survey completed in just under 4 minutes and the longest survey taking nearly 18 minutes. The Center's senior staff continually monitored the progress of interview outcomes to prevent problem cases that could interfere with the integrity of survey procedures.

2.10 SURVEY QUESTIONNAIRE

The telephone survey was conducted using a questionnaire developed by the Cape Cod Commission and the Center for Policy Analysis. Some of the survey questions were modeled on studies conducted in Wekiva, Florida and Orange County, California (Florida Department of Environmental Protection 2009; Wilen 2001). A copy of the survey questionnaire can be found in Appendix B.

[7] The study period included a one-day break for the July 4th holiday.

[8] The number of respondents for some questions is lower, thus the margin of error is higher in those instances.

2.20 SAMPLING PROCEDURES

The Center for Policy Analysis uses the Genesys Sampling System from Marketing Systems Group to generate random telephone numbers. The Genesys Sampling System is used by many private and university-based polling and survey research organizations. The system uses a list of all possible telephone numbers in a particular geographic area (e.g., a state) to randomly generate a telephone sample for the designated geographic area. The survey was conducted using a random digit dialing (RDD) sample. The RDD sample insures an equal and known probability of selection for every residential telephone number (listed and unlisted) in the sample geographic frame.

2.30 SURVEY ADMINISTRATION

The Center for Policy Analysis uses Computer Assisted Telephone Interviewing, or CATI, to conduct telephone surveys. Specifically, CFPA uses WinCATI software from Sawtooth Technologies, which is one of most widely used CATI systems in the world. Using WinCATI, telephone interviewers conduct interviews via computers, which provides highly reliable data because the computer controls the questionnaire, skip patterns are executed exactly as intended, responses are within range, and there are no missing data. Spanish and Portuguese speaking interviewers were available for respondents who speak those languages.

2.40 TELEPHONE INTERVIEWER TRAINING AND SUPERVISION

Center staff and student research assistants were employed as telephone interviewers. These interviewers have conducted numerous telephone polls on behalf of the Center and all have been trained intensively, including practice interviews. Senior-level staff at the Center for Policy Analysis monitored the interviewers at all times to ensure high quality data collection.

2.50 SAMPLE WEIGHTING

The sample was weighted to account for sampling bias. Sampling bias is defined as the tendency of a sample to exclude some members of the sampling universe and over-represent others. In this sample, females and older respondents are over-represented. Weighting the data allocates more "weight" to groups that are under-represented (e.g. younger males), while providing less weight to groups that are over-represented (e.g. older females). In other words, weighting adjusts the sample so that it looks more like the actual population of Barnstable County as defined by the U.S. Census Bureau (2005-2009 American Community Survey estimates). All data in this report have been weighted to adjust for sex and age, although the differences between the weighted and unweighted samples for each question are generally small (between 0.1% and 2.5%).

2.60 ANALYSIS OF RESULTS

Basic frequencies were tabulated for each survey question. In addition, crosstabulations were run for nearly all survey questions by the following variables: sex, education, age, household income, internal/external users, and region (Lower, Mid, and Upper Cape Cod). The Lower Cape region is defined as the towns of Brewster, Chatham, Eastham, Harwich, Orleans, Provincetown, Truro, and Wellfleet. The Mid Cape region is defined as the towns of Barnstable, Dennis, and Yarmouth. The Upper Cape region is defined as the towns of Bourne, Falmouth, Mashpee, and Sandwich. In comparison to Census data, Lower Cape respondents are somewhat over-represented in the sample, while Mid-Cape residents are under-represented (see Table 6).

Table 6

	Survey Sample (Age 18+)		*Census Age 18+	
Region	Number	Percent	Number	Percent
Lower Cape	155	29.1%	40,878	22.9%
Mid Cape	164	30.9%	69,081	38.7%
Upper Cape	212	39.9%	68,539	38.4%

**American Community Survey (2005-2009), U.S. Census Bureau. Residents age 18 and older.*
(Nineteen respondents did not provide their town of residence).

Crosstabulations were also run by property type (e.g. single family, condo, and apartment) and ownership status (homeowners vs. renters). Because most respondents own their homes and live in a single-family residence, the data was not statistically significant and the results of these analyses are not included in the report. Crosstabulations were also analyzed by respondents' lot size and lawn size, but the results showed no statistically significant correlations. Furthermore, in many cases lot and lawn size data provided by respondents were gross estimates and thus this data is not entirely reliable. Lastly, crosstabulations were run by the number of years the respondent has lived on the Cape or owned a home on the Cape. No statistically significant conclusions could be drawn from this data, although some of the differences based on years lived on the Cape might be more of a result of a respondent's age than how long they have resided in the region.[9]

[9] Crosstabs were considered to be statistically significant at the .05 level or below.

3.00 TOPLINE RESULTS

The survey measures self-reported behaviors and attitudes about outdoor fertilizer and pesticide use over the past 12 months.[10] Nearly seven-in-ten respondents (69.6%) report that they, a lawn care or pest control company, a landlord or condo/apartment manager, or a friend have applied a lawn fertilizer, a weed control product, and/or a pesticide in the past 12 months (see Figure 7). Among these respondents, 52.9% report that both a fertilizer and weed control/pesticide was applied, while 27.8% applied fertilizer only and 19.3% applied weed control or pesticides only (see Figure 8).

Figure 7

Applied Fertilizer, Weed Control, or Pesticide Products in the Past 12 Months

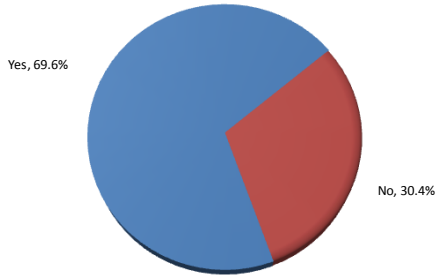
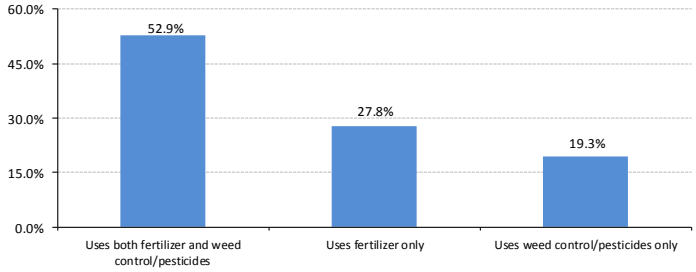


Figure 8

Type of Product Applied



Importantly, many respondents are unclear about the product they used, in which form it was applied, and the frequency of application. This is particularly true among respondents who contract with a lawn care or pest control company, although many respondents who apply the products themselves are also unable to provide specific product name and usage data. Despite respondent ambiguity, there are significant differences among respondents in terms of usage and a respondent's sex, age, education, income, and the region of the Cape in which they reside. Moreover, homeowners who apply the products themselves differ in usage patterns from those who hire a lawn care, landscape or pest control company. Due to these differentiations, fertilizer and weed/pest control users were combined into two groups for some analyses in this report:[11]

- Internal User: A person within the household applies the fertilizer, weed control, or pesticide product.
- External User: A person outside the household applies the fertilizer, weed control, or pesticide product. This group primarily consists of respondents who contract with a lawn care or pest control company, but also includes respondents who have these products applied by a landlord, condo association, apartment management, or a friend.[12]

[10] Because fertilizing and pest control are often done seasonally, it is likely that some respondents were thinking about the current calendar year when providing usage data.

[11] A similar methodology was used in *Wekiva Residential Fertilizer* Practices, 2009 (See sources for full citation).

[12] Three respondents fall under both categories. These respondents were excluded from internal/external analyses.

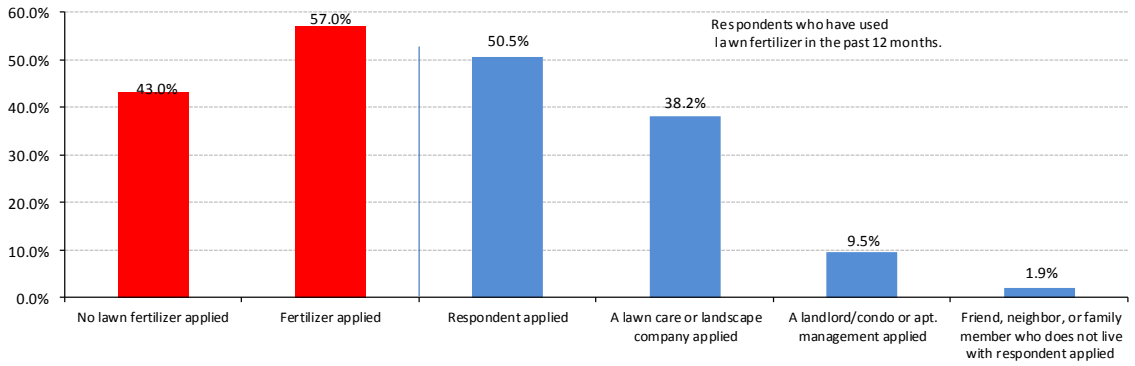
4.00 LAWN FERTILIZER USE

Respondents were asked several questions regarding outdoor lawn fertilizer use, including who applies the product, the name of the product used, what the product is used to treat, the frequency the product is applied, in which form the product is applied, and the type of store from which the product is purchased. Respondents were able to provide this information for up to 6 products.

Fifty-seven percent of respondents (57.0%) report that they used lawn fertilizer in the past 12 months, while 43.0% did not use lawn fertilizer. Among respondents who used lawn fertilizer, 50.5% applied the product themselves, while 38.2% had a lawn care or landscape company apply the product, 9.5% had a landlord or condo/apartment management apply the fertilizer, and 1.9% had a friend or other person who does not live with them apply the fertilizer (see Figure 9).

Figure 9

Can You Please Tell Me If You, Someone In Your Household, Or a Yard Care Professional Used Fertilizer On Your Lawn In the Past 12 Months?



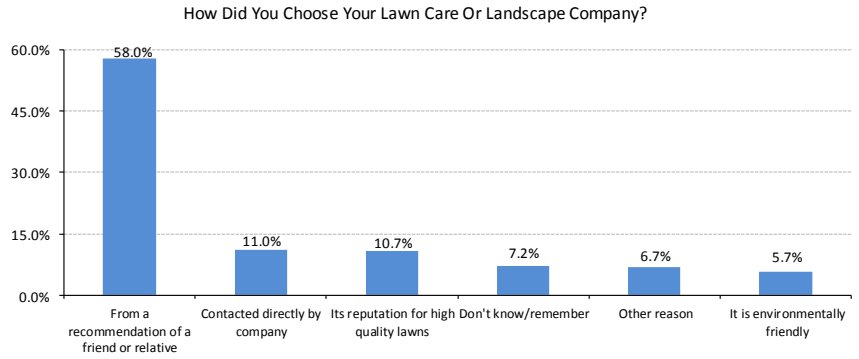
There are several statistically significant correlations in terms of who applies lawn fertilizer:

- Respondents 65 years of age and older are more likely to contract with a lawn care or landscape company in comparison to other age cohorts, while younger respondents are more likely to self-apply; 13.6% age 18 to 34, 18.2% age 35 to 49, 17.9% age 50 to 64, and 33.1% age 65 and older hired a lawn or landscape company. Conversely, 38.1% age 18 to 34, 29.1% age 35 to 49, 32.1% age 50 to 64, and 19.3% age 65 and older self-apply lawn fertilizer.
- Respondents who reside in the Lower Cape are less likely to have applied lawn fertilizer (either internally or externally) than are respondents who reside in the Mid-Cape and Upper Cape; 50.0% of Lower Cape respondents did not apply fertilizer in the past 12 months, compared to 39.0% of Mid-Cape respondents and 42.0% of Upper Cape respondents.
- Respondents with incomes above $100K are more likely to have applied fertilizer (67.4%) in comparison to respondents with incomes between $50K and $100K (57.0%) and less than $50K (45.0%).
- Respondents with lower incomes and lower levels of education are more likely to have a landlord or apartment management apply fertilizer than are other respondents, primarily because this group is more likely to rent than are other groups.

4.10 RESPONDENTS WHO EMPLOY A LAWN CARE OR LANDSCAPE COMPANY

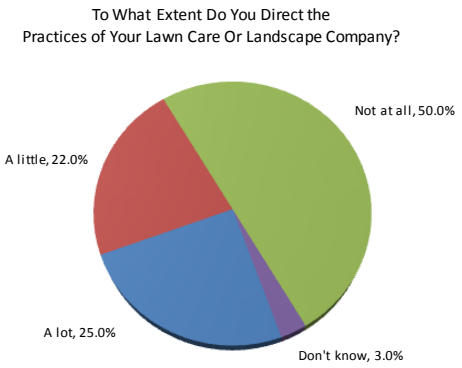
Three questions were asked to respondents who hired a lawn care or landscape company (N=121) to fertilize their lawn. In terms of how they chose the company, the majority of respondents used a recommendation from a friend or relative (58.0%), while smaller percentages were contacted directly by the company (11.0%), chose the company based on its reputation (10.7%), don't know or remember (7.2%)[13], some other reason (6.7%),[14] and because the company is environmentally friendly (5.7%) (see Figure 10).

Figure 10



Most respondents who contract with a lawn care or landscape company direct the practices of the company very little if at all; 50.0% report that they do not direct the company's practices "at all," while 22.0% provide only "a little" direction. Only a quarter of respondents (25.0%) report that they provide "a lot" of direction (see Figure 11). However, an analysis of the data by respondent shows that the majority who report that they direct their lawn or landscape company's practices "a little" or "a lot" actually know very little in terms of the specific product used and how often it is applied; only 17.5% of this group are able to name the product used, its form (e.g. dry granules, spray), and the frequency in which it is applied, although most can answer at least one of those questions correctly.[15] In fact, among all respondents who hire a lawn care or landscape company, only about 25.0% actually know the product being applied and how often.

Figure 11



[13] In many of these cases the respondent was not the person in the household who hired the company.

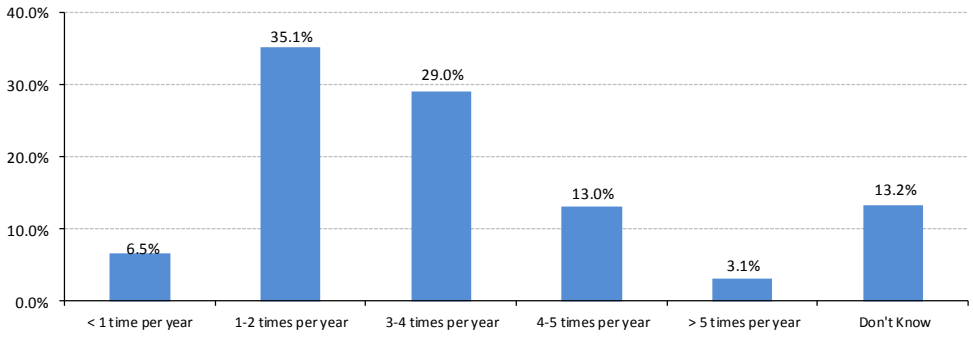
[14] Other reasons include apartment management decides (N=5), or condo association decides (N=3).

[15] It may be the case that some respondents who report that they direct their lawn or landscape company "a lot" were aware of the specifics of the service when they hired the company, but have since have forgotten. Thus, while they may not recall details of the fertilization program, they did direct the lawn care company when the agreement was first signed. Conversely, twelve respondents who reported that they do not direct their lawn care or landscape company "at all" were actually able to name the product used, its form, and the frequency in which it is applied. Again, these may be respondents who are not involved in application of fertilizers throughout the season but nonetheless did direct the company's practice when the agreement for services was created.

In terms of frequency of application, the majority of respondents have their lawn care or landscape company fertilize their lawn 1 to 4 times per year; 6.5% have their lawn fertilized less than 1 time per year, 35.1% fertilize 1 to 2 times per year, 29.0% fertilize 3 to 4 times per year, 13.0% fertilize 4 to 5 times per year, 3.1% fertilize more than 5 times per year, and 13.2% don't know (see Figure 12).

Figure 12

How Often Does Your Landscape Company Apply Fertilizer To Your Lawn?



4.20 SPECIFIC LAWN FERTILIZER PRODUCTS

Respondents were asked to indicate the specific brand and product name of the fertilizer that was used on their lawn. Many respondents were unable to name the product used; among respondents who had fertilizer applied in the past 12 months, 42.9% don't know or remember what product was applied – neither the company that makes the product (e.g. Scotts, Pennington) or the specific product name (e.g. Weed & Feed, Step 1, Crabgrass Killer, etc.).[16] The majority of these respondents contract with a lawn care or landscape company ((81.7% don't know/remember what was applied) or have fertilizer applied by a landlord or condo/apartment management (100.0% don't know/remember what was applied), although 8.5% of respondents who applied the fertilizer themselves don't know or remember the specific product name (see Table 7).[17] In addition, a significant number of respondents were able to identify the company that makes the product but not the specific product name. For example, many respondents simply answered "Scotts" but were unable to provide more detailed information about the product.

Table 7

Who Applies?	% Respondents "Don't Know/ Remember" Product Name
Respondent	8.5%
A lawn care or landscape company	81.7%
A landlord/condo or apt. management	100.0%
Friend, neighbor, or family member who does not live with respondent	0.0%

Products used by respondents or that were applied by others include:

- Ace (N=2)
- Ace Cow Manure
- Agway (general) (N=3)
- Agway Organic (N=2)
- Agway Starter Fertilizer (N=6)
- Broad leaf weed kill
- Chicken based fertilizer (N=2)
- Compost (N=2)
- Corn gluten
- Costco (N=2)
- Espoma Garden Tone
- Espoma Holly Tone
- GrubEx (N=2)
- John Deere Fertilizer
- John Deere Organic
- Jonathan Green (N=4)
- Lawn fertilizer (N=3)
- Lawn Restorer
- Lesco (N=4)
- Lime (N=6)
- Milorganite (N=3)
- Miracle Grow (N=3)
- Organic (N=11)
- Pennington (N=8)
- Scotts (no specific product) (N=46)
- Scotts 4 step (N=30)
- Scotts Organic
- Scotts Step 1 (N=6)
- Scotts Step 2 (N=2)
- Scotts Step 3
- Scotts Step 4
- Scotts Turf Builder (N=8)
- Scotts Weed & Feed (N=4)
- Trugreen (N=6)
- Trugreen Chemlawn
- Trugreen Organic
- Weed-B-Gon

[16] The telephone interviewers were instructed to ask for the specific product name.

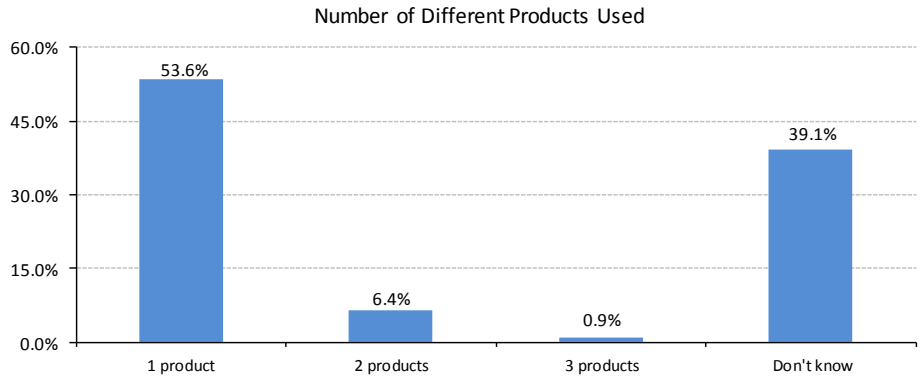
[17] This result may partly be due to a recollection issue, that is, internal users simply cannot remember the product name because it was applied several months ago. However, in most cases these same respondents are able remember the purpose for which they used the product, its form, and/or the frequency of application. Thus, it is likely that this group represent a combination of respondents who cannot remember the product name and respondents who do not pay much attention to the specific details of the product.

4.30 NUMBER OF PRODUCTS USED

The majority of respondents (53.6%) used only one product (see Figure 13), although they may be using the product to treat more than one issue (fertilize grass, kill weeds, etc.) and using it more than one time per year. The number of products used by respondents are conservative for three reasons:

- As noted earlier, it is likely that some respondents are thinking about the current calendar year when providing usage data and not the past 12 months. The survey was conducted in the summer and additional products may be applied in the fall season.
- Thirty respondents indicated that they are using "Scotts 4 Step," with the majority of these respondents reporting that they use the product more than twice per year. This may indicate that some of these respondents are in fact using the Scotts 4 step program or any combination of the program and not just one product (i.e. applying 2 to 4 different products throughout the season: Turf Builder, Weed and Feed, Turf Builder SummerGuard, and/or Turf Builder WinterGuard).
- Over thirty-nine percent of respondents (39.1%) can't provide the specific product(s) name and these are primarily respondents who contract with a lawn care or landscape company. Research shows that usage by lawn care companies is higher than when homeowners apply the product(s) themselves.

Figure 13



A series of questions was asked to better understand the purpose of applying the fertilizer, its form, the frequency it is applied, and where the product was purchased.

4.40 PURPOSE FOR USING PRODUCT

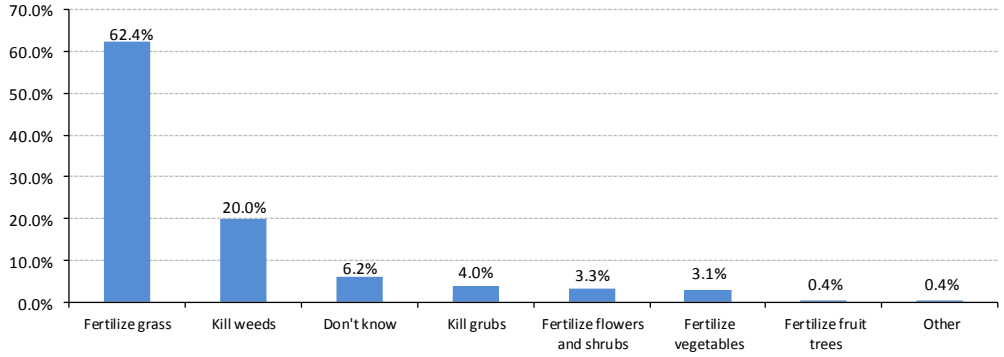
Respondents cite a variety of reasons for using the fertilizer products, with the majority using the products to fertilize grass (62.4%). Smaller percentages use the products to kill weeds (20.0%), kill grubs (4.0%), fertilize flowers and shrubs (3.3%), fertilize vegetables (3.1%), fertilize fruit trees (0.4%), and other reasons (0.4%) (see Figure 14).[18] Just over 6 percent of respondents (6.2%) don't know what the product was used for and these respondents are all external users.

There are some statistically significant correlations in terms of who applies lawn fertilizer:

- Respondents 65 years of age and older are the most likely age cohort to use a spray or ready to use liquid fertilizer; 0.0% in the 18 to 24 age cohort, 1.8% in the 35 to 49 age cohort, 7.1% in the 50 to 64 age cohort, and 14.7% in the age 65+ cohort use a liquid fertilizer. Conversely, the 65+ age cohort is least likely to use dry granules (although a majority uses them). These results are primarily due to the fact that a higher percentage of respondents 65+ contract with a lawn care or landscape company, who are more likely to use a spray fertilizer.
- Similarly, a higher percentage of external users 11.8% use liquid fertilizers in comparison to internal users (1.9%), again because this group are more likely to contract with a lawn care or landscape company.

Figure 14

What Did You Use the Product For?



[18] Other reasons include to prevent moss (N=1) and reduce soil acidity (N=1).

4.50 PRODUCT FORM

Products used are primarily in dry granular form (62.8%), with 24.8% of respondents reporting that they don't know the form of product used (see Figure 15). These are all external users. When these respondents are excluded, 83.5% of the products used are in dry granular form, while 10.6% are in a ready to use spray or liquid fertilizer, 3.5% are in another form, and 0.8% in a concentrated spray, with 1.6% who don't remember (see Figure 16).[19]

- A higher percentage of internal users apply dry granules in comparison to external users (89.8% vs. 73.5%), while a higher percentage of external users apply, or have someone else apply, a ready to use liquid or spray applied (26.5% vs. 1.9%).[20]

Figure 15

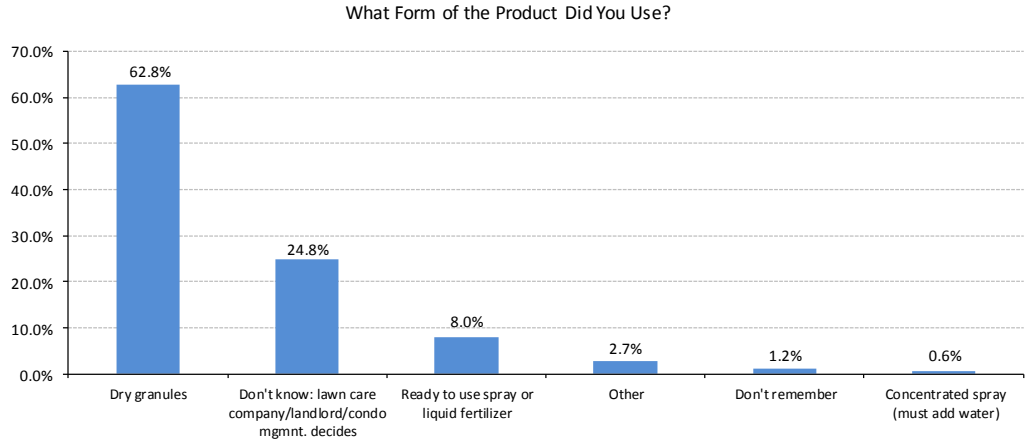
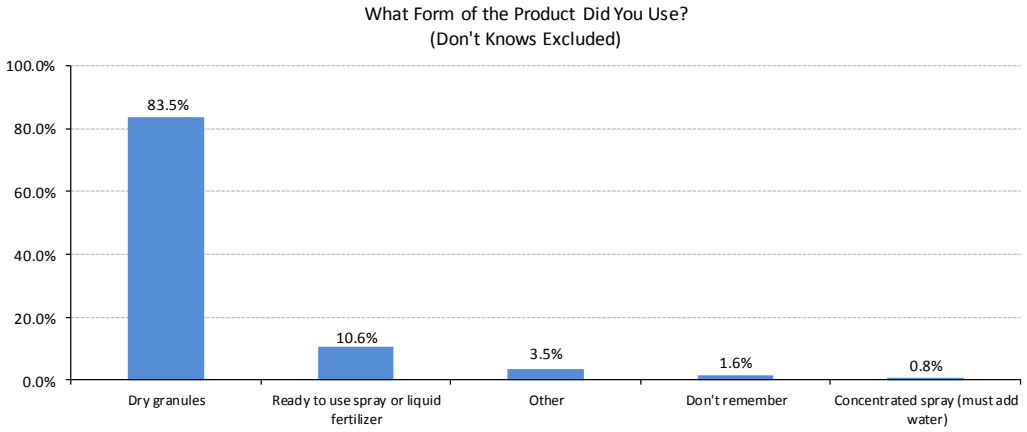


Figure 16



[19] Other forms include compost (N=7), manure (N=2), and powder (N=1).
[20] This crosstabulation does not include respondents who do not know the form because their lawn or landscape company decides.

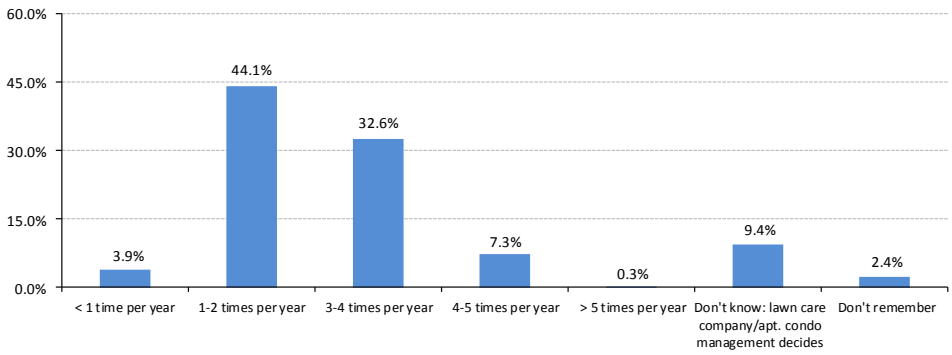
4.60 FREQUENCY OF APPLICATION AND AMOUNT APPLIED

In terms of the frequency in which the lawn fertilizer is applied, 3.9% of respondents fertilize less than 1 time per year, 44.1% fertilize 1 to 2 times per year, 32.6% fertilize 3-4 times per year, 7.3% fertilize 4 to 5 times per year, 0.3% fertilize more than 5 times per year, 9.4% don't know because someone else applies the fertilizer, and 2.4% don't know (see Figure 17).

- As one might expect, external users are less likely to know the frequency in which the product is applied in comparison to internal users. However, respondents who contract with a lawn care or landscape company are somewhat more likely to know the frequency in which the product is applied in comparison to its form, which may be due to the fact that the respondent was provided a detailed scope of services that specified the frequency that the product would be applied but not the form or amount.

Figure 17

How Often Do You Apply the Product Each Year?



There is no statistically significant correlation between the type of product applied (e.g. spray, dry granules, etc.) and the frequency of application. However, internal users apply these products at a lower rate than external users;

- While a higher percentage of internal users apply the product(s) 1 to 2 times per year (52.3% vs. 39.5%), they are less likely to apply 3 to 4 times per year (33.8% vs. 45.6%) and 4 to 5 times per year (4.6% vs. 14.9%) (see Table 8). This is consistent with research that shows that the average application rate of fertilizer applied by lawn and landscape professionals is higher than the application rate of homeowners (Law et al, 2008; Souto et al, 2009). However, it is not possible to extrapolate the total amount of fertilizer being applied because such a significant number of respondents either don't know the product that is applied, the frequency the product is applied, and/or the amount that is being applied.

Table 8

Frequency	Internal	External
Less than 1 time per year	8.6%	0.0%
1-2 times per year	52.3%	39.5%
3-4 times per year	33.8%	45.6%
4-5 times per year	4.6%	14.9%
More than 5 times per year	0.7%	0.0%

Note: This data does not include external users who "let their lawn or landscape company decide" the frequency of application as well as respondents who "don't know."

4.70 AMOUNT APPLIED

In terms of how respondents decide the amount of fertilizer to apply, 47.5% let the lawn company decide (Figure 18). When these respondents are excluded from the data, 71.3% of respondents report that they use the directions on the bag, while 11.0% guess/estimate, 9.8% use past experience, 6.1% don't know or remember, 1.2% use the amount that fits in the spreader, and 0.6% use a store's recommendation (see Figure 19).

While most respondents report that they are applying the appropriate amount of fertilizer, an important component going forward will be to determine the degree to which lawn care companies are using accepted practices, since the fertilizer being applied by these companies constitutes a large proportion of the total fertilizer being used on the Cape. It is also important to determine if these companies are offering organic products to their clients as well as alternative practices such as top seeding and aeration.

Figure 18

How Do You Decide How Much Fertilizer to Apply to the Lawn at One Application?

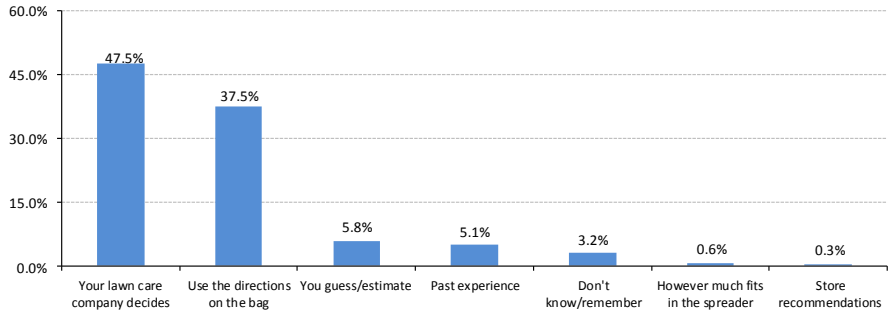
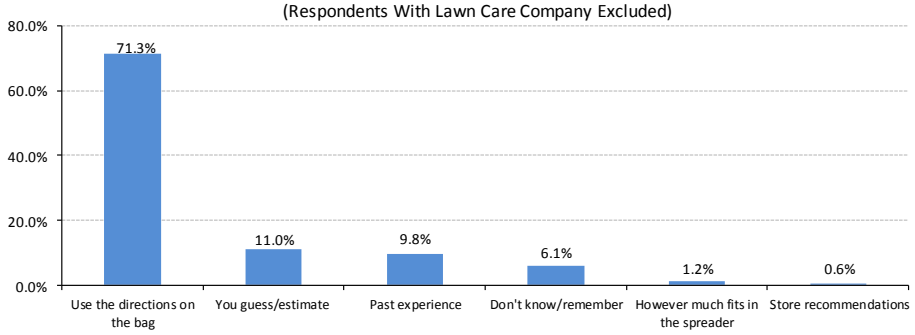


Figure 19

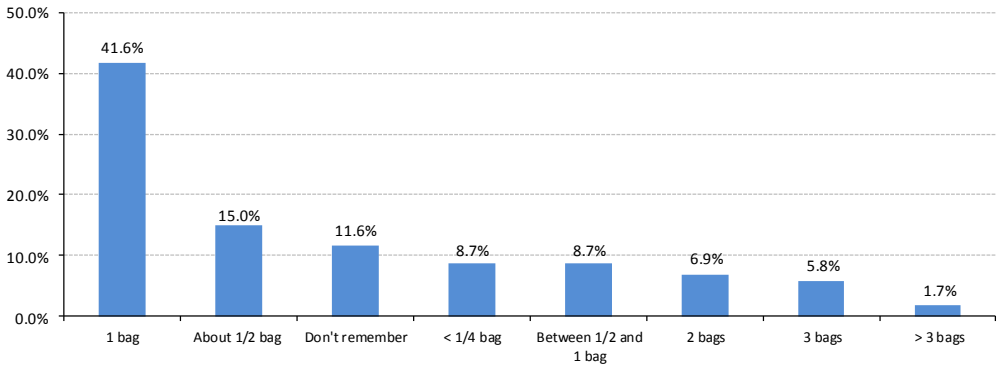
How Do You Decide How Much Fertilizer to Apply to the Lawn at One Application?
(Respondents With Lawn Care Company Excluded)



Respondents were asked to indicate the number of fertilizer bags they applied. Over forty-one percent of respondents (41.6%) used 1 bag, while lower percentages of respondents used smaller amounts (see Figure 20). Combining bag size data with the frequency of application, respondents on average apply an estimated 59 pounds of dry granular fertilizer to their lawns annually.[21] This estimate only includes respondents who were able to provide the type and amount of fertilizer applied and the frequency in which it is applied. As noted, this self-reported data may be somewhat unreliable due to recollection issues and/or the fact that respondents are simply not paying much attention to the specific details of the product they used and the way in which it is applied. However, employing the same methodology to estimate the average amount of fertilizer applied in future studies will provide an accurate estimate of whether the amount of fertilizer being applied is increasing or decreasing over time.

Figure 20

How Many Bags of Fertilizer Are Applied to the Lawn at Each Application?

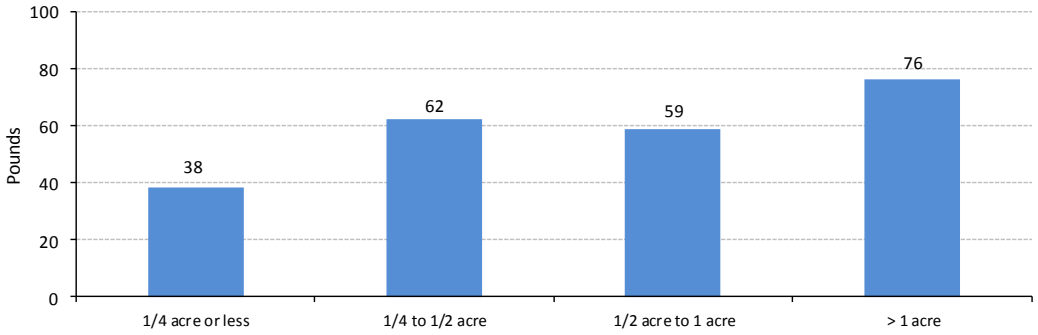


Generally, the larger a respondent's lot size the more fertilizer they use (see Figure 21

Figure 21). Similarly, the biggest users are those with larger lawns (see Figure 22).

Figure 21

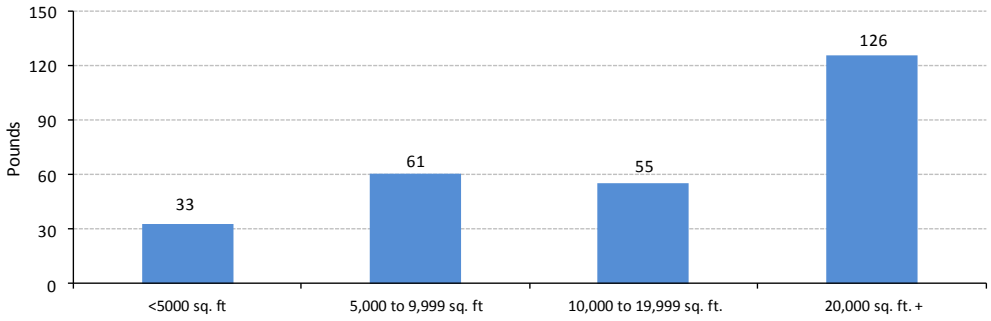
Average Pounds of Granular Fertilizer Used Annually By Lot Size



[21] For reference, one bag of Scotts Turfbuilder, which covers 15,000 square feet of lawn, is about 48 pounds.

Figure 22

Average Pounds of Granular Fertilizer Used Annually By Square Footage of Lawn

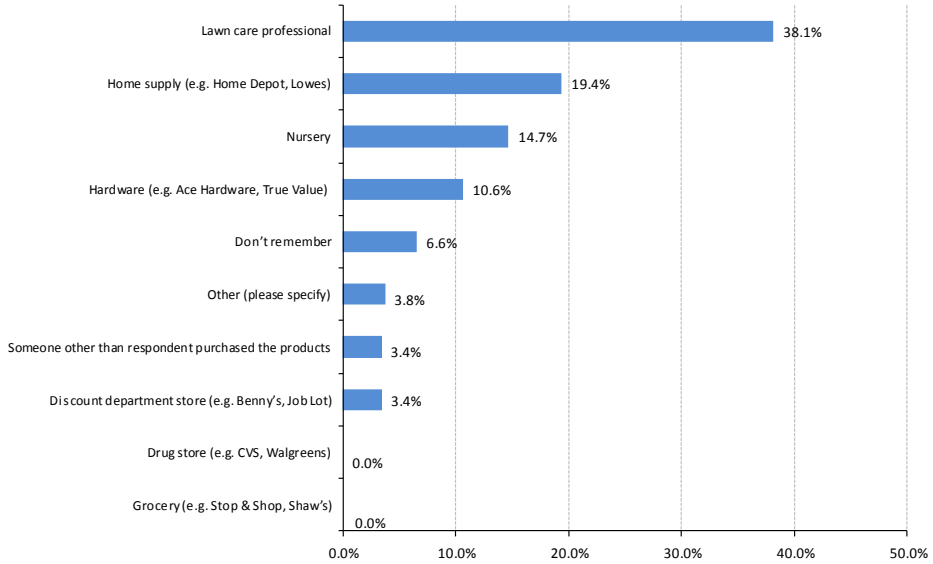


4.80 STORES WHERE PRODUCT WAS PURCHASED

Just over thirty-eight percent of respondents (38.1%) purchased their fertilizer through a lawn care professional (see Figure 23). When these respondents are excluded from the data, 31.3% of respondents report that they purchased their fertilizer at a home supply store, 23.7% at a nursery, 17.2% at a hardware store, and 5.6% at a discount department store (see Figure 24). No respondents purchased their fertilizer at a drug store or grocery store. In addition, 10.6% don't remember where they purchased the product, 6.1% purchased from other types of stores,[22] and 5.6% report that someone else purchased the product.[23] Again, the significant percentage of fertilizer that is purchased through lawn care companies highlights the need to ensure that these companies are employing best practices.

Figure 23

At Which Type of Store or Stores Were These Fertilizer Products Purchased?

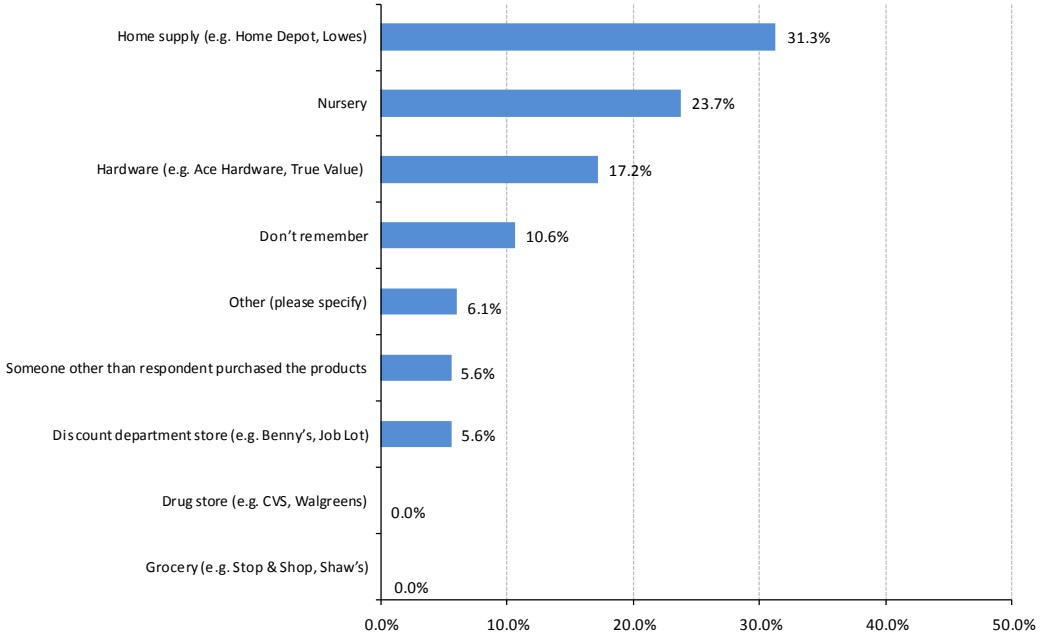


[22] Other includes Agway (N=7), Sears, John Deere, organic supply store, from a catalogue, and respondent makes their own.

[23] There are several statistically significant correlations in terms of where products are purchased and a respondent's sex, education, age, internal/external, and region. However, nearly all the differences are within the survey's margin of error and conclusions should be made with caution. See Appendix C for detailed crosstabulation data.

Figure 24

At Which Type of Store or Stores Were These Fertilizer Products Purchased?
(Excluding Respondents Who Contract With a Lawn Care Professional)



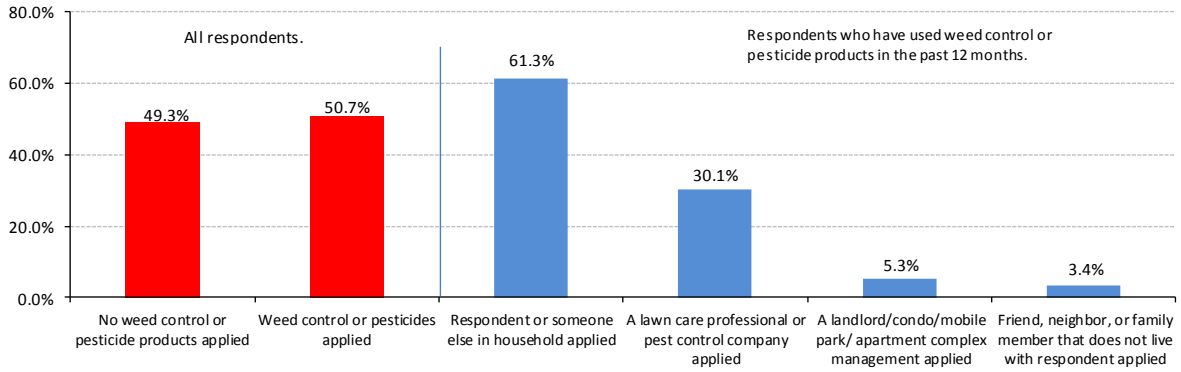
5.00 WEED AND PEST CONTROL PRODUCT USE

Respondents were asked several questions regarding outdoor weed and pest control product use, including who applies the product, the name of the product, the purpose for which they use the product, the frequency it is applied, in which form, and from which stores it is purchased.

Just over half of respondents (50.7%) report that they or someone else used weed or pest control products on their property in the past 12 months, while 49.3% applied none of these products. Among respondents who have used these products, 61.3% applied the product themselves or it was applied by someone in the household, while 30.1% used a lawn care or pest control company, 5.3% had a landlord or condo/apartment management apply, and 3.4% had a friend or other person who does not live with them apply (see Figure 25).[24]

Figure 25

Can You Please Tell Me If You, Someone In Your Household, Or a Yard Care Professional Used Fertilizer On Your Lawn In the Past 12 Months?



There are several statistically significant correlations in terms of who applies weed or pest control products:

- Respondents 65 years of age and older are most likely to contract with a lawn care or pest control company; 21.7% in the 65+ age cohort, 4.6% in the 18 to 34 cohort, 19.0% in the 35 to 49 age cohort, and 12.9% of respondents in the 50 to 64 age cohort.
- The higher a respondent's level of education, the less likely they are to have used weed or pest control products in the past 12 months; 46.7% of respondents with a Bachelor's degree or higher, 52.3% of respondents with an Associate's degree/some college experience, and 59.5% with a high school diploma or less.
- A smaller percentage of Lower Cape respondents applied weed or pest control products (either internally or externally) in the past 12 months; 43.0% of Lower Cape respondents, 48.7% of Mid-Cape respondents, and 56.1% of Upper Cape respondents, although this result is not statistically significant.
- There are only minor differences in the percentages of respondents who are internal or external users and the region in which they live (i.e. Lower, Mid, Upper Cape).

[24] Respondents who report that they don't know the person who applied the product (N=29) are not included in this data. These are primarily respondents who are not the household member who applies weed or pest control products. The initial survey screen asked to speak to the household member who primarily makes decisions regarding *fertilizer* use. A similar screen question was not used for weed or pest control products use to avoid "passing off" the telephone interview to another household member, which would compromise the overall survey results and decrease the survey completion rate.

5.10 SPECIFIC WEED AND PEST CONTROL PRODUCTS

Respondents were asked to provide the specific product name of the weed or pest control product that was used. Similar to the fertilizer use results, many respondents are unable to name the product used; among respondents who applied or had applied weed or pest control products in the past 12 months, 33.8% don't know or remember what product was applied – neither the company that makes the product (e.g. Ortho, Spectracide) or the specific product name (e.g. Cutter Yard Guard, Bayer Advanced, Ortho Weed-B-Gon, etc.).[25] The majority of these respondents contract with a lawn care or pest control company (85.0% don't know the product name) or who have these products applied by a landlord or condo/apartment management (100.0% don't know the product name) (see Table 9).

In addition, a significant number of respondents are only able to identify the company that makes the product. For example, many respondents answer "Ortho" but are unable to provide the specific product name.

Table 9

Who Applies?	% Respondents "Don't Know/Remember" Product Name
Respondent	3.1%
A lawn care or landscape company	85.0%
A landlord/condo or apt. management	100.0%
Friend, neighbor, or family member who does not live with respondent	33.3%

[25] The telephone interviewers were instructed to ask for the specific product name.

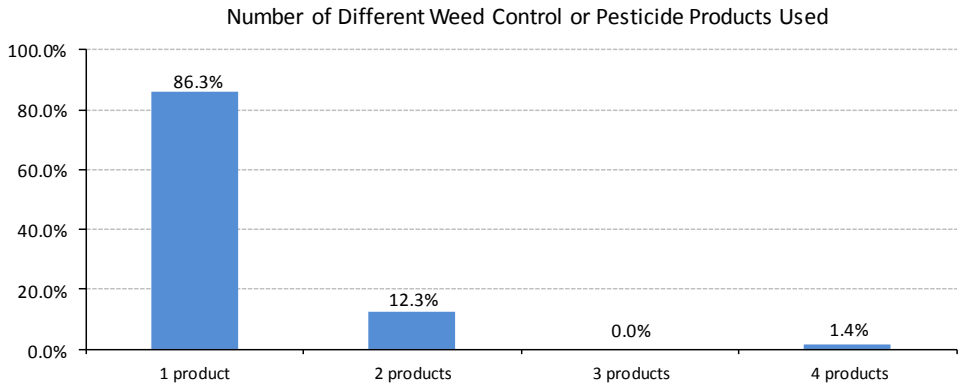
Products used by respondents or that were applied by others include:

- Agway (N=3)
- Agway Pest Control
- Ant Shield
- Bayer (N=8)
- Bayer Advanced (N=3)
- Bayer season
- Bleach (N=2)
- Borax (N=4)
- Borax and sugar
- Corn gluten
- Cutter Yard Guard (N=2)
- Delta Dust
- GrubEx (N=6)
- John Deere Weed & Insect
- Jonathan Green
- Milky Spore
- Mint
- Miracle Gro Weed Preventer (N=3)
- Neptune's Harvest
- Organic (general)
- Ortho (general) (N=21)
- Ortho ant Powder
- Ortho Bug-B-Gon
- Ortho grow
- Ortho Home Defense (N=9)
- Ortho Max (N=2)
- Ortho Weed-B-Gon (N=22)
- Plant Tone (N=2)
- Preen (N=2)
- Preen Weed Preventer
- Raid (N=12)
- Ready Tone
- Roundup Weed Killer (N=8)
- Roundup (N=15)
- Roundup Crabgrass
- Roundup Poison Ivy (N=3)
- Scotts Step 1 (N=7)
- Scotts (N=17)
- Scotts Crabgrass
- Scotts Organic
- Scotts Pest Control
- Scotts Plus 2
- Scotts Weed & Feed
- Scotts Weed-B-Gon (N=2)
- Seven (N=3)
- Sluggo
- Spectracide (N=11)
- Spectracide Weed & Grass Killer (N=3)
- Speedzone
- Terminix (N=2)
- Terro
- Thermador
- Trugreen (N=3)
- Trugreen Ant Control
- Weed & Feed Crabgrass
- Weed killer

5.20 NUMBER OF PRODUCTS USED

The majority of respondents (86.3%) used only one weed or pest control product in the past 12 months (see Figure 26), although many are using the product to treat more than one issue (kill more than one type of insect, various weeds, etc.) and applying it more than one time per year. As noted in Section 4.30, the number of products used by respondents is understated due to recollection issues (i.e. the respondent cannot remember) or the fact that their pest control company or landlord is applying the products. In fact, 119 respondents were not able to name the product used, most who are external users.

Figure 26

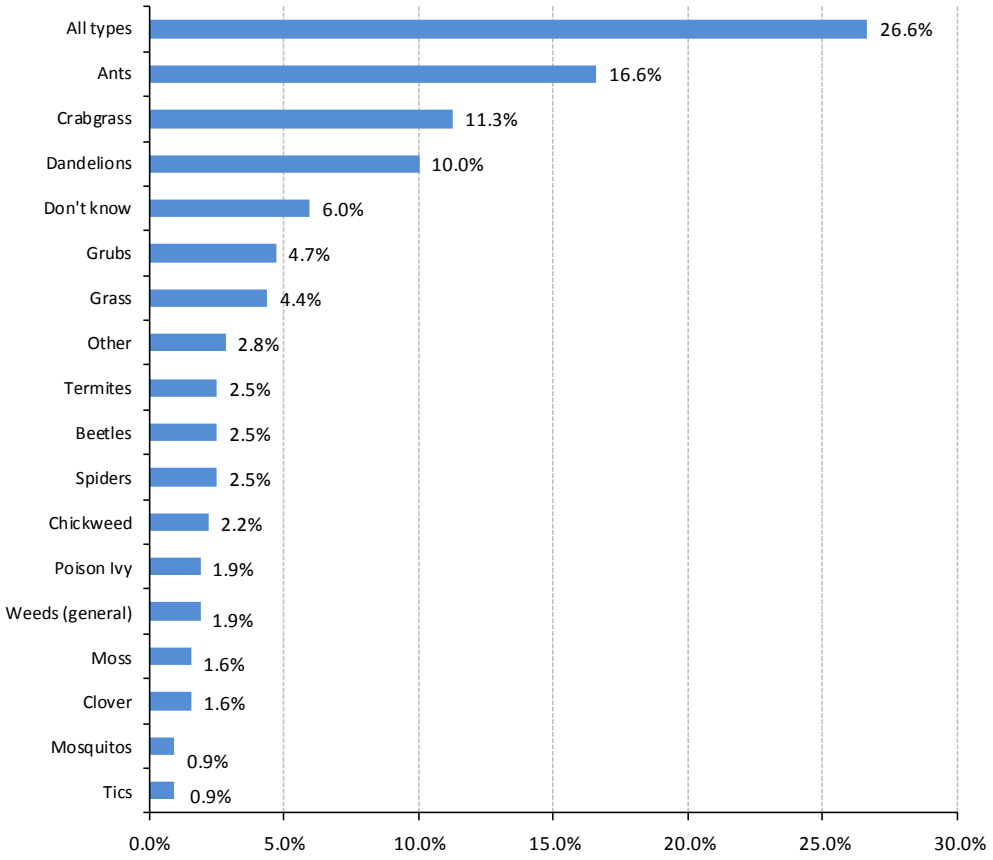


5.30 TYPES OF INSECTS AND WEEDS MANAGED

Respondents manage many different types of weeds and insects, with over a quarter (26.6%) reporting that they manage "all types." In terms of specific insects and weeds, 16.6% use the products to manage ants, 11.3% for crabgrass, 10.0% for dandelions, 6.0% don't know, 4.7% for grubs, and 4.4% for grass, among others.[26] Including only respondents who provided a specific weed or insect that they manage, 67.4% are using the products to manage weeds and 32.6% are using the project to manage insects.[27]

Figure 27

Which Type of Insects and Weeds Do You Actively Manage?



[26] Respondents who "don't know" are primarily those who have a landlord, condo management or a friend apply the product.

[27] There is some minor overlap between respondents who report that they use a Scotts product to fertilize their lawn and a Scotts product for weed control. These may in fact be the same product. However, this overlap is limited to only 10 cases and among these there are only 4 in which the respondent reports that they use the fertilizer to "kill weeds." Due to this small number of cases the issue of overlap is not overly problematic.

5.40 FORM OF PRODUCT USED

The majority of products used by respondents are ready to use sprays or liquids (43.4%), dry granules (20.7%), concentrated sprays (16.9%), and other forms (1.0%),[28] while 3.8% of respondents don't know or remember (see Figure 28). Just over fourteen percent of respondents (14.1%) don't know the product's form because they hire a lawn care or pest control company to apply the product, or a landlord, condo management, or a friend applies the product. When these respondents are excluded from the data, just over half (50.6%) are using ready to spray liquid, followed by dry granules (24.1%), concentrated spray (19.7%), don't know/remember (4.4%), and other forms (1.2%) (see Figure 29).

There is no statistically significant correlation between the form of product applied (e.g. spray, dry granules, etc.) and the frequency of application. In addition, there are only small differences between internal and external users and the form of the product applied.

Figure 28

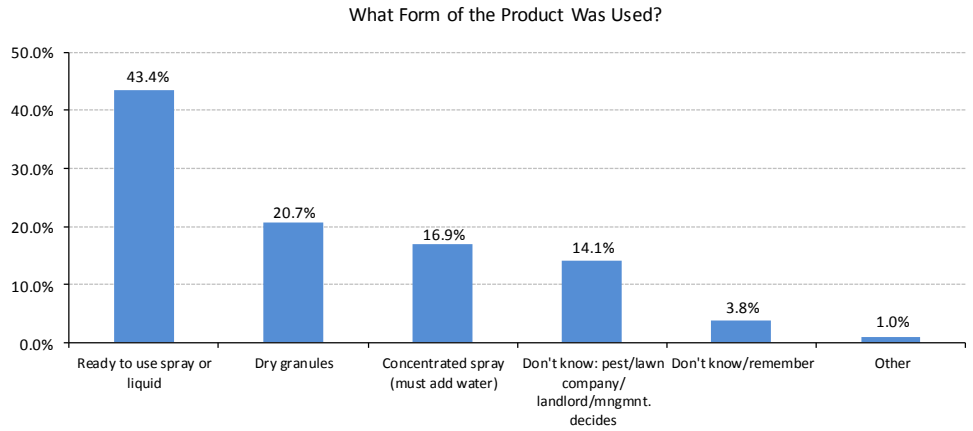
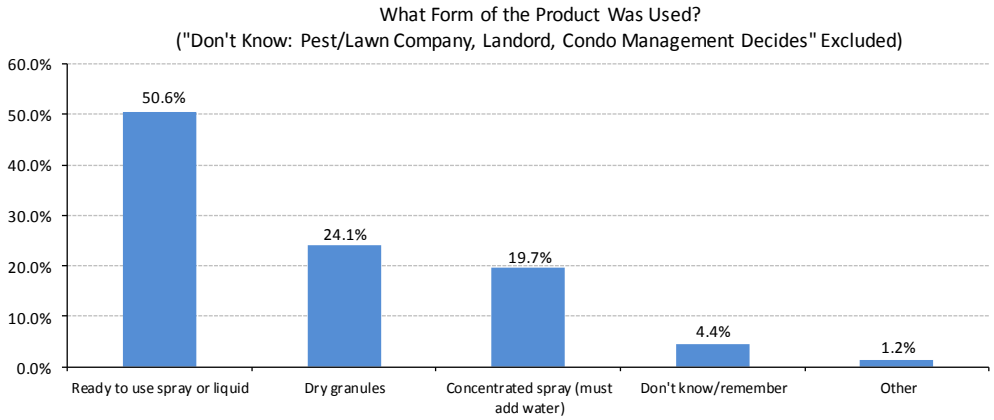


Figure 29



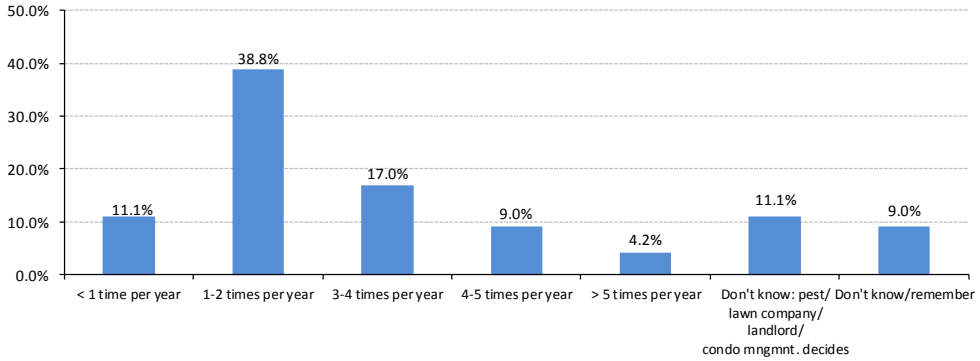
[28] "Other" forms includes bocks (N=2) and traps (N=1).

5.50 Frequency of Application and Amount Applied

Most respondents apply weed control and/or pest control products 1 to 4 times per year; 11.1% apply these products less than 1 time per year, 38.8% apply them 1 to 2 times per year, 17.0% apply them 3-4 times per year, 9.0% use them 4 to 5 times per year, 4.2% use them more than 5 times per year, 11.1% don't know because their lawn or pest control company decides, and 9.0% don't know or remember (see Figure 30). As one might expect, respondents who are external users are less likely to know the frequency in which the product is applied in comparison to internal users.

Figure 30

How Often Is Product Applied Each Year?



Internal users fertilize at a lower rate than external users; while a higher percentage of internal users apply the product(s) 1 to 2 times per year (55.1% vs. 42.6%), they are less likely to apply 3 to 4 times per year (16.9% vs. 33.3%) and 4 to 5 times per year (9.0% vs. 18.5%) (see Table 10).

Table 10

Frequency	Internal	External
Less than 1 time per year	11.2%	1.9%
1-2 times per year	55.1%	42.6%
3-4 times per year	16.9%	33.3%
4-5 times per year	9.0%	18.5%
More than 5 times per year	7.9%	3.7%

Note: This data does not include external users who "let their lawn or landscape company decide" the frequency of application and respondents who "don't know."

In addition, respondents who live in the Lower Cape use these products more frequently than respondents who reside in other regions; 44.9% of respondents who reside in the Lower Cape apply these products 3 or more times per year, which compares to only 21.9% who reside in the Upper Cape and 27.4% who reside in the Mid-Cape.

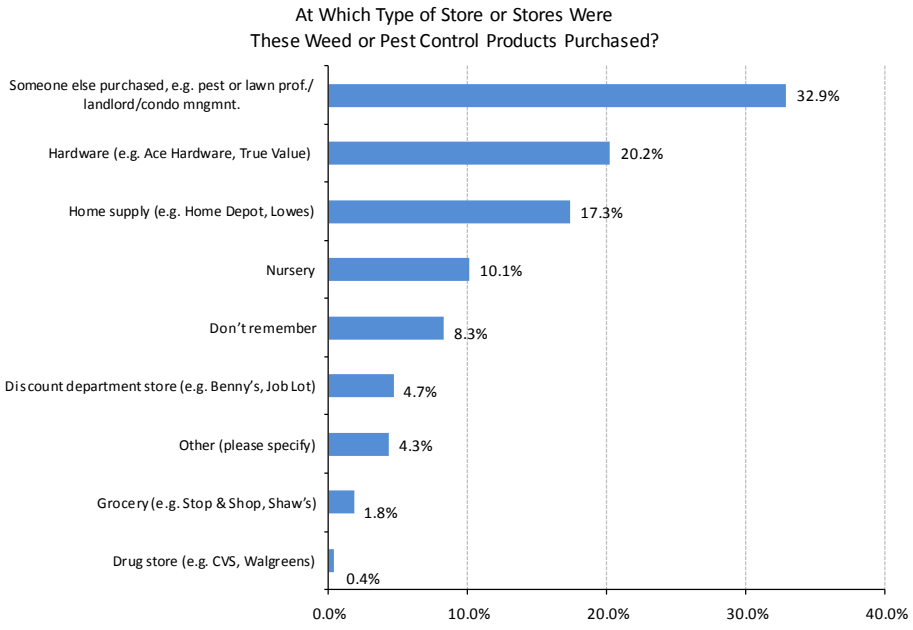
Table 11

Frequency	Upper	Mid	Lower
Less than 1 time per year	14.9%	7.1%	10.1%
1-2 times per year	40.4%	42.9%	30.4%
3-4 times per year	10.5%	13.1%	29.0%
4-5 times per year	7.0%	9.5%	13.0%
More than 5 times per year	4.4%	4.8%	2.9%
Don't know: company/ landlord/mngmnt. decides	11.4%	13.1%	8.7%
Don't know	11.4%	9.5%	5.8%

5.60 STORES WHERE PRODUCT WAS PURCHASED

Just under a third of respondents (32.9%) report that someone else purchased their weed or pest control products, with the vast majority of these respondents hiring a lawn care or pest control professional (see Figure 31). When these respondents are excluded from the data, 30.1% of respondents report that they purchased their weed or pest control products at a hardware store, 25.8% at a home supply store, 15.1% at a nursery, 7.0% at a discount department store, 6.5% at an "other" location, 2.7% at a grocery store, and 0.5% at a drug store (see Figure 31).[29] In addition, 12.4% of respondents don't remember where they purchased the product, most who are not the primary users of weed control and pesticides in the household.

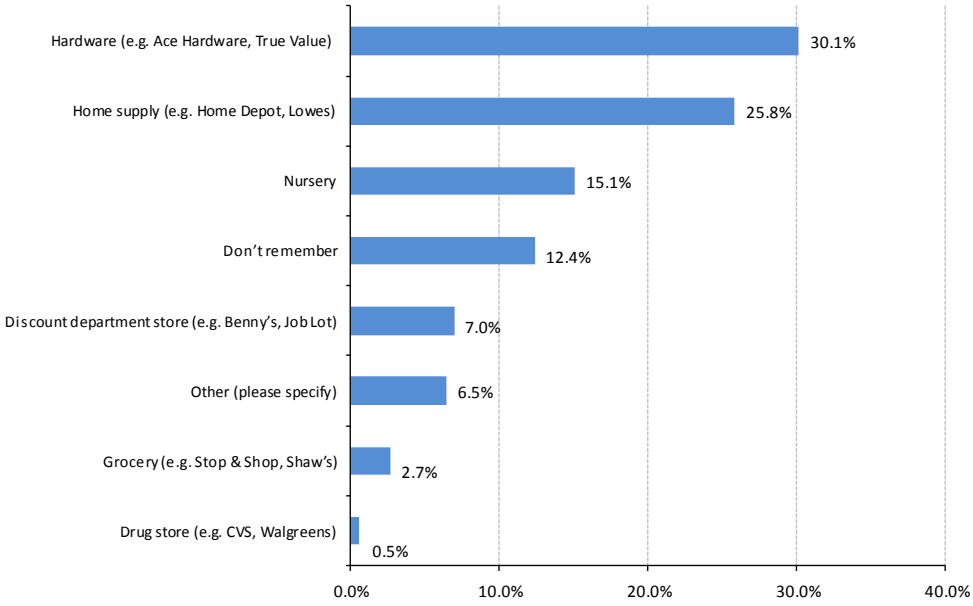
Figure 31



[29] Other includes Agway (N=7), Sears, John Deere, organic supply store, from a catalogue, and respondent makes their own,

Figure 32

At Which Type of Store or Stores Were
These Weed or Pest Control Products Purchased?
(Excludes Respondents Who Contract wih a Lawn Care or Pest Control Professional)



6.00 ALTERNATIVE LAWN CARE PRACTICES

One of the project goals is to measure Cape Cod residents' awareness of organic land maintenance alternatives. To that end, respondents were asked several questions regarding alternative lawn care practices.

Respondents are generally aware of alternative lawn care practices, although most have not used them. Many respondents report that they do not use alternative practices because they don't know enough about them, not because they are not amenable to applying these methods. Thus, educating residents about the availability and uses of alternative lawn care practices may result in an increase in the use of these methods. Outreach should also extend to lawn care professionals, since many respondents indicate that their lawn care company does not offer alternative methods or that they are not sure if they are offered.

6.10 AWARENESS OF ALTERNATIVE LAWN CARE PRACTICES

In terms of respondent awareness of alternative lawn care practices aimed at eliminating or minimizing the use of conventional fertilizers and pesticides (e.g. top dressing, aeration, and organic products), 59.5% report that they are aware of these alternatives, while 11.2% are somewhat aware and 29.4% are not aware. Awareness increases slightly when respondents who don't use fertilizer, weed control, or pest control products are excluded from the data (see Figure 33). Among respondents who are at least somewhat aware, 44.7% report that they have used these alternative lawn care practices (see Figure 34).

Figure 33

Awareness of Alternative Lawn Care Practices

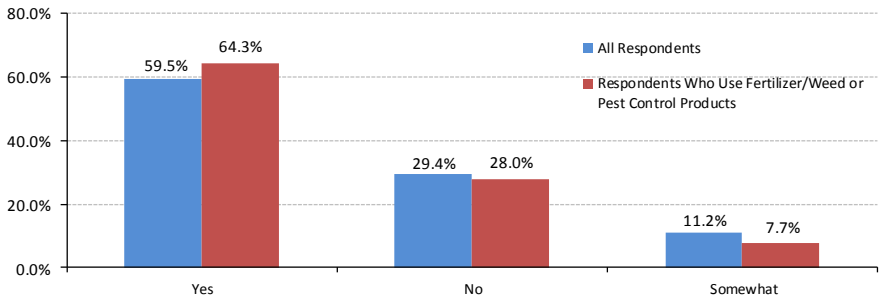
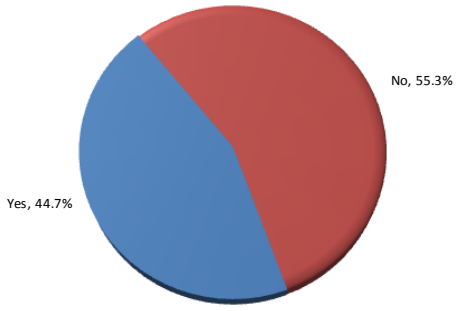


Figure 34

Have You Used Any of These Alternative Lawn Care Practices
(Among Respondents Who are Aware)



Alternative lawn care practices used by respondents include:

- Aeration (N=31)
- Baking soda
- Beer (to kill slugs)
- Borax
- Calcium limestone
- Chicken based fertilizer
- Coffee grinds (N=4)
- Compost/Composting (N=11)
- Fish (bone and blood meal)
- Holly Tone (N=3)
- Jonathan Green Organic (N=3)
- King Neptune
- Ladybugs
- Lime (N=2)
- Makes own fertilizer(N=2)
- Manure (N=6)
- Milky spores
- Mulch (N=7)
- Organic (general) (N=58)
- Plant Tone
- Seaweed
- Top dressing (N=5)
- Top seeding
- Vinegar (N=9)

* Note: Several respondents report that they do not remember which alternative practice they used.

There are several statistically significant correlations in terms of respondent awareness of alternative lawn care practices:

- A higher percentage of females (64.0%) report that they are familiar with alternative lawn care practices in comparison to males (54.4%).
- Respondents with a Bachelor's degree or higher are more aware of alternative lawn care practices (66.6%) in comparison to respondents with an Associate's degree/some college experience (48.4%) and respondents with a high school diploma or less (50.6%).
- Respondents with household income above $100K are more familiar with alternative lawn care practices (71.1%) in comparison to respondents with household incomes between $50K and $100K (57.5%) and household incomes less than $50K (50.4%).

In terms of using these alternative practices:

- Respondents with a Bachelor's degree or higher are more likely to have used alternative lawn care practices (50.2%) in comparison to respondents with an Associate's degree/some college experience (40.8%) and respondents with a high school diploma or less (28.8%). Importantly however, this result is somewhat explained by the fact that respondents with lower levels of education are more likely to have a landlord or condo management apply fertilizer or pesticides.
- Respondents with household incomes above $100K are more likely to have used alternative lawn care practices (58.3%) in comparison to respondents with household incomes between $50K and $100K (48.9%) and household incomes less than $50K (30.9%). Again, this result is partly explained by the fact that respondents with lower levels of education are more likely to rent and therefore have a landlord or condo management apply fertilizer or pesticides.

6.20 Reasons For Not Using Alternative Lawn Care Practices

Respondents who have not used alternative lawn care practices were asked why they have not used them. Thirty-nine percent (39.0%) report that they don't use alternative lawn care practices because they don't know enough about them (see Figure 35).[30] This result includes respondents who do not use fertilizer or weed and pest control products. When these respondents are excluded from the results, 46.7% report that they do not use alternative lawn care practices because they don't know enough about them, while 16.5% indicate that they are skeptical of the effectiveness of alternative lawn care practices, 11.1% don't know why they don't use these products, 10.2% cite other reasons, 9.3% indicate that they cost too much, and 3.9% indicate that the company they contract with does not offer these types of products (see Figure 36).

Figure 35

Can You Please Tell Me Why You Have Not Used Any Alternative Lawn Care Practices?

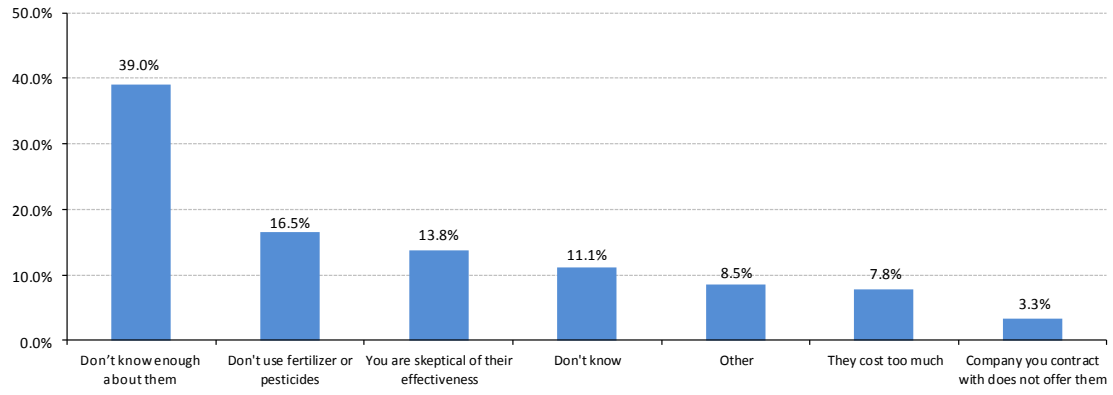
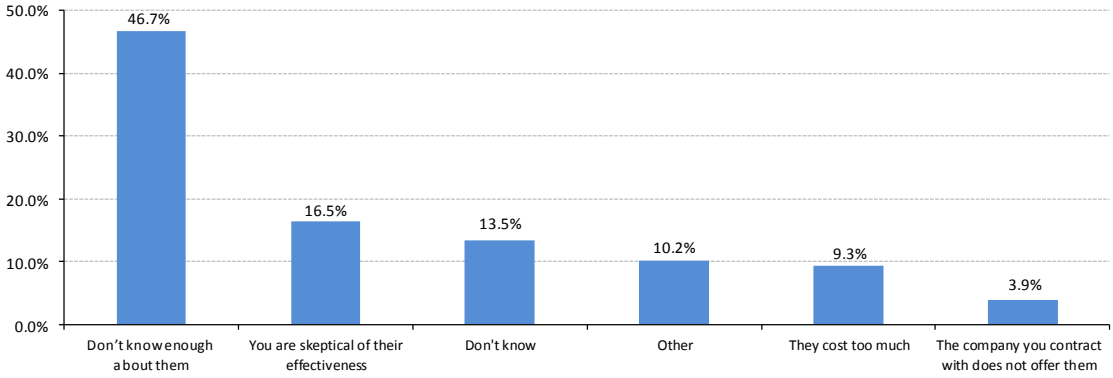


Figure 36

Can You Please Tell Me Why You Have Not Used Any Alternative Lawn Care Practices?
(Excluding Respondents Who Did Not Use Fertilizer or Pesticides)



[30] The "other" category includes responses that are primarily from respondents who do not use fertilizers or pesticides either because they don't care what their lawn looks like (N=18), do not have enough time to apply fertilizers or pesticides (N=5), they don't have a lawn (N=5), or because they feel that their lawn is fine as is (N=4). Only two comments were specific to alternative lawn care practices: "alternative products do not seem to help" and "alternative products are possibly just as harmful to environment."

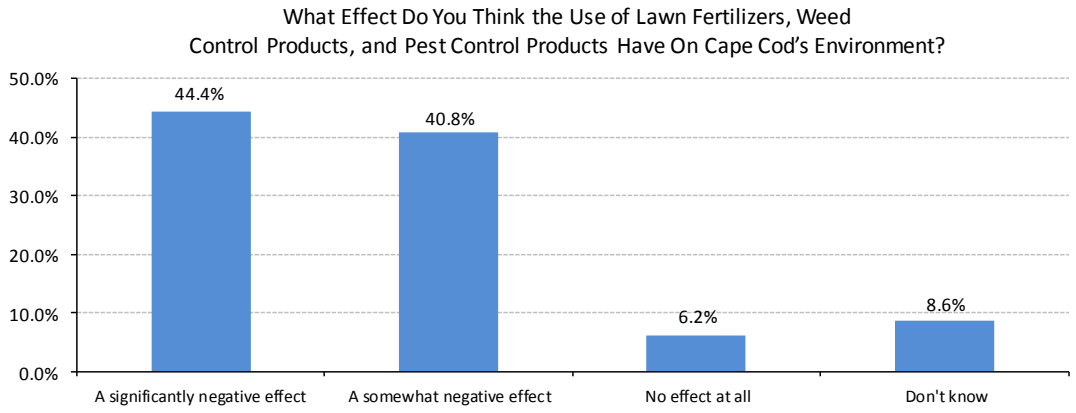
7.00 Overall Concerns About the Environment

Respondents were asked about the effect that fertilizers, weed control products, and pesticides have on the Cape's environment as well as their level of concern that these products are having a negative effect on the Cape's environment.

7.10 Effect of Lawn Fertilizers, Weed Control products, and Pest Control Products on Cape Cod's Environment

Over forty-four percent of respondents (44.4%) believe that the use of fertilizers, weed control products, and pest control products have a significantly negative effect on the environment, while 40.8% believe that these products have a somewhat negative effect, 6.2% believe they have no effect at all, and 8.6% don't know (see Figure 37).

Figure 37



There are several statistically significant correlations:

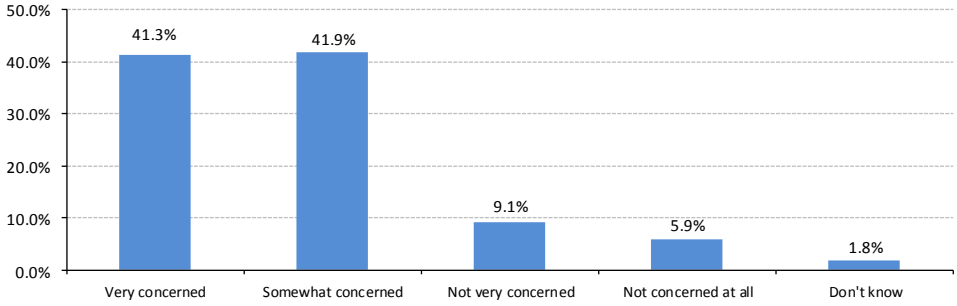
- A higher percentage of females (49.1%) believe the use of these products has a significantly negative effect on the environment in comparison to males (39.1%).
- The higher a respondent's level of education, the more likely they are to believe that the use of these products has a significantly negative effect; 48.5% of respondents with a bachelor's degree or higher, 46.3% of respondents with an Associate's degree/some college experience, and 29.2% with a high school diploma or less. Interestingly, while a higher percentage of respondents with at least a Bachelor's degree believe that these products have a significantly negative effect, this is the group (in terms of education) that is most likely to use fertilizers, albeit at just a slightly higher percentage than other education cohorts.
- Younger respondents are most likely to believe that the use of these products has a significantly negative effect on the environment (60.2%), compared to 37.3% in the 35 to 49 age cohort, 47.4% in the 50 to 64 age cohort, and 35.2% in the 65 years of age and older cohort.
- While similar percentages of internal (41.7%) and external (39.9%) fertilizer/pesticide users believe that the use of these products has a significantly negative effect on the environment, a higher percentage of internal users (48.0% vs. 39.1%) believe that the use of these products has a somewhat negative effect on the environment. Conversely, higher percentages of external users feel that the use of these products has no effect (9.4% vs. 4.9%) or don't know (11.6% vs. 5.4%).

7.20 LEVEL OF CONCERN

Respondents were asked to indicate their level of concern about the impact that the use of lawn fertilizers, weed control products, and pest control products are having on the Cape's environment. More than forty-one percent (41.3%) report that they are very concerned that the use of these products are having a negative effect on the Cape's environment, while 41.9% are somewhat concerned, 9.1% are not very concerned, 5.9% are not concerned at all, and 1.8% don't know (see Figure 38).

Figure 38

How Concerned Are You That the Use of Lawn Fertilizers, Weed Control Products, and Pest Control Products Are Having a Negative Effect On the Cape's Environment?



There are several statistically significant correlations:

- Younger respondents are most likely to be very concerned that these products are having a negative effect on the Cape's environment; 49.2% in the 18 to 34 cohort, 40.0% in the 35 to 49 age cohort, 48.1% in the 50 to 64 age cohort, and 30.7% in the 65+ cohort, although the 65+ cohort is most likely to be somewhat concerned.
- A lower percentage of external users are very concerned that the use of these products are having a negative effect on the Cape's environment; 31.9% of external users are very concerned, compared to 46.8% of internal users, although external users are more likely to be somewhat concerned (47.8% vs. 39.4%).
- As one might expect, respondents who believe that the use of fertilizers, weed control products, and pest control products have a significantly negative effect on the environment (see Section 7.10) have higher levels of concern about the negative impact that these products are having on Cape Cod's environment.

8.00 CONCLUSION

Nearly seven-in-ten respondents (69.6%) report that a lawn fertilizer, a weed control product, and/or a pesticide have been applied on their property in the past 12 months. The good news is that most respondents are following the product recommendations when they apply these products, although many cannot recall the details of the products used. This is particularly true among external users, who generally allow their lawn or pest control company to make the decision about which products are used, in what amounts, and how often. A key task, therefore, is to determine the degree to which lawn care and pest control companies are employing best practices, including offering organic products and alternative methods such as top seeding and aeration to their clients.

A two pronged strategy - educating residents about the environmental effects of fertilizer and pest control products, while promoting best practices and encouraging the use of alternative practices and products among lawn care and pest control companies - may be the most effective solution. Overall, however, reducing the amount of fertilizer and pesticides entering the Cape's environment is likely best achieved by affecting behavioral changes on the demand side, that is, lawn care and pesticide companies are most likely to change their practices if residents demand these types of alternatives and are more active in directing the services provided by their lawn care and pest control contractors. This strategy can be coupled with a general education campaign aimed at internal users that highlights the harmful environmental effects of these products while promoting safe and effective alternatives.

Fortunately, although a majority of respondents have not used alternative lawn care practices, they are generally aware of them. Moreover, while most have not used alternative practices, it is primarily because they don't know enough about them, not because they are not amenable to using these methods; 46.7% of respondents who use fertilizer or pest control products report that they do not use alternative lawn care practices because they don't know enough about them. Thus, educating residents about the availability, uses, and effectiveness of alternative lawn care practices may increase demand for these alternatives and in turn affect the behavior of lawn care and pest control companies.

The effectiveness of this strategy will also be enhanced by residents' concern for the Cape's environment and the effect that fertilizers and pesticides have on it; 41.3% report they are very concerned that the use of lawn fertilizers, weed control products, and pest control products are having a negative effect on the Cape's environment, while 41.9% are somewhat concerned. Thus, there may be a latent demand for alternative lawn care and pesticide products and education efforts will likely increase their use.

APPENDIX A – SOURCES

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Souto, Leesa et al, University of Central Florida Stormwater Management Academy. 2009. *Wekiva Residential Fertilizer Practices.* Florida Department of Environmental Protection.

Wilen, Cheryl A. 2001. Survey of Residential Pesticide Use and Sales in the San Diego Creek Watershed of Orange County California. California Department of Pesticide Regulation.

APPENDIX B – SURVEY QUESTIONNAIRE

<INTRO>

Hi, my name is _____ and I'm calling from UMass Dartmouth on behalf of Barnstable County. How are you today? We are conducting an important survey about fertilizer and pesticide use on Cape Cod. The results of the survey will help the County to develop education programs on the Cape that aim to make your environment and drinking water safer by reducing pesticide and fertilizer use. Keep in mind that all responses are strictly confidential and that we do not have any information about you other than your telephone number.

[INTERVIEWER: IF ASKED - THIS SURVEY SHOULD TAKE NO MORE THAN 10 MINUTES OF YOUR TIME.]

Q1. To confirm that we are talking only to Cape Cod residents, can you tell me if you live on Cape Cod at least part-time?

1 Yes, lives on Cape Cod full-time/part-time
2 No, does not live on Cape Cod [INTERVIEWER READ: SORRY, BUT YOU DO NOT RESIDE IN THE AREA WE ARE STUDYING] (SKP END)
9 Refused (SKP END)

[IF RESPONDENT SAYS THEY ARE NOT INTERESTED IN PARTICIPATING IN THE SURVEY OR SEEMS READY TO END THE INTERVIEW, READ:

"YOUR OPINIONS ON THIS ISSUE ARE VERY IMPORTANT AND WE'D LIKE TO GIVE YOU AN OPPORTUNITY TO MAKE YOUR OPINIONS HEARD. ARE YOU SURE YOU DO NOT HAVE JUST A FEW MINUTES TO COMPLETE THE SURVEY?"]

2A. And just so we know we are talking to the right person, can you please tell me who primarily applies outdoor fertilizer, weed control, and pest control products at your residence?

1 Respondent (SKP Q3)
2 Another member of household (SKP Q2B)
3 A fertilizer or pest control company (SKP Q3)
4 A landlord, apartment complex management, or home-owners association (SKP Q3)
5 A friend, neighbor, or family member that does not live with respondent (SKP Q3)
6 No outdoor fertilizers or pest control products are applied (VOL.) (SKP Q3)
7 Does not have lawn (VOL.) (SKP to Q3)
8 Some other (specify) _____ (VOL) (SKP Q3)
9 Refused (SKP END)

Q2B. May we please speak to that person or someone who knows about the application of these types of products at your residence?

1 Yes, getting person (DISPLAY INTRO THEN SKP Q3)
2 No, person not available

Q2C. When would be a good time to call back so that we can speak to that person? (SCHEDULE CALLBACK)

Q3. And are you 18 years of age or older?

1 Yes (SKP Q5)
2 No
9 Refused (SKP END)

Q4. Can I please speak to someone who is 18 or older who knows about the application of fertilizer, weed control, and pest control products at your home?

1 Yes, getting person (DISPLAY INTRO THEN SKP Q5)
2 No, person not available (SKP Q2C)
9 Refused (SKP END)

Q5. INTERVIEWER: RECORD RESPONDENT'S SEX

1 Male
2 Female

Q6. OK, I'd like to begin by asking just a couple of questions about your home and the size of your lawn. These questions are important for determining the amount of fertilizer and pesticides that people use. May I ask, do you live in a **[INTERVIEWER: READ CHOICES]**

1 Single family detached home
2 Condo or townhouse
3 Apartment
4 Mobile home
5 Other (please specify) _____
9 DK/Refused

Q7. And approximately how large is the lot that your house sits on? Is it: **[INTERVIEWER: READ CHOICES]**
(IF Q6>1 and Q6<9) THEN DISPLAY:

"I am only interested in the size of the lot that you own, not the area of the entire condo, townhouse, or apartment complex."

1 A quarter acre or less
2 A quarter acre to a half acre
3 A half-acre to an acre
4 Greater than 1 acre
8 Don't Know
9 Refused

Q8. About what percentage of your lot is lawn? It's OK if you don't know the exact percentage.

(IF Q6>1 and Q6<9) THEN DISPLAY: "I am only interested in the area of your lawn that you actually maintain, not the lawn area of the entire condo or apartment complex."

Fertilizer Use

Q9. Now I would like to ask you some specific questions about outdoor fertilizer use. Can you please tell me if you, someone in your household, a lawn care professional, or landscape company used fertilizer on your lawn in the past 12 months? **[INTERVIEWER: CHECK ALL THAT APPLY]**

[INTERVIEWER: PROBE FOR SPECIFIC RESPONSE IF NOT PROVIDED BY RESPONDENT]

1 Respondent or someone else in household (SKP Q13A)
2 A lawn care or landscape company
3 A landlord/condo/mobile park/ apartment complex management (SKP Q13A)
4 Friend, neighbor, or family member that does not live with respondent (SKP Q13A)
5 Other (please specify) _____ (SKP Q13A)
6 No lawn fertilizer applied in past 12 months [SKP 19]
8 Don't Know
9 Refused

(IF Q9=2 SKP Q10)
(IF Q9>5 SKP Q19)
(IF Q9=1 or Q9=3 or Q9=4 or Q9=5 SKP Q13A)

Q10. How did you choose your lawn care or landscape company? Was it that: **[INTERVIEWER: READ CHOICES AND CHECK ALL THAT APPLY]**

1 You were contacted directly by company
2 From a recommendation of a friend or relative
3 Its reputation for high quality lawns
4 It had the cheapest rates
5 It is environmentally friendly
6 Other reason (please specify) _____
8 Don't know **(VOL.)**
9 Refused

Q11. To what extent do you direct the practices of your lawn care or landscape company? For example, what part do you play in deciding when to fertilize and what products to use? Would you say you direct the lawn care or landscape company **[INTERVIEWER: READ CHOICES]**

1 A lot
2 A little
3 Not at all
8 Don't Know **(VOL.)**
9 Refused

Q12. And how often does your landscape company apply fertilizer to your lawn? **[INTERVIEWER: READ CHOICES]**

1 Less than 1 time per year
2 1-2 times per year
3 3-4 times per year
4 4-5 times per year
5 More than 5 times per year
8 Don't know **(VOL.)**
9 Refused

Q13A. I'd like to ask you the specific names of the products that you or a lawn care company used on your lawn. Can you please tell me the name of the first product? It will be helpful if you can provide the brand name and the specific product name. **[INTERVIEWER: ACCEPT RESPONSES FOR UP TO 6 PRODUCTS]** <PRODUCT1>

8 Don't know/remember name of product (SKP Q14A)

Q13B. Did you apply any other lawn products? <PRODUCT 2>

1 No other products applied
8 Don't know/remember name of product (SKP Q14A)

Q13C. Did you apply any other lawn products? <PRODUCT 3>

1 No other products applied
8 Don't know/remember name of product (SKP Q14A)

Q13D. Did you apply any other lawn products? <PRODUCT 4>

1 No other products applied
8 Don't know/remember name of product (SKP Q14A)

Q13E. Did you apply any other lawn products? <PRODUCT 5>

1 No other products applied
8 Don't know/remember name of product (SKP Q14A)

Q13F. Did you apply any other lawn products? <PRODUCT 6>

1 No other products applied
8 Don't know/remember name of product (SKP Q14A)

(ASK Q14A-Q14C FOR EACH PRODUCT USED)

Q14A. And what was <PRODUCT1> used for? **[INTERVIEWER: PROBE FOR RESPONSE IF NECESSARY. CHECK ALL THAT APPLY]**

1 Fertilize grass
2 Fertilize vegetables
3 Fertilize fruit trees
4 Fertilize flowers and shrubs
5 Kill weeds
6 Kill grubs
7 Other (please specify) _____
8 Don't Know
9 Refused

Q14B. What form of <PRODUCT1> was used? Was it a: **[INTERVIEWER: READ CHOICES]**

1 Ready to use spray or liquid fertilizer
2 Concentrated spray, that is, you must add water
3 Dry granules
4 Other (please specify) _____
8 Don't know **(VOL.)**
9 Refused

Q14C. How often is <PRODUCT1> applied each year? Is it applied : **[INTERVIEWER: READ CHOICES]**

1 Less than 1 time per year
2 1-2 times per year
2 3-4 times per year
3 4-5 times per year
4 More than 5 times per year
8 Don't know **(VOL.)**
9 Refused

Q15. How do you decide how much fertilizer to apply to the lawn at one application? Do you**: [INTERVIEWER: READ CHOICES AND CHECK ALL THAT APPLY]**

1 Use the directions on the bag
2 Your lawn care company/landlord/apt. management decides
3 Past experience
4 Store recommendations
5 However much fits in the spreader
6 You guess/estimate
7 Other (please specify)_____
8 Don't know **(VOL.)**
9 Refused

Q16. How many bags of fertilizer are applied to the lawn at each application? **[INTERVIEWER: PROBE FOR RESPONSE IF NECESSARY]**

1 Less than 1/4 bag
2 About 1/2 bag
3 Between 1/2 and 1 bag
4 1 bag
5 2 bags
6 3 bags
7 More than 3 bags
8 Don't know/remember **(VOL.)**
9 Don't know - Lawn care company/landlord/apt. management decides
10 NA – Use liquid fertilizer
99 Refused

Q17. How large are the bags of fertilizer that your purchase for the lawn? _____

[INTERVIEWER: RESPONDENT MAY ANSWER IN TERMS OF POUNDS (E.G. 30 LB. BAG) OR SQUARE FOOT COVERAGE (e.g. 5,000 SQ. FT., 15,000 SQ. FT.]

9 Don't remember

Q18. At which type of store or stores were these fertilizer products purchased? For example, a … **[INTERVIEWER: READ CHOICES AND CHECK ALL THAT APPLY]**

1 Nursery
2 Home supply (e.g. Home Depot, Lowes)
3 Hardware (e.g. Ace Hardware, True Value)
4 Grocery (e.g. Stop & Shop, Shaw's)
5 Drug store (e.g. CVS, Walgreens)
6 Discount department store (e.g. Benny's, Job Lot)
7 Lawn care professional
8 Other (please specify) _____
9 Someone other than respondent purchased the products
98 Don't remember
99 Refused

Weed and Pest Control Product Use

Q19. Now I would like to ask you just a few questions about outdoor weed and pest control products. Can you please tell me if you, someone in your household, a lawn care professional, or pest control company used any type of outdoor weed or pest control product in the past 12 months? **[INTERVIEWER: CHECK ALL THAT APPLY]**

[INTERVIEWER: PROBE FOR SPECIFIC RESPONSE IF NOT PROVIDED BY RESPONDENT]

1 Respondent or someone else in household
2 A lawn care professional or pest control company
3 A landlord/condo/mobile park/ apartment complex management
4 Friend, neighbor, or family member that does not live with respondent
5 Other (please specify) _____
6 No weed or pest control products applied in past 12 months [SKP Q24]
8 Don't Know [SKP Q24]
9 Refused

Q20. What types of insects and weeds do you actively manage? **[INTERVIEWER: DO NOT READ CHOICES]**

1 All types	11 Ants	21 Other (please specify) _____
2 Crabgrass	12 Tics	22 Other (please specify) _____
3 Dandelions	13 Spiders	23 Other (please specify) _____
4 Poison ivy	14 Mosquitos	98 Don't know
5 Chickweed	15 Fleas	99 Refused
6 Grass	16 Mites	
7 Clover	17 Bed bugs	
8 Moss	18 Cockroaches	
9 Algae	19 Beetles	
10 Mushrooms	20 Termites	

Q21A. I'd like to ask you the specific names of the outdoor weed and pest control products that you, your lawn care company, or pest control company used. Can you please tell me the name of the first product? It will be helpful if you can provide the brand name and the specific product name.

[INTERVIEWER: ACCEPT RESPONSES FOR UP TO 6 PRODUCTS] <PRODUCT 1>

8 Don't remember name of product (SKP Q23)

Q21B. <PRODUCT2>

1 No other products used
8 Don't know/remember name of product (SKP Q22A)

Q21C. <PRODUCT3>

1 No other products used
8 Don't know/remember name of product (SKP Q22A)

Q21D. <PRODUCT4>

1 No other products used
8 Don't know/remember name of product (SKP Q22A)

Q21E. <PRODUCT5>

1 No other products used
8 Don't know/remember name of product (SKP Q22A)

Q21F. <PRODUCT6>

1 No other products used
8 Don't know/remember name of product (SKP Q22A)

(ASK Q22A-Q22B FOR EACH PRODUCT USED)

Q22A. What form of [FIRST PRODUCT] was used? Was it a: **[INTERVIEWER: READ CHOICES]**

1 Ready to use spray or liquid
2 Concentrated spray, that is, you must add water
3 Dry granules
4 Other (please specify) _____
8 Don't know **(VOL.)**
9 Refused

Q22B. How often is [PRODUCT1] applied each year? Is it applied: **[INTERVIEWER: READ CHOICES]**

1 Less than 1 time per year
2 1-2 times per year
3 3-4 times per year
4 4-5 times per year
5 More than 5 times per year
8 Don't know **(VOL.)**
9 Refused

Q23. At which type of store or stores were these weed and pest control products purchased? For example, a … **[INTERVIEWER: READ CHOICES AND CHECK ALL THAT APPLY]**

1 Nursery
2 Home supply (e.g. Home Depot, Lowes)
3 Hardware (e.g. Ace Hardware, True Value)
4 Grocery (e.g. Stop & Shop, Shaw's)
5 Drug store (e.g. CVS, Walgreens)
6 Discount department store (e.g. Benny's, Job Lot)
7 Other (please specify) _____
8 Someone other than respondent purchased the products
98 Don't remember **(VOL.)**
99 Refused

Alternative Lawn Care Practices

Q24. Now I'd like to ask you just a few questions about alternative lawn care practices. Are you aware of alternative lawn practices aimed at eliminating or minimizing the use of conventional fertilizers and pesticides such as top dressing, aeration, and organic products?

1 Yes
2 No (SKP Q27)
3 Somewhat aware **(VOL.)**
9 Refused (SKP Q27)

Q25. Have you used any of these alternative lawn care practices?

1 Yes
2 No (SKP Q27)
8 Don't know (SKP Q27)
9 Refused (SKP Q27)

Q26. Which alternatives lawn care practices have you used? _____
(SKP Q28)

Q27. We'd like to know why people do not use alternative lawn care practices. Can you please tell me why you have not used any alternative lawn care practices? Is it because **[INTERVIEWER: READ CHOICES AND CHEK ALL THAT APPLY]**

1 Don't know enough about them
2 The company you contract with does not offer them
3 They cost too much
4 You are skeptical of their effectiveness
5 Any other reason? (please specify) _____
8 Don't Know
9 Refused

Q28. OK, just a few more questions about the environment in general. What effect do you think the use of lawn fertilizers, weed control products, and pest control products have on Cape Cod's environment? Would you say they have: **[INTERVIEWER: READ CHOICES]**

1 A significantly negative effect
2 A somewhat negative effect, or
3 No effect at all
8 Don't know **(VOL.)**
9 Refused

Q29. How concerned are you that the use of lawn fertilizers, weed control products, and pest control products are having a negative effect on the Cape's environment? Would you say you are: **[INTERVIEWER: READ CHOICES]**

1 Very concerned
2 Somewhat concerned
3 Not very concerned
4 Not concerned at all
8 Don't know
9 Refused

The final questions are for statistical purposes only, so that we can make sure we interview a representative group of people. I want to remind you that your responses will be kept confidential.

Q30. Can you please tell me your age?

____ years
97 97 or older
99 Don't know/Refused **(VOL.)**

Q31. And in which town do you live?

1 Barnstable
2 Bourne
3 Brewster
4 Chatham
5 Dennis
6 Eastham
7 Falmouth
8 Harwich
9 Mashpee
10 Orleans
11 Provincetown
12 Sandwich
13 Truro
14 Wellfleet
15 Yarmouth
16 Other (please specify) _____
99 Refused

Q32. Do you own or rent you Cape Cod residence?

1 Own
2 Rent
8 Don't know
9 Refused

Q33. Is your Cape Cod home your year-round residence or part-time residence?

1 Year-round
2 Part-time residence
9 Refused

Q34. About how long have you lived or had a home on the Cape? _____

Q35. What is the last grade or class that you completed in school? **[INTERVIEWER: DO NOT READ CHOICES]**

1 None, or grade 1-8
2 High school incomplete (Grades 9-11)
3 High school graduate (Grade 12 or GED certificate)
4 Technical, trade, or vocational school AFTER high school
5 Some college, associate degree, no 4-year degree
6 College graduate (B.S., B.A., or other 4-year degree)
7 Post-graduate training or professional schooling after college (e.g., toward a master's Degree or Ph.D.; law or medical school)
9 Don't know/Refused **(VOL.)**

Q36. I am going to read several different income categories. Without telling me your exact income, into which category did your total household income for the past year fall?

[INTERVIEWER: READ CHOICES]

1 Under $25,000
2 $25,000 up to $50,000
3 $50,000 up to $75,000
4 $75,000 up to $100,000
5 Over $100,000
99 Don't know/refused

Thank you very much for your participation.

APPENDIX C – DATA TABLES

Cape Cod Commission, Residential Fertilizer & Pest Control Use Poll

Totals & Crosstabs
(Note: Percentages may not add to 100% do to rounding)
Cells highlighted are statistically significant at the .05 level
Study Dates: June 27 through July 6, 2012
Total Suveys Completed: 550
Margin of Error: 4.2%
Response Rate (AAPOR #4): 15.1%

Fertilizer Use

Q9. Can you please tell me if you, someone in your household, or a yard care professional used fertilizer on your lawn in the past 12 months? (All Respondents)

Crosstabulations

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Respondent	160	29	33	25	23	31	30	38	29	32	19	19	31	37	NA	NA	30	32	26
A lawn care or landscape company	121	22	21	22	19	18	23	14	18	18	33	14	21	28			17	26	21
A landlord/condo/mobile park/ apartment complex management	30	5	5	6	13	4	4	9	4	3	7	11	5	3			11	2	1
Friend, neighbor, or family member who does not live with respondent	6	1	0.4	1	1	0	1	0	0	1	1	1	1	0			0	1	1
No lawn fertilizer applied in past 12 months	238	43	42	45	44	48	42	40	49	47	39	55	43	33			42	39	50

Q10. How did you choose your lawn care or landscape company? (Respondents with landscape service)

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
You were contacted directly by company	13	11	9	12													14	12	9
From a recommendation of a friend or relative	69	58	54	60	Sample size too small.			Sample size too small.				Sample size too small.			NA	NA	43	63	62
Its reputation for high quality lawns	13	11	7	14													22	5	6
It had the cheapest rates	1	1	2	0													0	2	0
It is environmentally friendly	7	6	9	3													3	7	9
Other reason	8	7	5	8													14	0	9
Don't know	10	7	14	3													5	12	6
																	Caution: Small sample size		

Q11. To what extent do you direct the practices of your lawn care or landscape company? (Respondents with landscape service)

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
A lot	30	25	18	30													19	23	30
A little	27	22	29	18	Sample size too small.			Sample size too small.				Sample size too small.			NA	NA	22	27	18
Not at all	60	50	52	47													60	48	42
Don't know	4	3	1.8	4.5													0	2.3	9.1
																	Caution: Small sample size		

Q12. And how often does your landscape company apply fertilizer to your lawn? (Respondents with landscape service)

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Less than 1 time per year	8	7	4	9													5	7	9
1-2 times per year	43	35	33	38	Sample size too small.			Sample size too small.				Sample size too small.			NA	NA	30	27	55
3-4 times per year	35	29	35	27													32	30	24
4-5 times per year	16	13	11	14													14	18	0
More than 5 times per year	4	3	4	2													3	7	0
Don't know	15	13	15	11													16	11	12
																	Caution: Small sample size		

Cape Cod Commission, Residential Fertilizer & Pest Control Use Poll

Totals & Crosstabs
(Note: Percentages may not add to 100% do to rounding)
Cells highlighted are statistically significant at the .05 level
Study Dates: June 27 through July 6, 2012
Total Suveys Completed: 550
Margin of Error: 4.2%
Response Rate (AAPOR #4): 15.1%

Fertilizer Use (Continued)

Q14A. What did you use [the product] for?

	Total		Crosstabulations: Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Fertilize grass	293	62	63	61	61	64	62	59	61	62	64	60	62	62	68	65	62	64	63
Fertilize vegetables	16	3	3	3	3	2	3	2	2	3	3	2	3	3	5	1	3	2	3
Fertilize fruit trees	5	0	0	1	0	2	0	2	0	0	1	1	1	1	1	-	1	1	1
Fertilize flowers and shrubs	18	3	3	4	3	4	5	4	4	4	2	4	4	4	3	1	4	3	5
Kill weeds	94	20	22	18	20	19	21	21	22	18	21	19	20	23	19	20	20	23	20
Kill grubs	17	5	3	4	4	3	4	4	4	5	4	5	3	3	2	1	3	3	4
Don't know	28	6	6	10	9	6	6	8	7	8	5	9	7	4	2	12	7	4	4

other = reduce soil aciditiy (2), prevent moss (1)

Q14B. What form of [the product] did you use?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Ready to use spray or liquid fertilizer	29	8	7	7	8	15	4	0	2	7	15	12	8	5	1.9	11.8	5	8	8
Concentrated spray, that is, you must add water	2	1	0	1	0	2	0	0	0	1	0	0	0	0	0.6	0.0	0	0	0
Dry granules	226	63	68	57	57	60	64	67	60	69	54	57	60	67	90.4	33.3	63	63	63
Other	8	3	1	3	0	2	3	0	4	6	0	2	2	4	4.5	0.0	2	2	3
Don't know: lawn care company/apt. condo management decides	84	25	23	30	33	19	28	31	33	16	31	28	28	24	0.0	54.9	29	26	26
Don't remember	4	1	1	2	2	3	1	3	2	1	0	2	3	0	2.6	0.0	2	1	1

Note: totals not = to above cause 14A used for multiple purposes

Q14C. How often do you apply [the product] each year?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Less than 1 time per year	16	4	5	3	2	8	4	0	4	8	3	7	5	6	4	4	2	2	11
1-2 times per year	154	44	43	39	35	28	45	42	36	52	32	25	38	52	36	48	41	39	38
3-4 times per year	110	33	34	33	33	46	30	30	40	23	42	37	37	28	40	23	26	45	29
4-5 times per year	24	7	8	8	10	3	8	4	7	10	9	7	8	6	9	6	8	8	8
More than 5 times per year	3	0	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1
Don't know: lawn care company/apt. condo management decides	37	9	9	14	20	11	11	21	7	5	14	25	9	7	10	16	20	5	11
Don't remember	9	2	1	3	0	5	2	3	6	1	0	0	3	0	1	3	3	1	1

Q15. How do you decide how much fertilizer to apply to the lawn at one application?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Use the directions on the bag	117	38	42	33	41	34	38	39	48	45	24	32	41	42	38	38	32	44	40
Lawn care company/landlord/apt. condo management decides	148	47	43	51	55	41	48	37	41	39	65	56	43	44	47	50	49	47	46
Past experience	16	5	4	6	2	2	7	10	7	5	1	2	7	5	3	8	8	2	4
Store recommendations	1	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
However much fits in the spreader	2	1	1	0	0	2	1	0	2	0	1	0	1	1	1	0	0	1	1
You guess/estimate	18	6	8	4	2	14	4	11	2	6	4	9	5	3	8	2	7	6	4
Don't know/remember	10	3	1	6	0	8	2	3	0	5	5	2	4	5	3	3	5	0	5

Q16. How many bags of fertilizer are applied to the lawn at each application?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Less than 1/4 bag	15	5																	
About 1/2 bag	26	8	Sample size too small.		Sample size too small.			Sample size too small.				Sample size too small.			Sample size too small		Sample size too smal.		
Between 1/2 and 1 bag	15	5																	
1 bag	72	23																	
2 bags	12	4																	
3 bags	10	3																	
More than 3 bags	3	1																	
Don't remember	20	6																	
Lawn care company/landlord/condo mngmnt. decides	139	45																	

Q17. How large are the bags of fertilizer that you purchase for your lawn?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower

See report for detailed data

Q18. At which type of store or stores were these fertilizer products purchased?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Nursery	46	15	11	16	12	16	14	21	19	15	5	13	15	11	17	8	14	13	17
Home supply (e.g. Home Depot, Lowes)	62	19	22	16	26	19	18	20	28	16	16	13	20	20	14	27	14	28	13
Hardware (e.g. Ace Hardware, True Value)	34	11	17	5	0	22	10	18	7	11	8	10	9	15	12	9	14	4	14
Grocery (e.g. Stop & Shop, Shaw's)	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drug store (e.g. CVS, Walgreens)	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Discount department store (e.g. Benny's, Job Lot)	11	3	5	2	10	3	2	4	0	6	3	8	2	2	5	2	4	3	3
Lawn care professional	122	38	35	43	41	27	42	25	35	33	54	36	36	44	40	38	37	41	42
Other (please specify)	13	4	4	4	2	0	5	1	0	8	4	2	5	5	4	3	2	6	4
Someone other than respondent purchased the products	11	3	2	5	6	3	3	0	0	6	7	5	4	1	5	1	4	3	3
Don't remember	21	7	5	9	4	11	6	10	11	6	4	13	8	2	3	13	12	2	5

Cape Cod Commission, Residential Fertilizer & Pest Control Use Poll

Totals & Crosstabs
(Note: Percentages may not add to 100% do to rounding)
Cells highlighted are statistically significant at the .05 level
Study Dates: June 27 through July 6, 2012
Total Suveys Completed: 550
Margin of Error: 4.2%
Response Rate (AAPOR #4): 15.1%

Weed & Pest Control

Q19. Can you please tell me if you, someone in your household, or a yard care professional used any type of weed or pest control product in the past 12 months?

Crosstabulations

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	*18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Respondent or someone else in household	163	31	35	27	37	39	27	36	30	36	24	36	31	28	NA	NA	34	28	27
A lawn care or landscape company	80	15	14	16	13	11	17	5	19	13	22	10	17	16			16	18	11
A landlord/condo/mobile park/ apartment complex manager	14	3	3	3	8	2	2	0	3	1	6	4	2	2			4	2	2
Friend, neighbor, or family member who does not live with re	9	2	1	2	3	1	1	0	1	1	3	3	2	0			2	1	3
No weed or pest control products applied in past 12 months	259	49	48	51	41	48	53	60	48	48	46	47	49	54			44	51	57

Note: There are 29 respondents who don't know who applied. Not includede in this data.

* Small # respondents in this cohort.

Q20. What types of insects or weeds do you actively manage?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
All types	85	26																	
Ants	53	17	Sample size too small.		Sample size too small.			Sample size too small.				Sample size too small.			Sample size too small.		Sample size too small.		
Crabgrass	36	11																	
Dandelions	32	10																	
Don't know	19	6																	
Grubs	15	5																	
Grass	14	4																	
Other	9	3																	
Spiders	8	3																	
Beetles	8	3																	
Termites	8	3																	
Chickweed	7	3																	
Weeds (general)	6	2																	
Poison Ivy	6	2																	
Moss	5	2																	
Clover	5	2																	
Tics	3	0.9																	
Mosquitos	3	0.9																	

Other = algae, aphids, bed bugs, blight (N=2), caterpillars, earwigs, fleas, and slugs

Q22A. What form of [the product] did you use?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Ready to use spray or liquid	126	43	51	36	47	46	41	43	43	50	39	52	45	36	48	34	42	41	48
Concentrated spray, that is, you must add water	49	17	15	17	15	15	18	19	19	11	19	9	16	26	21	8	15	17	18
Dry granules	60	21	17	24	19	23	19	11	11	24	20	20	22	16	24	15	22	21	16
Other	3	1	2	1	-	-	2	2	2	4	-	2	1	5	2	2	-	1	4
Don't know: pest/lawn company/landlord/mngmnt. decides	41	14	11	17	17	8	16	11	11	9	22	14	13	15	-	41	16	17	10
Don't know/remember	11	4	4	4	2	8	3	15	15	2	1	3	4	2	6	1	4	4	4

Other includes blocks (2) and traps (1)

Q22B. How often do you apply [the product] each year?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Less than 1 time per year	32	11	8	14	13	13	10	8	13	14	9	14	12	12	15	5	15	7	10
1-2 times per year	112	39	47	32	51	34	37	46	36	39	36	40	44	31	48	20	40	43	30
3-4 times per year	49	17	15	18	9	15	18	8	20	21	15	12	15	20	18	15	11	13	29
4-5 times per year	26	9	9	8	4	15	10	10	10	5	12	3	12	12	8	11	7	10	13
More than 5 times per year	12	4	7	3	2	3	6	6	-	7	3	6	3	10	6	3	4	5	3
Don't know: pest/lawn company/landlord/mngmnt. decides	32	11	7	15	8	7	14	10	12	6	15	11	10	12	-	31	11	13	9
Don't know	26	9	7	10	13	13	6	10	10	7	10	14	5	5	5	16	11	10	6

Q23. At which type of store or stores were these fertilizer products purchased?

	Total		Sex		Education			Age				HH Income			Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Nursery	28	10	11	7	4	5	12	7	13	10	6	5	11	11	10	6	10	8	11
Home supply (e.g. Home Depot, Lowes)	48	17	18	14	19	19	13	9	20	23	11	10	22	15	24	2	13	18	12
Hardware (e.g. Ace Hardware, True Value)	56	20	21	22	21	34	16	48	18	16	14	34	16	19	32	3	20	25	20
Grocery (e.g. Stop & Shop, Shaw's)	5	2	2	2	2	2	2	2	2	0	2	3	1	0	3	0	1	4	0
Drug store (e.g. CVS, Walgreens)	1	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0
Discount department store (e.g. Benny's, Job Lot)	13	5	6	4	15	2	3	7	2	5	5	10	3	4	8	0	6	3	6
Someone else purchased, e.g. pest/lawn prof/landlord	91	33	31	38	36	24	38	11	36	27	54	30	31	39	3	2	34	39	32
Other (please specify)	12	4	4	4	2	0	5	0	0	9	4	2	4	9	5	87	2	3	9
Don't remember	23	8	8	10	0	15	10	16	9	8	6	7	12	4	14	0	14	1	9

Cape Cod Commission, Residential Fertilizer & Pest Control Use Poll

Totals & Crosstabs
(Note: Percentages may not add to 100% do to rounding)
Cells highlighted are statistically significant at the .05 level
Study Dates: June 27 through July 6, 2012
Total Suveys Completed: 550
Margin of Error: 4.2%
Response Rate (AAPOR #4): 15.1%

Alternative Lawn Care Practices & Environmental Concerns

Q24. Are you aware of alternative lawn practices aimed at eliminating or minimizing the use of conventional fertilizers and pesticides such as top dressing, aeration, and organic products?

	Total		Crosstabulations: Sex		Education			Age				HH Income			*Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Yes	322	60	54	64	51	48	67	68	54	60	57	50	58	71	69	58	58	62	61
No	159	29	35	25	31	38	25	23	31	29	34	37	29	22	24	34	31	29	29
Somewhat aware (volunteered)	60	11	11	12	19	14	8	10	16	12	9	12	13	7	7	8	12	9	11

(Note: 9 respondents refused to answer question)

Q25. Have you used any of these alternative lawn care practices?

	Total		Sex		Education			Age				HH Income			*Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Yes	171	45	45	45	29	41	50	44	45	51	40	31	49	58	55	48	51	42	39
No	211	55	55	55	71	59	50	56	55	50	60	69	51	42	45	52	49	58	61

Q26. Which alternative lawn practices have you used?

	Total	
	Number	Percent
See report for detailed responses.	NA	NA

Q27. (If "No" to Q25) Can you please tell me why have you not used any alternative lawn care practices?

	Total		Sex		Education			Age				HH Income			*Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Don't know enough about them	156	39	40	42	32	55	38	31	43	43	44	43	47	42	41	48	41	45	39
The company you contract with does not offer them	13	3	3	3	1	3	3	3	3	3	3	3	2	6	0	10	0	4	4
They cost too much	31	8	6	6	10	6	4	10	7	4	4	9	5	5	13	3	13	9	3
You are skeptical of their effectiveness	55	14	14	11	13	3	16	10	14	14	13	9	12	13	17	14	16	14	13
Other	34	9	9	9	13	8	8	13	11	5	9	10	10	9	18	10	0	7	8
Don't use fertilizer or pesticides	66	17	18	17	10	18	20	25	13	21	11	14	16	18	NA	NA	16	12	25
Don't know	45	11	11	12	22	8	9	9	9	11	16	12	9	8	12	16	14	10	9

Q28. What effect do you think the use of lawn fertilizers, weed control products, and pest control products have on Cape Cod's environment?

	Total		Sex		Education			Age				HH Income			*Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
A significantly negative effect	243	44	39	49	29	46	49	60	37	47	35	40	49	47	42	40	38	49	50
A somewhat negative effect	224	41	41	41	46	41	40	32	47	38	45	46	42	41	48	39	45	38	41
No effect at all	34	6	8	5	12	2	6	4	5	5	10	8	3	7	5	9	7	5	4
Don't know	47	9	12	6	12	11	6	3	11	9	10	6	6	5	5	12	11	8	5

Q29. How concerned are you that the use of lawn fertilizers, weed control products, and pest control products are having a negative effect on the Cape's environment?

	Total		Sex		Education			Age				HH Income			*Who Applies?		Region		
	Number	Percent	Male	Female	<=H.S.	Some/Assoc.	Bach+	18-34	35-49	50-64	65+	<50K	$50K-100K	>100K	Internal	External	Upper	Mid	Lower
Very concerned	226	41	34	48	37	42	43	49	40	48	31	35	48	42	47	32	41	39	45
Somewhat concerned	229	42	44	40	46	41	41	40	39	36	50	50	39	41	39	48	40	44	42
Not very concerned	50	9	13	6	7	12	9	8	12	7	10	8	6	12	9	12	9	11	8
Not concerned at all	32	6	7	5	8	3	6	3	4	7	8	6	6	6	3	8	8	5	4
Don't know	10	2	2	1	2	3	1	0	6	1	1	1	1	0	2	1	1	1	2

* Internal includes respondents who apply fertilizer, weed and pest control products, or both. External includes respondents who have someone else outside the household apply fertilizer or weed and pest control products, or both.