Active Ingredient Data Package

ATRAZINE

Version #5 (May 14, 2015)

Long Island Pesticide Pollution Prevention Strategy
Active Ingredient Assessment

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Bureau of Pest Management
Pesticide Product Registration Section

Contents

Attachments

1.0 Active Ingredient General Information – Atrazine

1.1 Pesticide Type

Atrazine is a type of selective herbicide commonly used for controlling broadleaf and some grassy weeds. The herbicide is taken up into the plant via the root system or the foliage and works by disrupting photosynthesis. Atrazine is typically applied as a pre-emergent so that it is taken up by the roots of the newly emerging weeds, however, it can also be a foliar application. The low cost of atrazine combined with its ability to control weeds with little to no harm to the crop makes atrazine an important herbicide.

1.2 Primary Pesticide Uses

Atrazine is commonly applied during corn production and used for season-long control of annual grasses and broadleaf weeds. Atrazine is the active ingredient in 21 products registered for use on Long Island. AAtrex 4L and AAtrex Nine-0 are two of the most commonly used products containing the active ingredient atrazine. Application rates for corn typically range from 0.5 to 2.0 pounds of active ingredient per acre (lb ai/acre) with a maximum application rate not to exceed 2.5 lb ai/acre. According to the 2006 Environmental Protection Agency Interim Reregistration Eligibility Decision document, 75% of field corn is managed with the use of atrazine. Historically (up until early 1990's), atrazine was also used to control weeds in non-agricultural areas, including along railroad lines, utility stations and corridors, highway medians, and paved areas, etc. at application rates significantly higher than the current application rates. Specifically, atrazine could be applied in these non-crop areas at rates of approximately 20 – 40 lb ai/acre.

1.3 Registration History

- 1958 Atrazine first registered by the US EPA.
- 1990 Federal Groundwater mitigation added to product label.
- 1990 Classification of all atrazine-containing products not used for lawn care, turf, and conifer use as a restricted use pesticide.
- 1990 Product labels revised to reduce non-crop application rates from 40 lb ai/acre to 10 lb ai/acre.
- 1992 Federal Surface water mitigation added to product label.
- 1992 Product labels revised to remove non-crop atrazine usage.
- 2003 Interim Reregistration Eligibility Decision.

1.4 Environmental Fate Properties

The table below summarizes some of the environmental fate properties for atrazine.

Active Ingredient	Adsorption Coefficient (Koc in g/ml)	Half-Life (days)	Aqueous Solubility (mg/l or ppm)	Notes
Atrazine	100	60 - 100	33	Values derived from PPDB database.

Because of these environmental fate properties, atrazine is generally expected to have a high potential for leaching from the soil column and contaminating groundwater.

According to the University of Hertfordshire Pesticide Product Database (PPDB) (http://sitem.herts.ac.uk/aeru/ppdb/en/Reports/43.htm#none), atrazine has a groundwater ubiquity score of 3.3 and is classified as having a high leaching potential. The table below summarizes the range in groundwater ubiquity scores along with the corresponding leaching potentials. The groundwater ubiquity score provides a general indication of hazard only. It is based on the physical and chemical properties of the chemical and takes no account of the local environmental conditions, the field application rate, application timing, or formulation.

Groundwater Ubiquity Score	Leaching Potential
<0.1	Extremely Low
0.1-1.0	Very Low
1.0-2.0	Low
2.0-3.0	Moderate
3.0-4.0	High
>4.0	Very High

The labels for products containing atrazine contain the EPA groundwater label advisory statement that is required for pesticide products that the EPA determined, based on environmental fate characteristics, may have a tendency to leach from the soil and contaminate underlying groundwater.

Groundwater studies suggest that atrazine is persistent in aquifer material with estimated half-lives ranging from 206 to 710 days (Schwab et al., 2005). A separate study suggested that the atrazine half-life in a groundwater environment may even approach six years (Gaus, 2000). Overall, atrazine has a tendency to degrade more readily under aerobic conditions with the degradation process slowing as conditions turn anaerobic.

The following compounds are atrazine breakdown products that form as the parent degrades in a soil medium. Deethylatrazine has a groundwater ubiquity score of 3.24 and is considered to have a high leachability. Groundwater ubiquity scores were not available for the remaining degradates. Deisopropylatrazine is also a degradate of the herbicide simazine.

1. Deethylatrazine (DEA)
2. Deisopropylatrazine
3. Didealkylatrazine
4. Hydroxyatrazine

1.5 Standards, Criteria, and Guidance

Federal and New York State water quality standards provide a quantitative basis for the implementation of the pollution prevention elements of the Long Island Pesticide Pollution Prevention Strategy (Strategy). These standards have been used as benchmarks in water quality monitoring to evaluate the level at which pesticide contamination has been detected and confirmed and are a factor in determining the type of response actions needed. These standards will continue to be used as the critical threshold calling for intervention and action under the Strategy.

Reference points outlined in the Strategy included standards and guidance values. A *standard* is a value that has been promulgated and placed into state or federal regulation. A *guidance value* may be used where a standard for a substance or group of substances has not been promulgated into regulation. Both standards and guidance values are expressed as the maximum allowable concentration in units of micrograms per liter (and parts per billion) unless otherwise indicated.

As summarized in the table below, there are four reference points for atrazine. These include:

1) DEC ambient groundwater quality standards for taste-, color- and odor-producing, toxic and other deleterious substances (6 NYCRR 703.5; includes the Principal Organic Contaminant (POC)[1] groundwater standard),
2) DEC ambient groundwater guidance values where no water quality standard is assigned (6 NYCRR 702.15, DOW TOGS 1.1.1.),
3) NYSDOH drinking water standards (10 NYCRR Part 5; includes POC and Unspecified Organic Contaminants ("UOCs") generic Maximum Contaminant Levels (MCLs)[2] as well as specific MCLs), and
4) Federal Safe Drinking Water Act standards (MCLs).

Active Ingredient	USEPA SDWA MCL	NYSDOH 10 NYCRR Part 5 MCL	NYSDEC NYCRR Part 703.5	NYSDEC DOW TOGS 1.1.1	USEPA Human Health Benchmark
Atrazine	3.0	3.0	7.5	7.5	NF

Notes: NF: Value not found in the references.

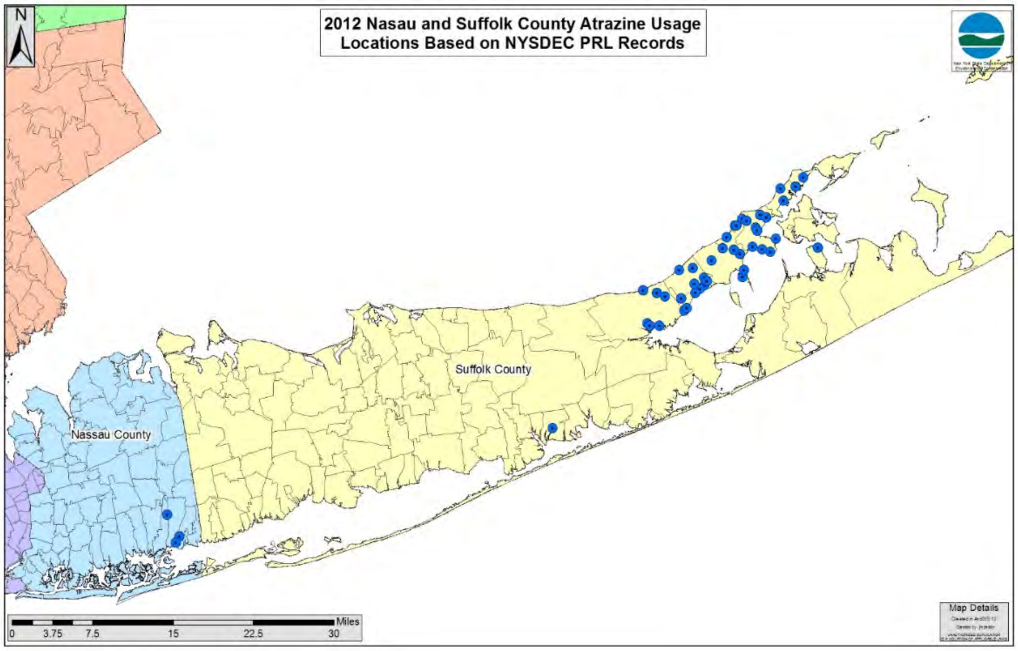
2.0 Active Ingredient Usage Information

2.1 Reported Use of Atrazine in New York State

Based on ArcGIS Geocoding of the 2012 pesticide usage data recorded in the Pesticide Reporting Law Annual Data, there were eight atrazine applications in Nassau County and 96 atrazine applications in Suffolk County. The figure below shows the geocoded locations where atrazine was applied in Nassau and Suffolk Counties. As can be seen, the atrazine applications are concentrated in the eastern portion of Suffolk County in the area of the north fork.

[1] *Principal organic contaminant classes* defined in 6 NYCRR 700.1 means the following classes of organic chemicals: Halogenated alkanes, Halogenated ethers, Halobenzenes and substituted halobenzenes, Benzene and alkyl- or nitrogen-substituted benzenes, Substituted, unsaturated hydrocarbons, or Halogenated nonaromatic cyclic hydrocarbons.

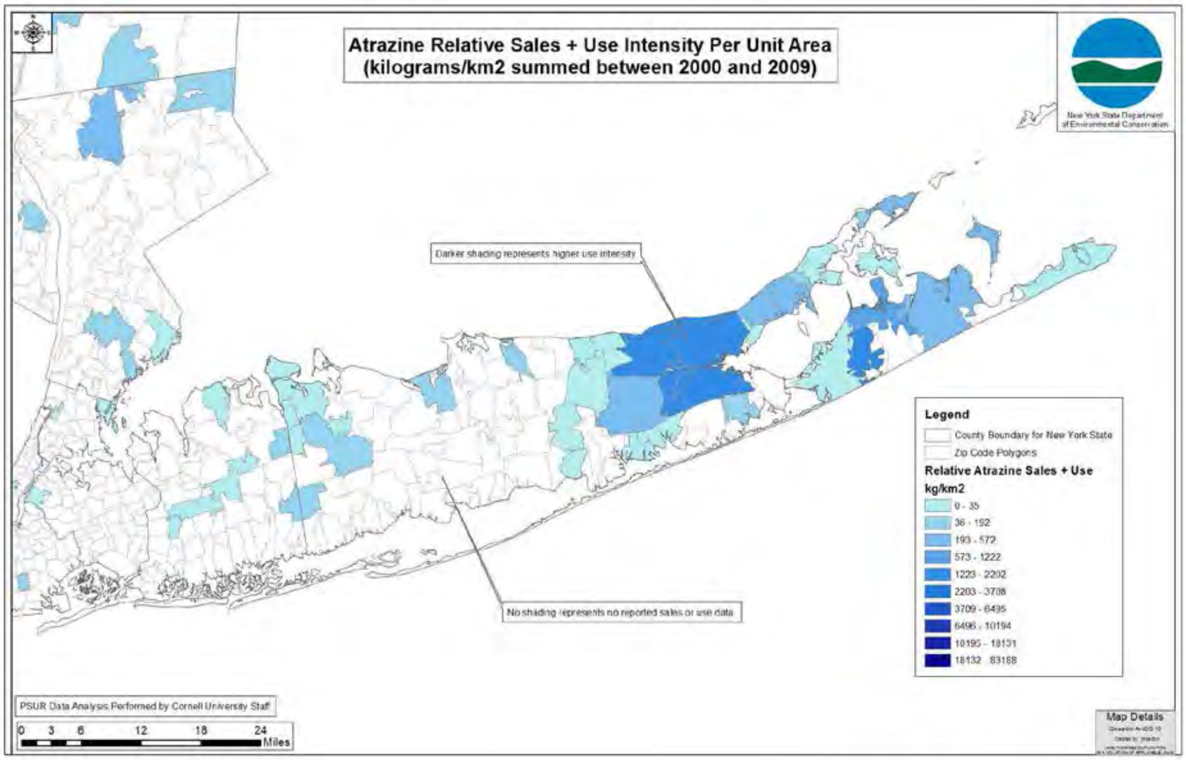
[2] UOCs comprise any organic compound (including pesticides and their degradates) for which the POC designation does not apply, and for which a specific MCL has not been adopted. The UOC standard is 50 ppb for any individual substance in the class. There is also a standard of 100 ppb for "total POCs and UOCs." UOCs, which apply to public water supplies in New York State, are not directly adopted as ambient groundwater standards.



Attachment 1 of this Active Ingredient Data Package also contains figures illustrating the atrazine usage data for 2003, 2006, 2009, and 2012. The table below summarizes the total number of atrazine applications that were reported in Nassau and Suffolk Counties in 2003, 2006, 2009, and 2012. As can be seen, the total number of reported atrazine applications was relatively consistent and low between 2003 and 2009, but increased considerably in 2012.

	Annual Number of Reported Applications			
Active Ingredient	**2003**	**2006**	**2009**	**2012**
Atrazine	11	11	9	104

To supplement the figures showing where the atrazine applications occurred for individual years, the following figure illustrates the relative atrazine sales plus use data obtained from the Pesticide Sales and Use Reporting (PSUR) Database for the ten year period between 2000 and 2009. The figure is an intensity map that combines reported uses and reported sales for individual zip codes in Nassau and Suffolk Counties. The sales plus use amounts are in kilograms per square kilometer. Darker shading represents a higher use intensity during this time period. No shading is used to indicate that no sales or use data was reported for that zip code. The figure below shows that the highest combined use and sales were reported in the western part of the north fork and the eastern part of the south fork. There was very little to no sales and use of atrazine in Nassau County and western Suffolk County.



2.2 Overall Number and Type of Products Containing the Active Ingredient

The table below summarizes the registrants that have products containing the active ingredient atrazine registered for use in New York State along with the total number of products for each registrant.

In NYS, there are 13 basic registrants with a total of 74 registered products that contain the active ingredient atrazine. Three of the 13 basic registrants have voluntarily revised their labels to not allow the use of their atrazine containing products on Long Island and four are currently phasing out their products on Long Island. In total, 21 of the 74 products are labeled for continued use on Long Island. Some of these products are registered in NYS by supplemental distributors. The table below summarizes the registrant and product details.

	Registrants with products Containing Atrazine as the Active Ingredient	EPA Company Number of Basic Registrant	Total Number of Products Registered for Use in NYS	Total Number of Products Allowed for Use on Long Island
1	SYNGENTA CROP PROTECTION, LLC	100	19	5*
2	DOW AGROSCIENCES LLC	62719	9	0
3	MONSANTO COMPANY	524	9	0

	Registrants with products Containing Atrazine as the Active Ingredient	EPA Company Number of Basic Registrant	Total Number of Products Registered for Use in NYS	Total Number of Products Allowed for Use on Long Island
4	BASF CORPORATION	7969	7	1*
5	MAKHTESHIM AGAN OF N. AMERICA, INC.	66222	7	3*
6	DREXEL CHEMICAL COMPANY	19713	4	3
7	LOVELAND PRODUCTS, INC.	34704	4	2
8	E.I. DU PONT DE NEMOURS AND COMPANY	352	5	1
9	WINFIELD SOLUTIONS, LLC	1381	3	1*
10	OXON ITALIA S.P.A	35915	2	2
11	SIPCAM AGRO USA, INC.	60063	2	0
12	UNIVERSAL COOPERATIVES, INC.	1386	2	2
13	AGRILIANCE, LLC	9779	1	1
		Total:	**74**	**21**

Notes:
*Products are currently being phased out and will no longer be available for use on Long Island.

2.3 Critical Need of Active Ingredient to Meet the Pest Management Need of Agriculture, Industry, Residents, Agencies, and Institutions

According to the Cornell Cooperative Extension of Suffolk County (CCE of SC) 2014 Pesticide Usage Report, atrazine is categorized as having a major use rating for sweet corn production and a limited to moderate use rating for field corn. CCE of SC indicates that overall, atrazine is categorized as having a major use rating in Suffolk County since the 1980's.

As summarized in the CCE of SC atrazine profile (Attachment 2), vegetable growers have found that atrazine, even when applied at or below 1.0 lb ai/acre, effectively controls difficult annual broadleaf weeds. With limited herbicide options labeled for other vegetable crops, growers rely on atrazine's control of weeds by rotating to crops with fewer weed management options. This gives growers residual control for these other crops. For instance, Galinsoga (*Galinsoga parviflora*) is a weed that is controlled in corn crops with the use of atrazine and can be reduced as a problem by residual control the following year for other vegetable crops.

2.4 Availability of Alternatives

The following sections summarize possible options to maximize the use of atrazine on sweet corn crops while reducing or eliminating the amount that enters the subsurface. Section 2.4.1 presents practices or modifications to the way atrazine is currently applied, Section 2.4.2 summarizes possible alternative herbicides that can also be used for corn on Long Island, and Section 2.4.3 presents cultural practices that apply to the use of atrazine on sweet corn crops. These options, along with the advantages and disadvantages associated with each, are further summarized in the Attachment 3 matrix.

2.4.1 Active Ingredient Application Modifications

There are possible modifications to the way atrazine is applied to potentially reduce the amount of atrazine usage. Some of these modifications are summarized below and will also be discussed in Section 5.

1) Tank mix atrazine with other herbicides to reduce the total amount of atrazine to be applied.
2) Reducing herbicide use by banding over the row and either cultivating or using post-emergence herbicides between the rows.
3) Restricting the use of atrazine on sweet corn to one application per year will reduce the possibility of over-application.
4) Lower atrazine application rate to 1 pound active ingredient/acre/year or less.
5) Optimize the timing of the atrazine application to avoid overspray and drift to prevent loss of herbicide through runoff and leaching.
6) Restricting atrazine to use on sweet corn crops would insure that atrazine usage remains limited in scope.
7) Adherence to buffer zones around features (wells, surface water bodies, drains, etc.) that may convey pesticide to the subsurface.
8) Improved calibration of application equipment to minimize delivery of excessive herbicide.

2.4.2 Possible Pesticide Alternatives

The CCE of SC atrazine profile summarizes possible alternative herbicides that can also be used for corn on Long Island. The table below has been modified after this summary and includes atrazine products along with some of the alternatives. It is important to note that no other pesticide product included in this table is a pre- and post-emergence selective herbicide for management of both broadleaf and grass weeds. Other pre- and post-emergence products include Callisto, Sandea, Prowl, and Roundup Weathermax. Only Roundup Weathermax controls both broadleaf and grass weeds, although it is a non-selective herbicide. Most of the other products registered for use with corn on Long Island are post-emergence herbicides.

The table below includes a summary of the Environmental Impact Quotient Field Use Ratings (EIQ FUR) for atrazine and each of the possible alternative pesticides. The EIQ FUR is a value obtained from published environmental impact information that allows pesticide users to factor in possible environmental effects when comparing commonly used pesticides. The approach is described in a 1992 Cornell University publication titled *A Method to Measure the Environmental Impact of Pesticides*. The EIQ FUR allows pesticides and various practices to be compared. The lower the

EIQ FUR, the lower the overall estimated environmental impact. Products containing the active ingredients nicosulfuron, carfentrazone, mesotrione, topramezone, tembotrione, and halosulfuron tend to have lower EIQ FUR values than the atrazine containing products.

Groundwater ubiquity scores and the maximum application rates on corn for the respective pesticides are also included in the table below. The active ingredients carfentrazone, pendimethalin, and glyphosate have the lowest leaching potentials. In this list of possible alternative pesticides, with the exception of glyphosate, each of the active ingredients are applied at maximum rates near or below the atrazine maximum application rate (2.5 lb ai/acre).

Pesticide Product Trade Name	Active Ingredient	Field Use EIQ	Groundwater Advisory EPA Statement	Groundwater Ubiquity Score (GUS)/Leaching Potential	Corn Maximum Use Rate (lb ai/acre/year)
AAtrex 4L, AAtrex Nine-0	atrazine	10-28.9	Yes	3.3/high	2.5
Accent	nicosulfuron	0.6	No	3.79/high	0.08
Aim EC	carfentrazone	0.1	No	-0.32/extremely low	0.031
Basagran	bentazon	12.3-16.5	Yes	2.3/moderate	2
Callisto	mesotrione	2.7-3.5 (preemergence)	No	3.43/high	0.24
Impact	topramezone	0.4	No	4.75/very high	0.0164
Laudis	tembotrione	1.3	Yes	2.53/moderate	0.164
Sandea, Permit	halosulfuron	0.6	Yes	8.56/very high	0.125
Prowl 3.3E C, Prowl H2O	pendimethalin	17.5-46.7	No	-0.39/extremely low	1.98
Roundup Weathermax	glyphosate	12.3-17.2	No	-0.69/extremely low	7.29
Weedar 64	2,4-D	11.7	yes	1.62/low	2.85

2.4.3 *Non-Pesticide Alternatives*

In addition to some of the pesticide alternatives summarized above, there are non-pesticide practices that can be considered to further reduce the need for using pesticide products. For corn, both sweet and field, these practices can help reduce weed populations. Some of these non-pesticide options are summarized below and will also be discussed in Section 5 (Summary of Possible Pollution Prevention Measures) and part of the Attachment 3 matrix.

1) Scout and map weeds to better understand degree of infestation and to select the most appropriate weed control practices.
2) Plant a cover crop after harvest to compete with weeds and improve soil quality.
3) Use cultivation practices, such as between row cultivation for the control, or partial control, of weeds. Cultivation practices are generally less effective when rainy conditions interfere with or lessen the frequency and proper timing of cultivation
4) Improve overall health of soil to promote healthy crops and reduce dependency on herbicides.
5) Shorten corn rotations (1 to 2 years) to disrupt weed cycles.

6) Early post-planting tine weeding (also called blind cultivation) timed at the white root stage of weed development. This can reduce annual broad leaf weeds and annual grasses. However, soil conservation efforts are compromised.
7) Control the field through mowing after harvest to reduce weed seed production.
8) Plant into a killed cover crop.
9) Interseed cover crops after last cultivation to reduce weed development.
10) Flame and hot weeding in row crops. This practice would normally only be used before corn plant emergence and requires specialized equipment.
11) Promote guidance on the proper handling of atrazine and the proper disposal of excess product and atrazine containers.
12) Improved irrigation practices to reduce the potential for atrazine to leach from the soil column. Irrigation scheduling should take into consideration atrazine application timing (i.e. prior to application and/or immediately after application to soil) as well as crop demand, soil moisture, soil water holding capacity, and forecast weather conditions. Evaluation of the actual irrigation system including emitter type, application efficiency and spacing, as well as evaluation of the system type (drip, sprinkler, or overhead) can increase application efficiency while reducing risk of off-site movement of atrazine.

2.5 Possible Outcomes Associated with Use Restrictions

As summarized in the CCE of SC atrazine profile, atrazine is an essential component of commercial sweet corn production on Long Island. Growers generally are applying atrazine at the rate of 1 pound of active ingredient per acre (lb ai/acre) or less. This rate has been able to be effectively reduced to as little as 0.25 lb ai/acre in recent years with the use of other herbicides that can be combined with atrazine to achieve broad spectrum weed control. CCE of SC staff are currently conducting field studies to determine what consequences might result from restriction or elimination of atrazine for sweet corn production. These studies are evaluating both the crop safety and weed control efficacy of currently labeled herbicides for sweet corn. The concern for many growers is that the loss of atrazine will result in more expensive and less effective weed management strategies. In addition, there is a concern that rotation restrictions of alternative products may limit or alter crop schedules. Growers need to adhere to best management practices for farmland rotations in order to avoid buildup of disease and insect pest populations. Weed population dynamics are affected by several factors. However, it is universally true that reducing weed seed production also helps reduce weed problems in successive crops and years. The loss of atrazine would possibly adversely affect not only corn production but other vegetable crop production as well because of the benefits that growers derive from the season-long weed control that atrazine provides.

2.6 Exposure Potential and Human Health Risk

Exposure of people to atrazine can occur through diet (crop residues from use in NYS and other areas and drinking water) or occupational use. There are no homeowner use products containing this chemical registered for use in the state and direct exposure of homeowners to atrazine is not expected.

Atrazine has low acute toxicity via oral, dermal and inhalation exposure routes and is neither an eye or skin irritant nor skin sensitizer. In both short and long-term feeding studies in laboratory animals, atrazine caused consistent toxic effects of reduced body weight gain and food intake as well as a decrease in erythrocyte parameters. Additionally, in chronic feeding studies in rats, atrazine, like other triazine pesticides, caused a disruption of the hypothalamic-pituitary axis which ultimately resulted in reproductive effects (e.g., delay in pubertal development). Although there are considerable differences between hypothalamic-pituitary-ovarian function in rats and humans, the U.S. EPA could not rule out the possibility of atrazine causing related adverse effects in humans. Based on all the available test data and scientific peer review, the U.S. EPA classified atrazine as "not likely to be a human carcinogen."

The U.S. EPA estimated risks from a majority of dietary exposures to atrazine in food and drinking water do not exceed their level of concern for the general population and all population subgroups. However, estimated seasonal dietary risk from exposure to atrazine in drinking water (primarily community water system scenarios in the Midwest) exceeded the U.S. EPA's level of concern for infants, children 1-6 years of age, and adults. In addition, occupational risks to mixers/loaders/applicators from atrazine in a variety of application scenarios were within the range considered acceptable by the U.S. EPA.

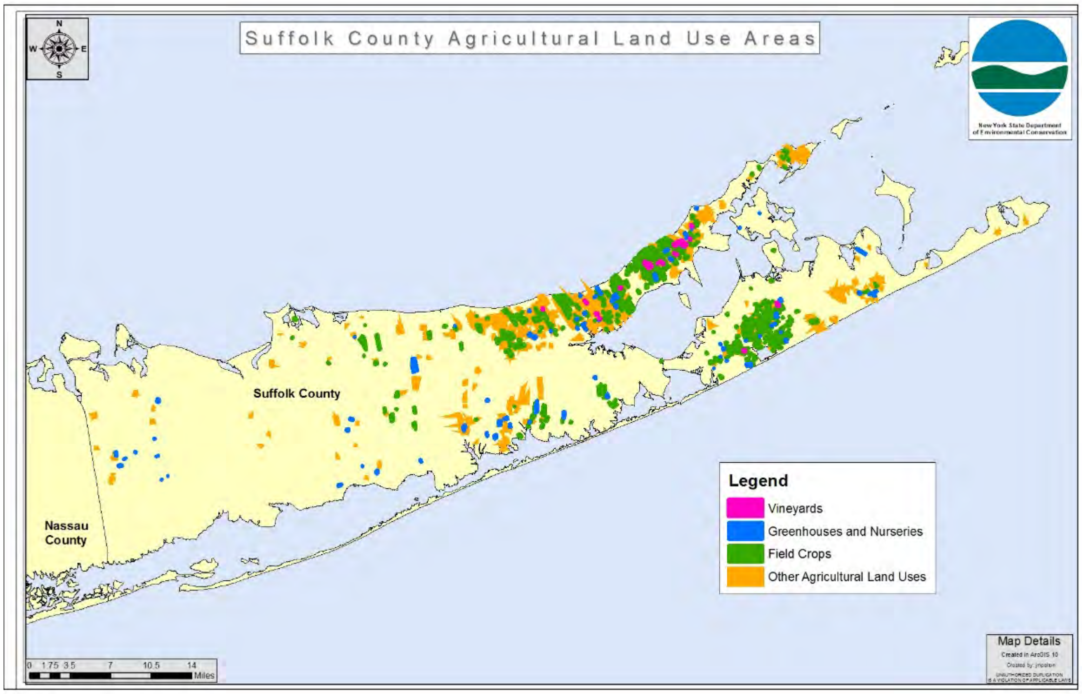
3.0 Land Use Information

The following figures illustrate some of the major agricultural-type land uses that occur in Suffolk County along with figures illustrating the locations and approximate areas of golf courses in both Suffolk and Nassau Counties. Since Nassau County is primarily developed for residential land use (approximately 60%) with a small fraction of agricultural land use, a figure showing Nassau County agricultural uses has not been prepared. The most recent census by the U.S. Department of Agriculture indicates that Nassau County contained approximately 2,682 acres of farmland and 55 farms (23 of which operate as equine farms) in 2012.

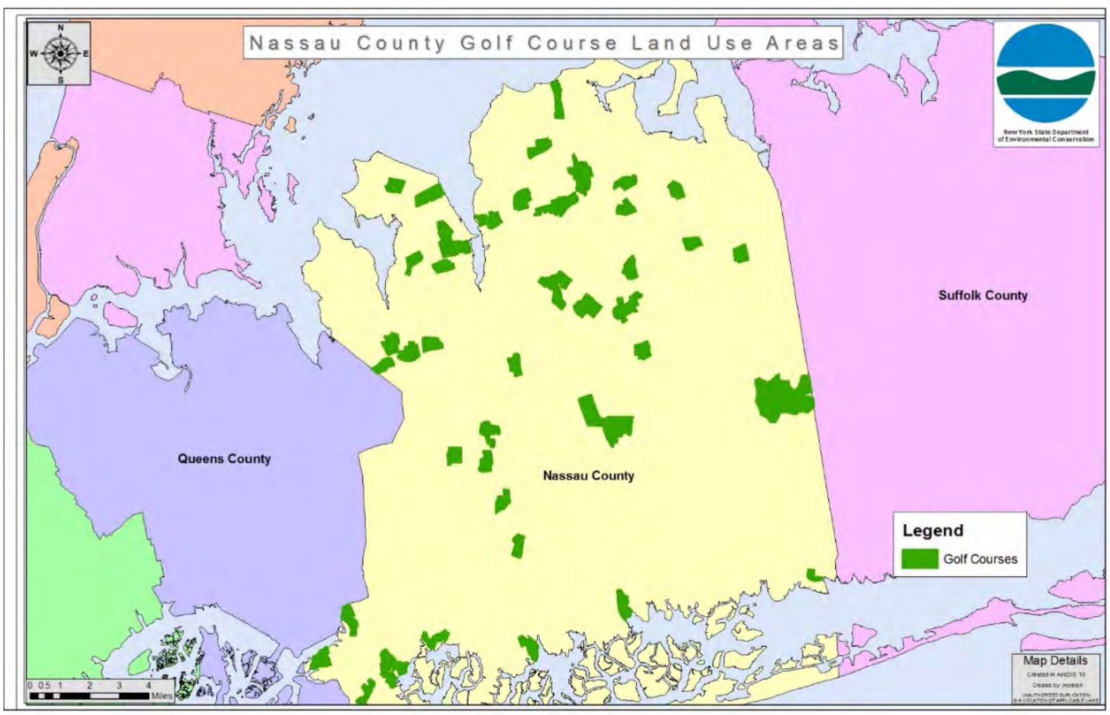
Although the western portion of Suffolk County is primarily used for residential purposes, there are a large number of farms and vineyards to the east and on both the north and south forks of Long Island. This can be seen in the figure below where shading has been used to illustrate the locations and areas of vineyards, greenhouses and nurseries, field crops, and other agricultural land uses in Suffolk County. The land use information is based on the Suffolk County Real Property Tax Service Agency data published in August 2014.

According to the most recent census by the U.S. Department of Agriculture, Suffolk County contained 35,975 acres of farmland and 604 farms in 2012. Of those numbers, 2,193 acres and 70 farms were dedicated for grape growing; 2,781 acres and 7 farms were dedicated for sod production; 2,605 acres and 72 farms were dedicated for potato growing; 1,075 acres and 48 farms were dedicated for sweet corn. As can be seen on the figure below, most vineyards are located in the area of the north fork. Greenhouses and nurseries do not appear to be concentrated in any specific area, but instead are located throughout Suffolk County.

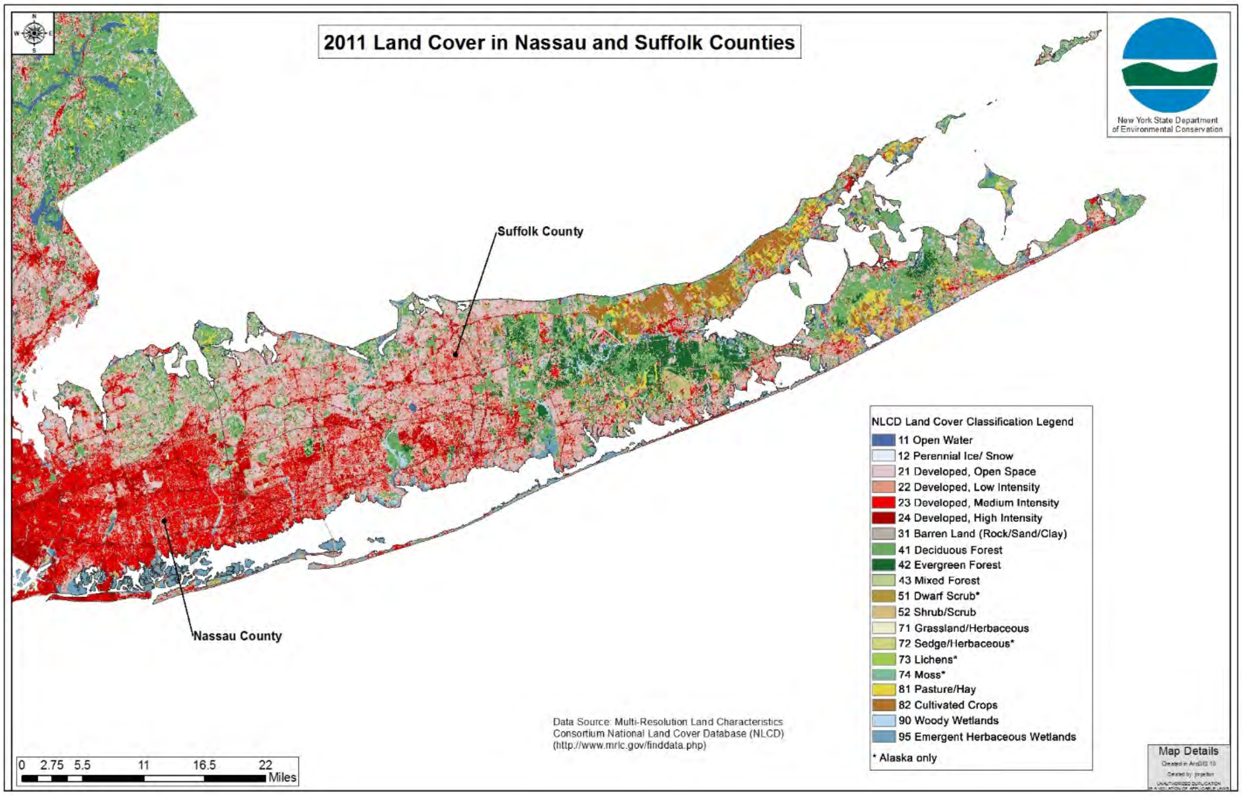
To illustrate the importance of agriculture to the Long Island community, in New York State, Long Island is the top region for the sale of nursery, greenhouse, floriculture and sod products. Suffolk County in particular is also New York's largest pumpkin, tomato and cauliflower producer.



In addition to agricultural type land uses, there is also a large amount of land use on Long Island dedicated to golf courses. The figures below show the locations of golf courses (green shading) in Suffolk County and Nassau County. In total, there are 145 public and private golf courses on Long Island. In Nassau County, approximately 8,321 acres are used for golf course purposes and in Suffolk County, approximately 9,563 acres are used for golf course purposes.



The 2011 land cover for both Nassau and Suffolk Counties is shown in the figure below. This is based on the National Land Cover Database and includes 16 land class covers based on Landsat satellite data. The majority of Nassau County and into western Suffolk County contains medium to high intensity development (red hues). Similar to the 2014 Suffolk County land use data shown above, the development intensity decreases eastward in Suffolk County while the amount of agricultural land use (cultivated crops and pasture/hay) increases. The 2011 land cover shows that a higher amount of agricultural land use occurs on the north fork than on the south fork.



4.0 Active Ingredient Analytical Results Summary

4.1 Groundwater Sample Collection History

Groundwater samples are collected annually by Suffolk County Department of Health Services staff from a combination of groundwater monitoring wells, private water supply wells, community water supply wells, and non-community water supply wells. Following collection, samples are submitted to the Suffolk County Public and Environmental Health Laboratory for the analysis of nearly 300 parameters. Most of the groundwater data included as part of this data package was collected between 1997 and 2013.

The table below provides a summary of the annual atrazine groundwater sampling data collected from the monitoring wells, private wells, and public water supply wells (community and non-community). For each year, the total number of individual locations where atrazine was detected relative to the total number of samples collected and analyzed for atrazine is provided, along with the annual minimum and maximum concentrations with a comparison to the NYSDOH Maximum Contaminant Level (MCL). The data summarized in the table below is also illustrated graphically as Attachment 4 of the data package.

As summarized in the table below, atrazine was detected in a single groundwater sample at a concentration (3.67 ppb) exceeding the NYSDOH MCL (3 ppb) during the period between 1997 and 2013. This detection occurred in 2003 and was collected from a private water supply well located in the East Quogue area. The next highest atrazine concentration (1.98 ppb) was detected in a groundwater sample collected from the same location the following year. Sampling from the same East Quogue area private well in 2011 showed a continued decline with atrazine being detected at a concentration of 0.6 ppb.

Prior to 2005, atrazine was detected in the annual groundwater samples at a maximum concentration exceeding 1 ppb in five of eight years (1998, 1999, 2002, 2003, and 2004). Following 2005, atrazine was not detected in the annual groundwater samples at a concentration exceeding 1 ppb. The highest atrazine concentration (0.8 ppb) after 2004 occurred in both 2005 and 2006. Review of more recently collected groundwater data (2011, 2012, and 2013) indicates that atrazine was detected in groundwater samples from six locations during this time period and that overall, the atrazine groundwater concentrations continued to decline. The maximum atrazine concentrations in groundwater samples collected from monitoring wells, private wells, and public water supply wells (community and non-community) during 2011, 2012, and 2013 were at or below 0.6 ppb.

The graph included as attachment 4 summarizes the atrazine groundwater data and includes 25th and 75th percentiles along with averages and minimum and maximum concentrations. As can be seen, prior to 2008, the 75th percentile for the annual atrazine groundwater data is greater than 0.5 ppb. After 2007, the 75th percentile declined to below 0.5 ppb.

Year	Total Number of Locations with Detections	Total Number of Samples	Percent Detected	Minimum Concentration Detected (ppb)	Maximum Concentration Detected (ppb)	MCL (ppb)	Frequency Exceeding MCL
Groundwater Sample Summary*							
1997	7	327	2.1%	0.12	0.65	3	0 of 327
1998	7	1,226	0.6%	0.13	1.2	3	0 of 1,226
1999	5	848	0.6%	0.19	1.4	3	0 of 848
2000	1	981	0.1%	0.15	0.15	3	0 of 981
2001	6	1,446	0.4%	0.20	0.99	3	0 of 1,446
2002	9	1,411	0.6%	0.20	1.27	3	0 of 1,411
2003	8	1,539	0.5%	0.11	3.67	3	1 of 1,539
2004	5	1,486	0.3%	0.10	1.98	3	0 of 1,486
2005	1	1,412	0.1%	0.30	0.80	3	0 of 1,412
2006	4	1,718	0.2%	0.19	0.80	3	0 of 1,718
2007	2	1,383	0.1%	0.20	0.60	3	0 of 1,383

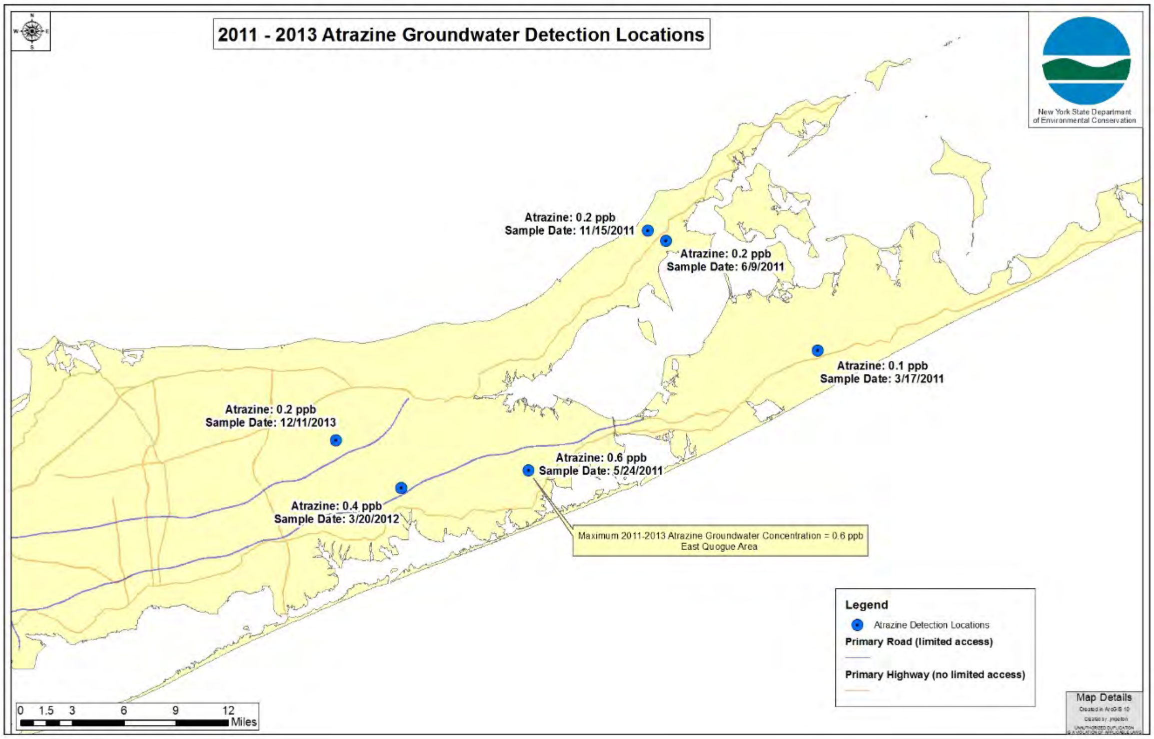
Year	Total Number of Locations with Detections	Total Number of Samples	Percent Detected	Minimum Concentration Detected (ppb)	Maximum Concentration Detected (ppb)	MCL (ppb)	Frequency Exceeding MCL
2008	4	1,599	0.3%	0.20	0.40	3	0 of 1,599
2009	5	1,555	0.3%	0.10	0.70	3	0 of 1,555
2010	6	1,266	0.5%	0.10	0.40	3	0 of 1,266
2011	4	1,112	0.4%	0.10	0.60	3	0 of 1,112
2012	1	1,132	0.1%	0.20	0.40	3	0 of 1,132
2013	1	1,058	0.1%	0.20	0.20	3	0 of 1,058

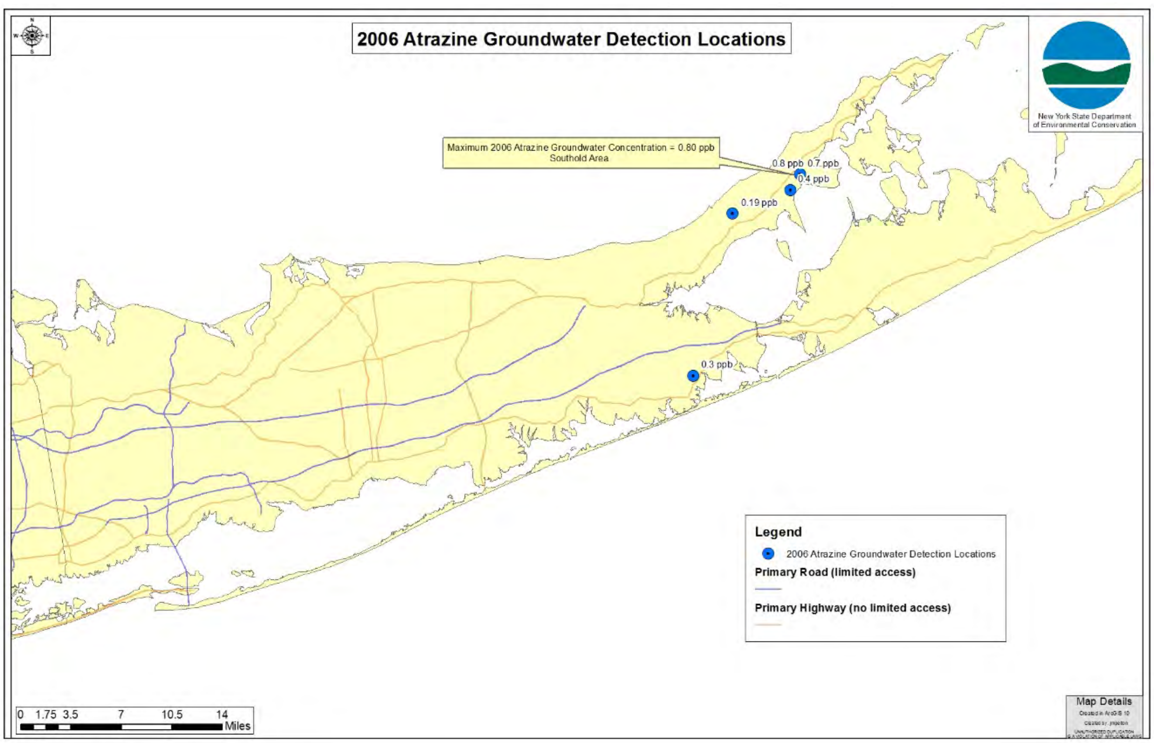
Notes:
* Groundwater Sample Summary includes groundwater samples collected from monitoring wells, private wells, and public wells.

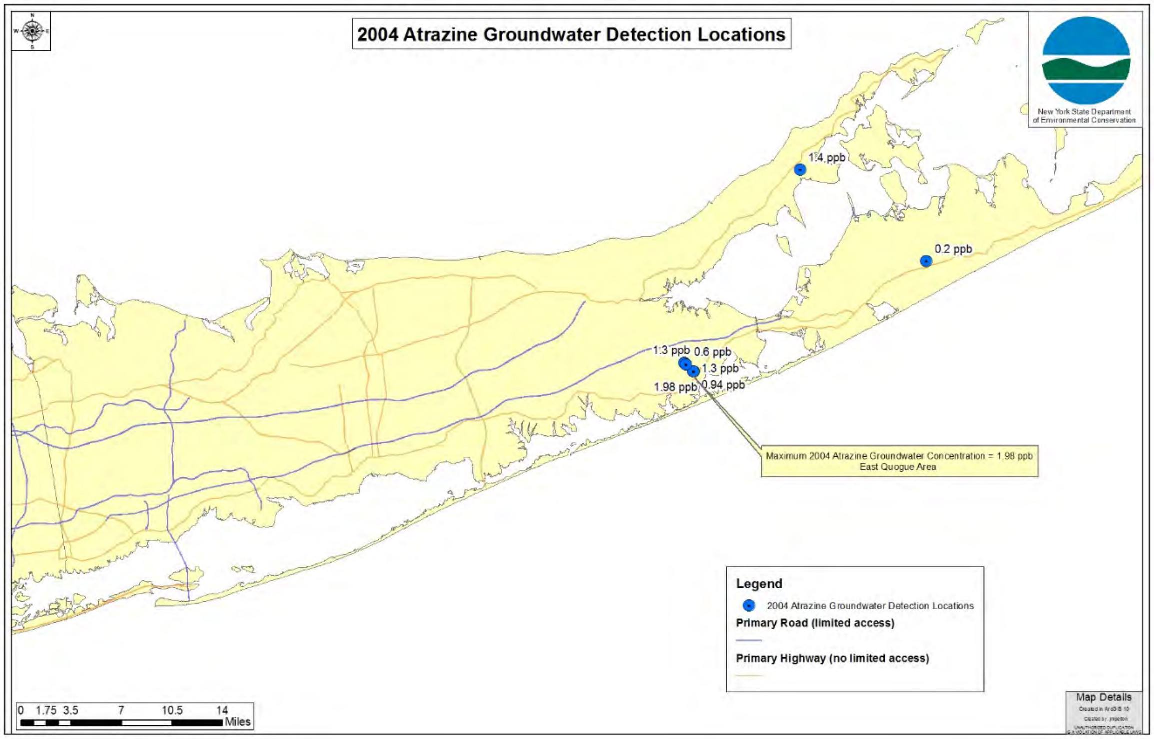
4.2 Groundwater Analytical Results Summary

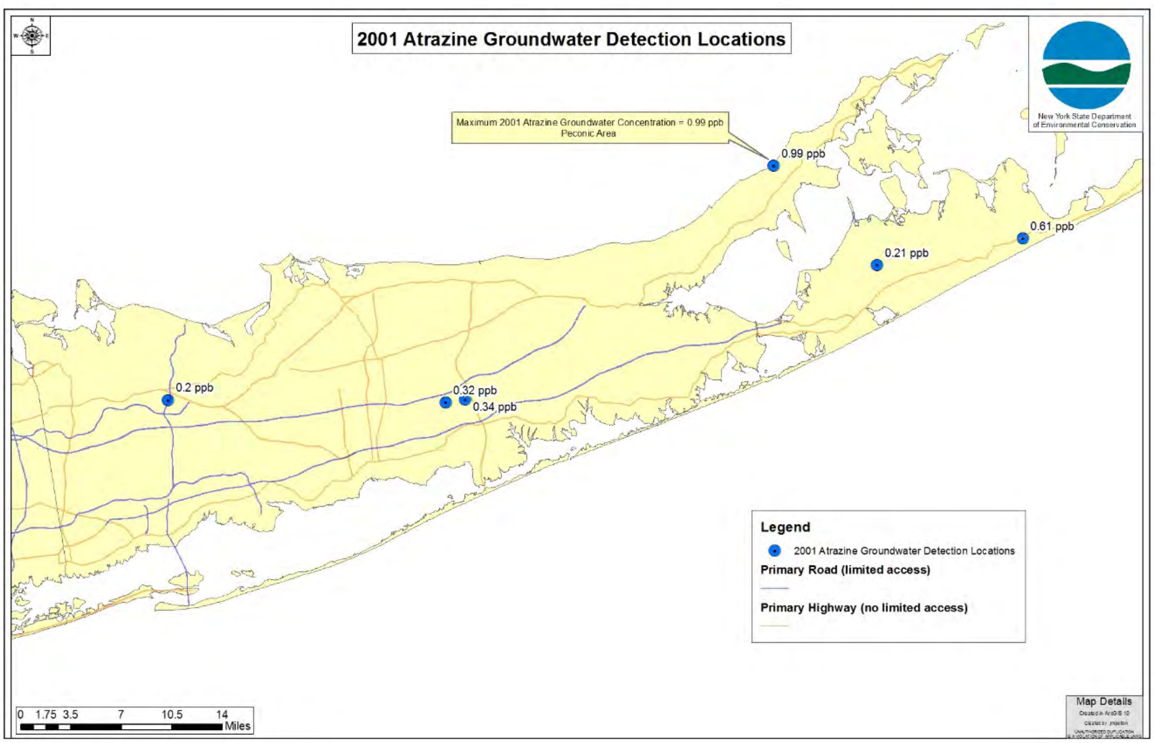
The following five figures were prepared to illustrate the locations where atrazine was detected in Suffolk County groundwater based on data collected between 1997 and 2013. Monitoring locations where atrazine was not detected in groundwater are not shown on the figures. The figures were prepared using groundwater data collected by Suffolk County from a combination of groundwater monitoring wells, private wells, and public wells (community and non-community). Since there were a total of six locations where atrazine was detected in groundwater samples collected from a combination of groundwater monitoring wells, private wells, and public wells between 2011 and 2013, the data from these three years was combined into a single figure (2011-2013 Atrazine Groundwater Detection Locations). Also, because of the infrequent annual detections of atrazine in groundwater, the atrazine groundwater data was not contoured. For each figure, an annotation has been added to indicate the area where the highest atrazine groundwater concentration occurred.

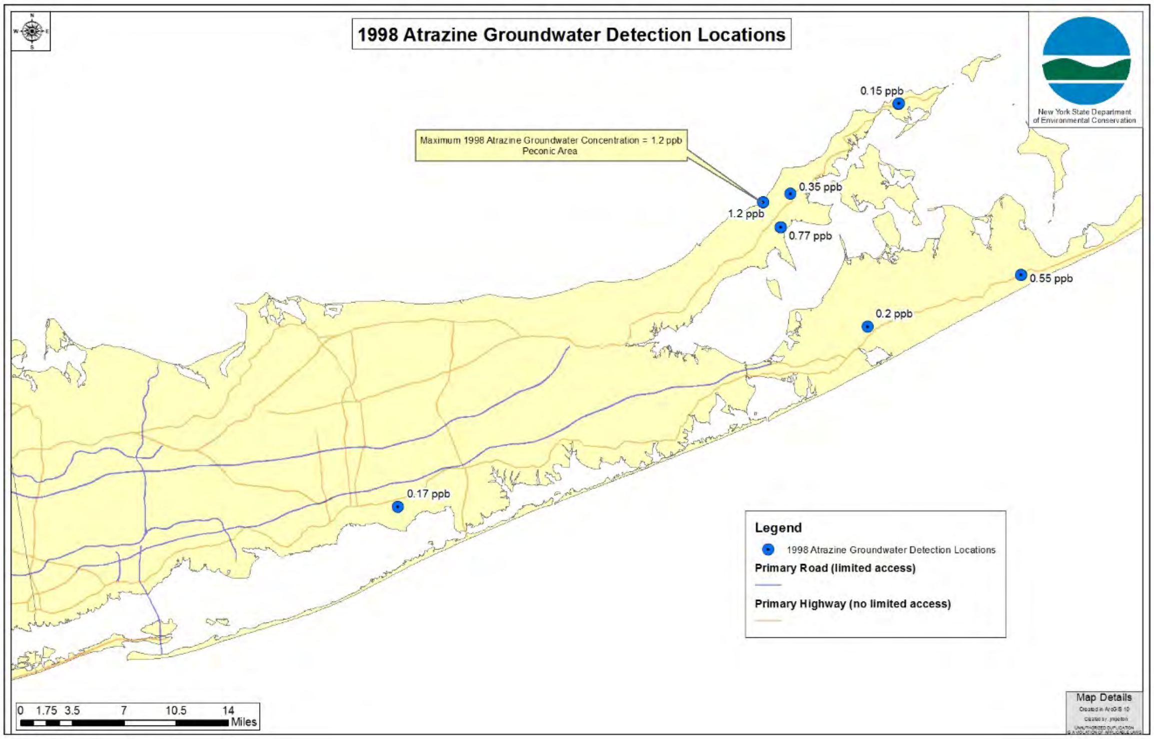
For each of the years illustrated in the figures below, atrazine was not detected at a concentration exceeding the NYSDOH MCL (3 ppb). As summarized in Section 4.1 (Groundwater Sample Collection History), atrazine was only detected at a concentration greater than 3 ppb from a single groundwater sample collected from a private well in 2003. Although there were occasional atrazine detections in groundwater collected from the central and western portion of Suffolk County, atrazine was consistently detected in groundwater collected from the area of the north and south forks. Furthermore, for each of the years between 1997 and 2013, the highest atrazine groundwater concentrations were detected in groundwater samples collected from either the north fork or the south fork.


2011 - 2013 Atrazine Groundwater Detection Locations
New York State Department of Environmental Conservation
Atrazine: 0.2 ppb
Sample Date: 11/15/2011
Atrazine: 0.2 ppb
Sample Date: 6/9/2011
Atrazine: 0.1 ppb
Sample Date: 3/17/2011
Atrazine: 0.2 ppb
Sample Date: 12/11/2013
Atrazine: 0.6 ppb
Sample Date: 5/24/2011
Atrazine: 0.4 ppb
Sample Date: 3/20/2012
Maximum 2011-2013 Atrazine Groundwater Concentration = 0.6 ppb
East Quogue Area
Legend
Atrazine Detection Locations
Primary Road (limited access)
Primary Highway (no limited access)
0 1.5 3 6 9 12
Miles
Map Details
Created in ArcGIS 10

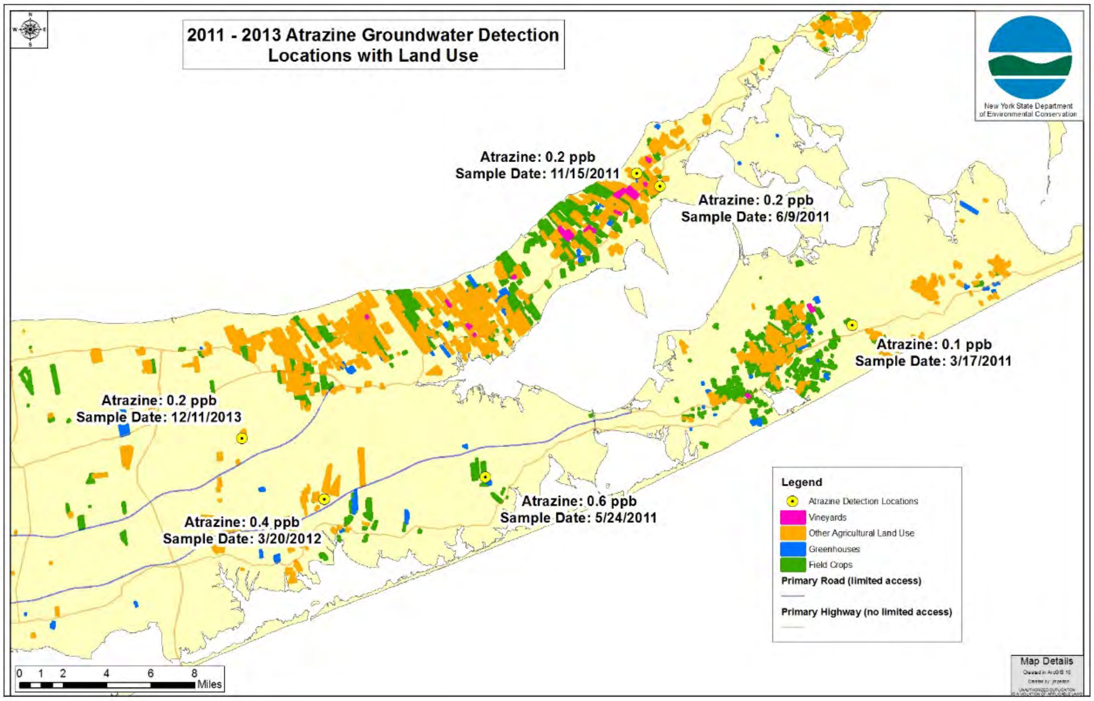

2006 Atrazine Groundwater Detection Locations
New York State Department of Environmental Conservation
Maximum 2006 Atrazine Groundwater Concentration = 0.80 ppb
Southold Area
0.8 ppb
0.7 ppb
0.4 ppb
0.19 ppb
0.3 ppb
Legend
2006 Atrazine Groundwater Detection Locations
Primary Road (limited access)
Primary Highway (no limited access)
0 1.75 3.5 7 10.5 14
Miles
Map Details
Created in ArcGIS 10


2004 Atrazine Groundwater Detection Locations
New York State Department of Environmental Conservation
1.4 ppb
0.2 ppb
1.3 ppb
0.6 ppb
1.3 ppb
1.98 ppb
0.94 ppb
Maximum 2004 Atrazine Groundwater Concentration = 1.98 ppb
East Quogue Area
Legend
2004 Atrazine Groundwater Detection Locations
Primary Road (limited access)
Primary Highway (no limited access)
0 1.75 3.5 7 10.5 14
Miles
Map Details

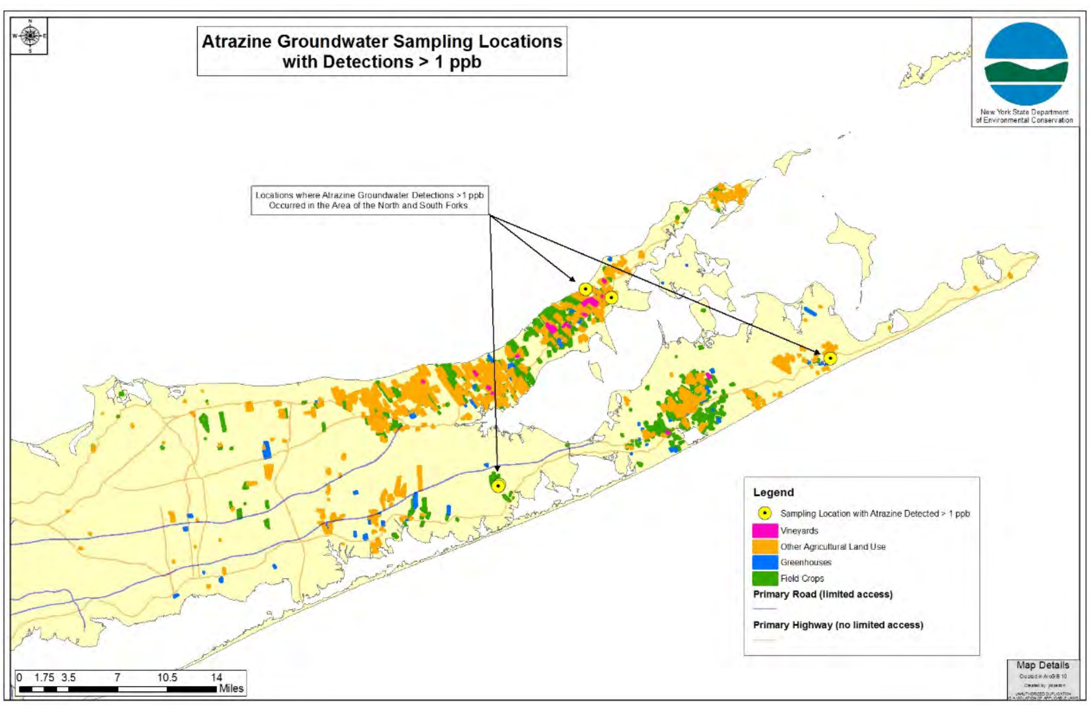

2001 Atrazine Groundwater Detection Locations
New York State Department of Environmental Conservation
Maximum 2001 Atrazine Groundwater Concentration = 0.99 ppb
Peconic Area
0.99 ppb
0.61 ppb
0.21 ppb
0.2 ppb
0.32 ppb
0.34 ppb
Legend
2001 Atrazine Groundwater Detection Locations
Primary Road (limited access)
Primary Highway (no limited access)
0 1.75 3.5 7 10.5 14
Miles
Map Details



The figure below shows the eastern half of Suffolk County along with the 2011-2013 atrazine groundwater data combined with the surrounding agricultural land uses. Between 2011 and 2013, atrazine was detected from a total of six locations at concentrations ranging from 0.1 ppb to 0.6 ppb. The six locations are shown on the figure below with yellow-filled symbols. As can be seen, each of the atrazine detections occurred in areas with nearby field crop and/or other agricultural land uses.



Based on the groundwater sampling completed between 1997 and 2013, atrazine was detected 14 times in groundwater samples collected from five separate locations at concentrations exceeding 1 ppb. As can be seen on the figure below, these five locations are within the area of the north and south forks. As summarized above, each of the atrazine detections occurring at concentrations above 1 ppb occurred prior to 2005.



5.0 Summary of Possible Pollution Prevention Measures

As discussed in Section 2.4 (Availability of Alternatives) and summarized in the atrazine alternatives table included as Attachment 3, there are several possible pollution prevention measures that can be applied to improve the overall use of atrazine while also reducing or eliminating the movement of atrazine into Long Island's groundwater. With atrazine no longer being used for non-agricultural purposes at the higher application rates and the primary atrazine use being related to sweet corn production at rates typically below 2.5 pounds ai/acre, emphasis is placed on possible pollution prevention measures for atrazine use on sweet corn crops. The reduced frequency of atrazine detections in groundwater combined with less atrazine usage support the use of best management practices and/or pollution prevention measures as an approach to address groundwater concerns. Success in reducing and/or eliminating the leaching of atrazine to the groundwater system will not necessarily occur with adoption of an individual practice, but instead will be realized through a combination of the practices identified for atrazine.

Possible Practices to Improve Atrazine Applications

With data suggesting that atrazine remains effective as a pre and post emergent herbicide at application rates at or slightly below one pound per acre per year, a best management practice will be adopted for the use of atrazine at a maximum rate of 1.0 pound per acre per year. The lower application rate can be accomplished in tank-mixes with other herbicides. By encouraging the lower application rates, this measure will reduce the overall amount of atrazine being applied on Long Island. This approach is consistent with voluntary best management practices developed by the Minnesota Department of Agriculture where atrazine should be used as part of a tank-mix at a maximum application rate of 0.8 lbs ai/acre.

In addition to a reduction in application rates, measures can be applied to more effectively apply atrazine to sweet corn crops. This includes applying atrazine by banding over the row of crops and either cultivating or using post-emergence herbicides between the rows. This practice involves applying atrazine as a focused band over the row crop at planting or during cultivation rather than over the entire field. It is not expected that applications by banding over the row would require the purchase of new equipment. Instead, applying this practice would require adjustments to the existing spraying equipment. Cultivation practices or alternative herbicides are applied to address weed population between the rows. Research by the US EPA Biological and Economic Analysis Division suggests that banding over the row reduces the amount of atrazine being applied by 50 to 67 percent.

To ensure that the correct atrazine rates are being applied, practices involving the proper setup, calibration, and maintenance of spraying equipment are necessary. This involves the use of the correct nozzles and pressures; periodic calibration of sprayers; and performing routine maintenance on nozzles, spray lines, and fittings, etc. Maintaining equipment improves application coverage and also reduces the likelihood that unnecessary and excessive amounts of atrazine will be applied and made available for downward migration to the groundwater system.

The timing of applications to avoid the loss atrazine through runoff during heavy rain events and the adherence to buffer zones to prevent off-field movement of atrazine into sensitive areas are two additional practices to reduce and/or eliminate groundwater contamination. The US EPA Biological and Economic Analysis Division estimated that potential atrazine runoff can be reduced by 50% with early-season atrazine applications. Maintaining buffer zones and setbacks from sensitive areas is a commonly applied practice and an effective approach to minimize the potential for atrazine migration into the groundwater.

Possible Non-Pesticide Practices for Weed Management

Several non-pesticide alternatives and integrated pest management practices have been identified and will be promoted to further reduce the overall use of atrazine on sweet corn crops. Specifically, scouting and mapping of weed populations can be used to select the most appropriate weed control practices. Scouting includes identifying the weed species, population location, and degree of infestation. Based on the scouting results, maps are prepared to define and monitor the extent of the weed infestation which allows growers to track and identify when action thresholds have been met. This helps ensure that control of weed populations occurs on the focal area of infestation at the proper timing with the most appropriate control mechanism which can reduce the overall usage and application area of atrazine.

Mechanical cultivation practices can also be used as an atrazine alternative for the management of weeds. This would include pre-plant tillage, zone tillage, and early post-planting tine weeding. Mechanical cultivation may not eliminate the total need for atrazine for weed control, but it may eliminate possible second applications. Additionally, to disrupt weed life cycles and to possibly reduce atrazine usage, shortened corn crop rotations can be employed. This may involve rotating corn with other crops at a one to two year frequency. Although not commonly used on Long Island, the use of cover crops after harvesting represents another practice for not only reducing atrazine usage, but also for improving the overall quality of soil. Cover crops are used to suppress weeds by competing for space, sunlight, and soil moisture. Cover crops are unlikely to provide complete weed control, but they may provide a reduction to the amount of atrazine that is needed as well as reduce the off-field runoff by buffering against erosion. The use of a cover crop however, tends to increase field management needs.

In addition to IPM practices described above and summarized in the Attachment 3 table, soil management practices will be promoted to further reduce or eliminate the leaching of atrazine. Specifically, improving soil management practices would combine approaches to increase and preserve the soil organic matter through the adoption of alternative cultivation practices. Increasing the amount of soil organic matter can be accomplished through cover cropping, crop rotations, herbaceous wind barriers, carbon-based mulching, and compost applications. Cultivation practices, including reduced tillage and zone tillage techniques can be applied to reduce the loss of organic matter while also controlling weeds. Reduced and no-till systems however can necessitate increases in atrazine use to achieve weed control in corn. Zone tillage with cover cropping is a recommended cultivation practice to minimize as much as possible the use of atrazine. Zone tillage clean tills a narrow seed bed within the standing cover crop thereby minimizing the area of atrazine application to achieve weed control while the cover crop aids in weed control and builds soil organic matter.

To further improve atrazine use, standard best management practices, involving the proper handling and disposal of containers and excess product and the proper transfer of atrazine product to spray equipment, will be promoted.

Education and Outreach

A key component to the implementation of these best management practices and pollution prevention measures is an education and outreach program. A combination of approaches will be used to promote the use and overall benefits of these practices. A factsheet detailing the specific atrazine best management practices will be developed and subsequently distributed in hardcopy and also electronically. At a minimum, the factsheet will be available electronically on the Cornell Cooperative Extension of Suffolk County, NYSIPM, Suffolk County Soil and Water Conservation District, and the Department's Long Island Strategy websites. The factsheet will be the basis for topics to be covered during educational programs offered by Cornell Cooperative Extension of Suffolk County, the Suffolk County Soil and Water Conservation District, and the Department.

Long-Term Monitoring and Measuring Success

To assess the effectiveness of these actions, groundwater samples will be routinely collected and submitted for laboratory analysis from a combination of existing groundwater monitoring locations along with an expanded network of groundwater monitoring wells. Through continued cooperation with Cornell Cooperative Extension of Suffolk County, additional groundwater monitoring wells will be installed downgradient of land uses where atrazine applications occur, where usage is expected to continue to occur, and where the selected best management practices will be employed. This will allow the Department to evaluate existing groundwater conditions and the overall efficacy of adopting mitigating measures. Based on monitoring results the Department will determine if additional measures are necessary or if modifications to the adopted practices are warranted.

Recently collected groundwater data shows that the overall frequency of atrazine detections has declined along with the maximum detected concentrations. With the promotion and increased implementation of the aforementioned best management practices, it is expected that overall atrazine groundwater concentrations and the frequency of detections will continue to decline. The groundwater monitoring program will be an integral part in assessing these short and long-term atrazine trends.

With an inherent time lag between implementation of the best management practices/pollution prevention measures and a corresponding effect on groundwater quality, progress will also be evaluated by tracking use of the priority BMPs and the educational efforts used to promote their use. An effort to track the implementation of the priority BMPs will be accomplished through the direct interaction with growers and possibly through the use of surveys. Distribution of factsheets, use of Strategy-derived website resources, and participation in educational events will be used to assess the effectiveness of outreach efforts.

6.0 References

1) Gaus, I. 2000, 'Effects of water extraction in a vulnerable phreatic aquifer: Consequences for groundwater contamination by pesticides, Sint-Jansteen area, The Netherlands', Hydrogeology Journal. 8, 218-229.

2) Schwab, A.P., Splichal, P.A., and Banks, M.K.: 2005, 'Persistence of atrazine and alachlor in ground water aquifer and soil', Water, Air, and Soil Pollution. 171, 203-235.

3) U.S. Environmental Protection Agency, Biological and Economic Analysis Division, Office of Pesticide Programs, 'Assessment of Potential Mitigation Measures for Atrazine'.

Attachment 1

Atrazine Usage Figures based on ArcGIS Geocoding of Pesticide Reporting Law Annual Data

Nassau County 2003

Nassau County 2006

Nassau County 2009

Nassau County 2012

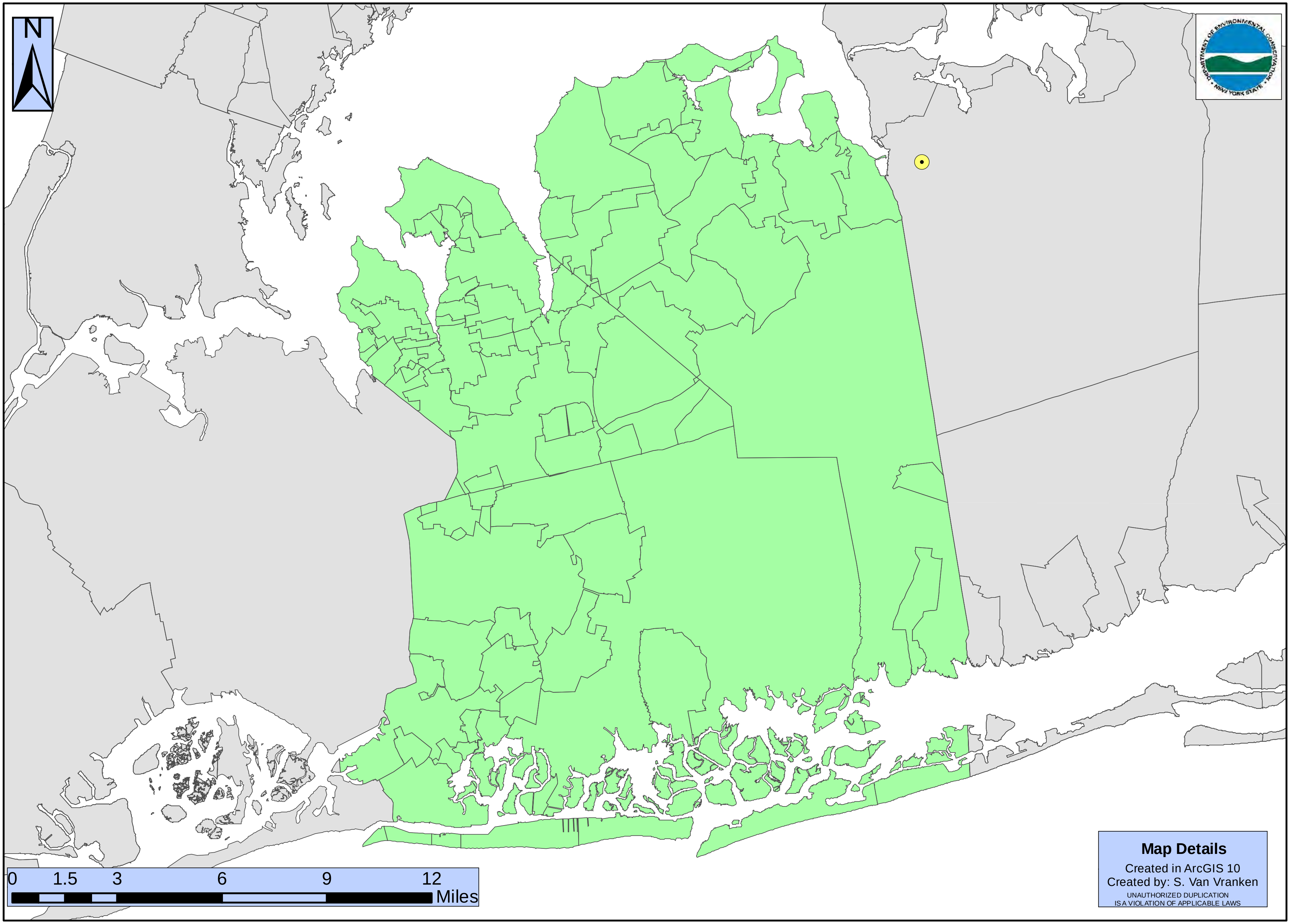
Suffolk County 2003

Suffolk County 2006

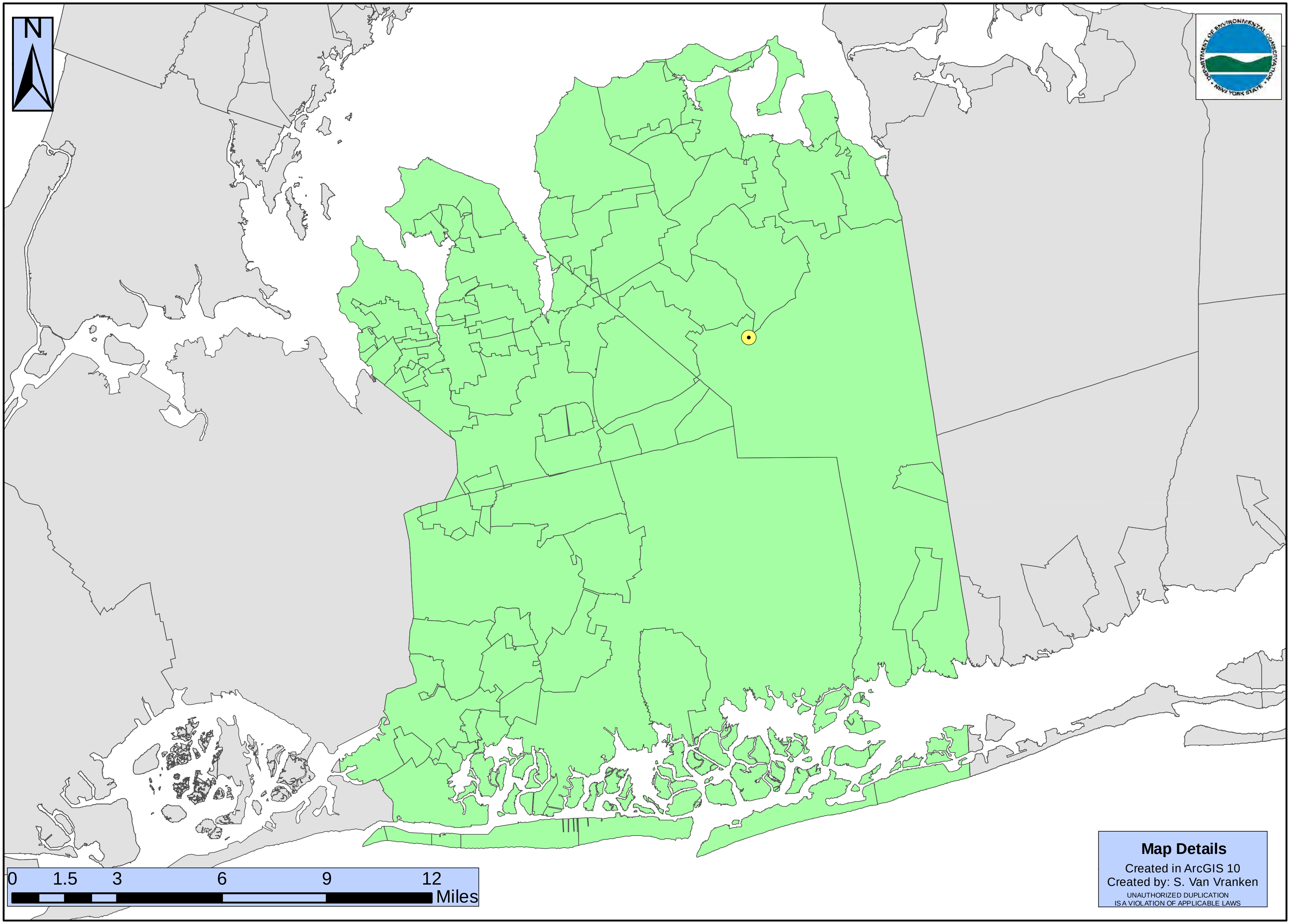
Suffolk County 2009

Suffolk County 2012

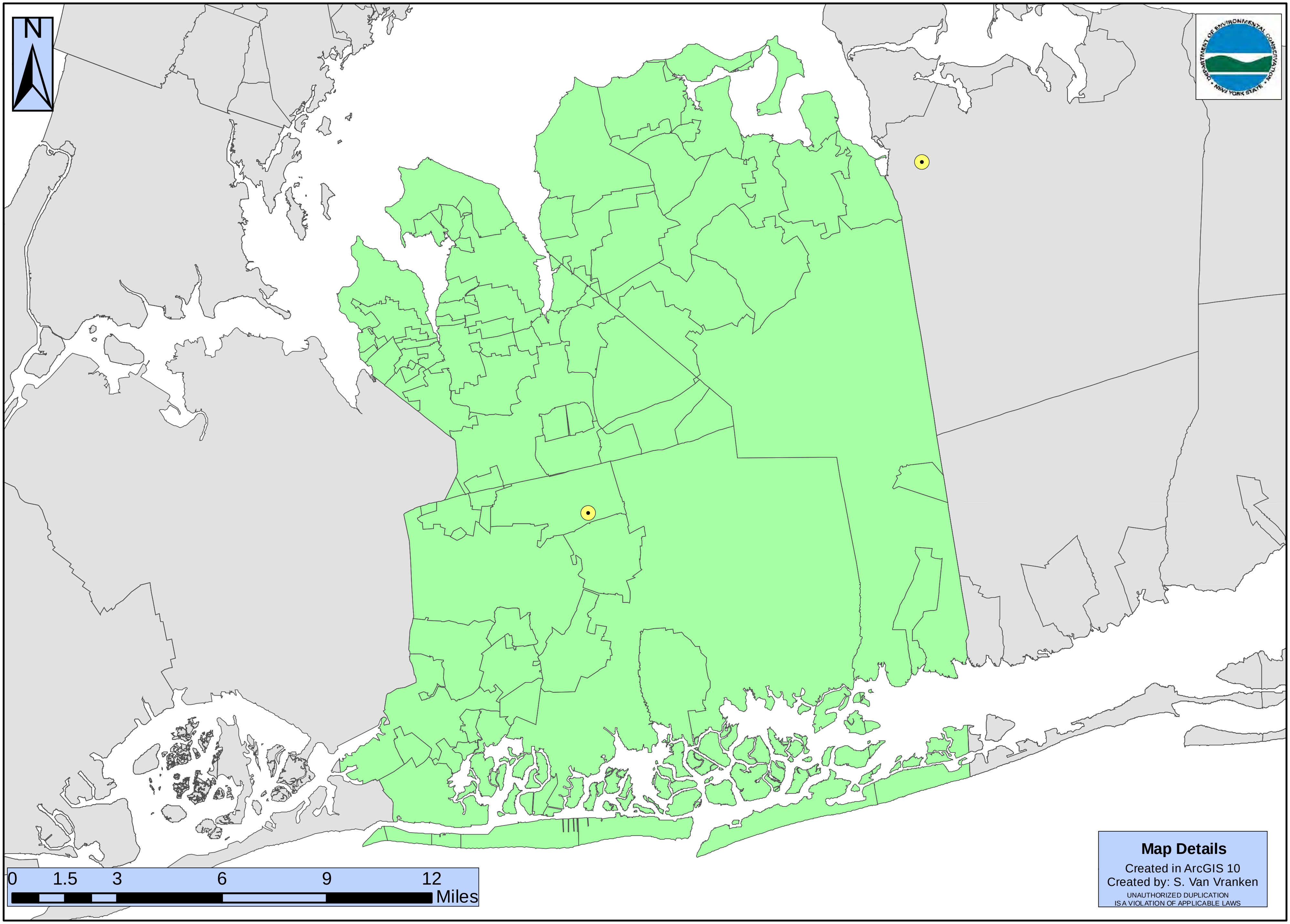
2003 NYSDEC Nassau County Atrazine Usage Locations



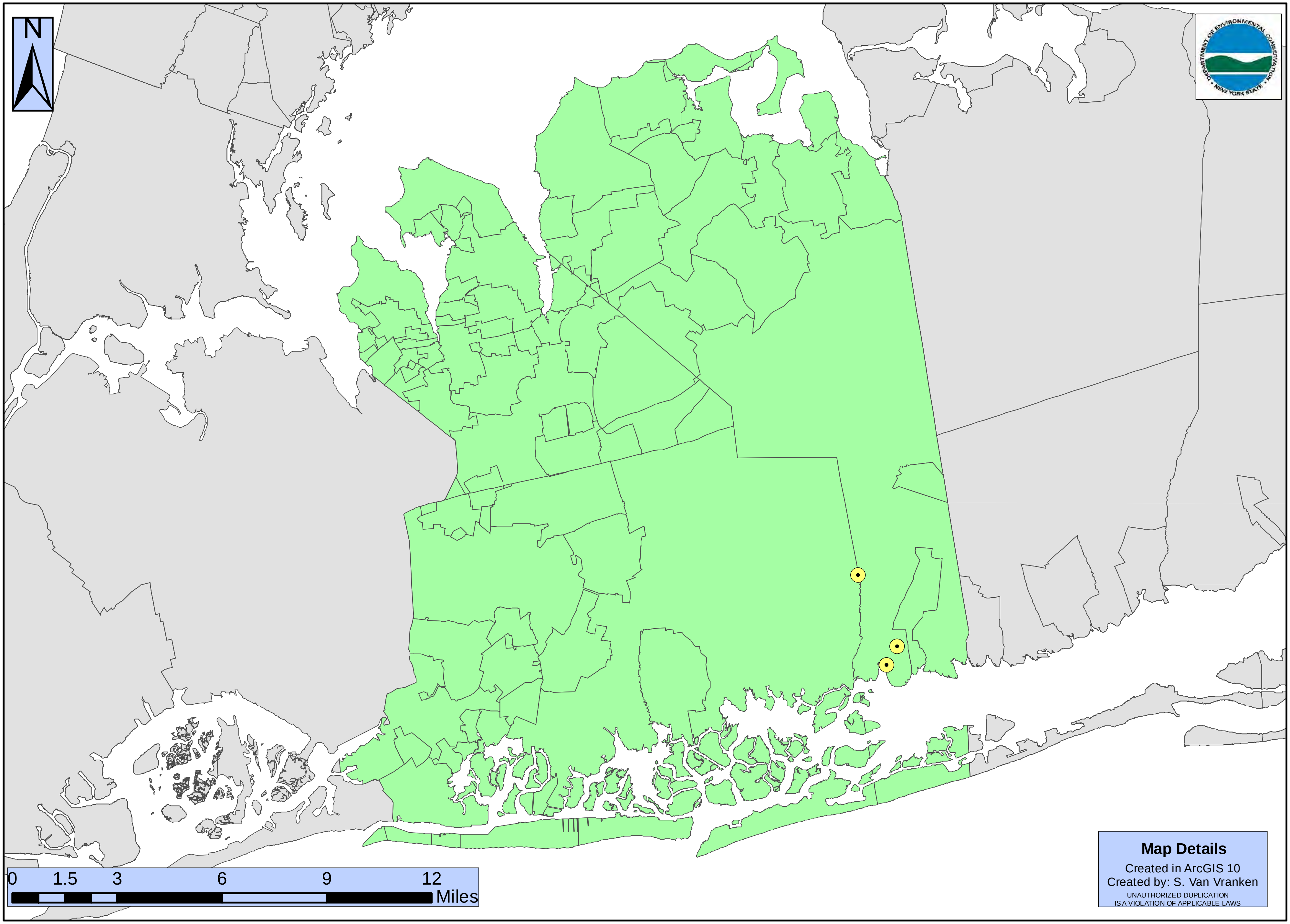
2006 NYSDEC Nassau County Atrazine Usage Locations



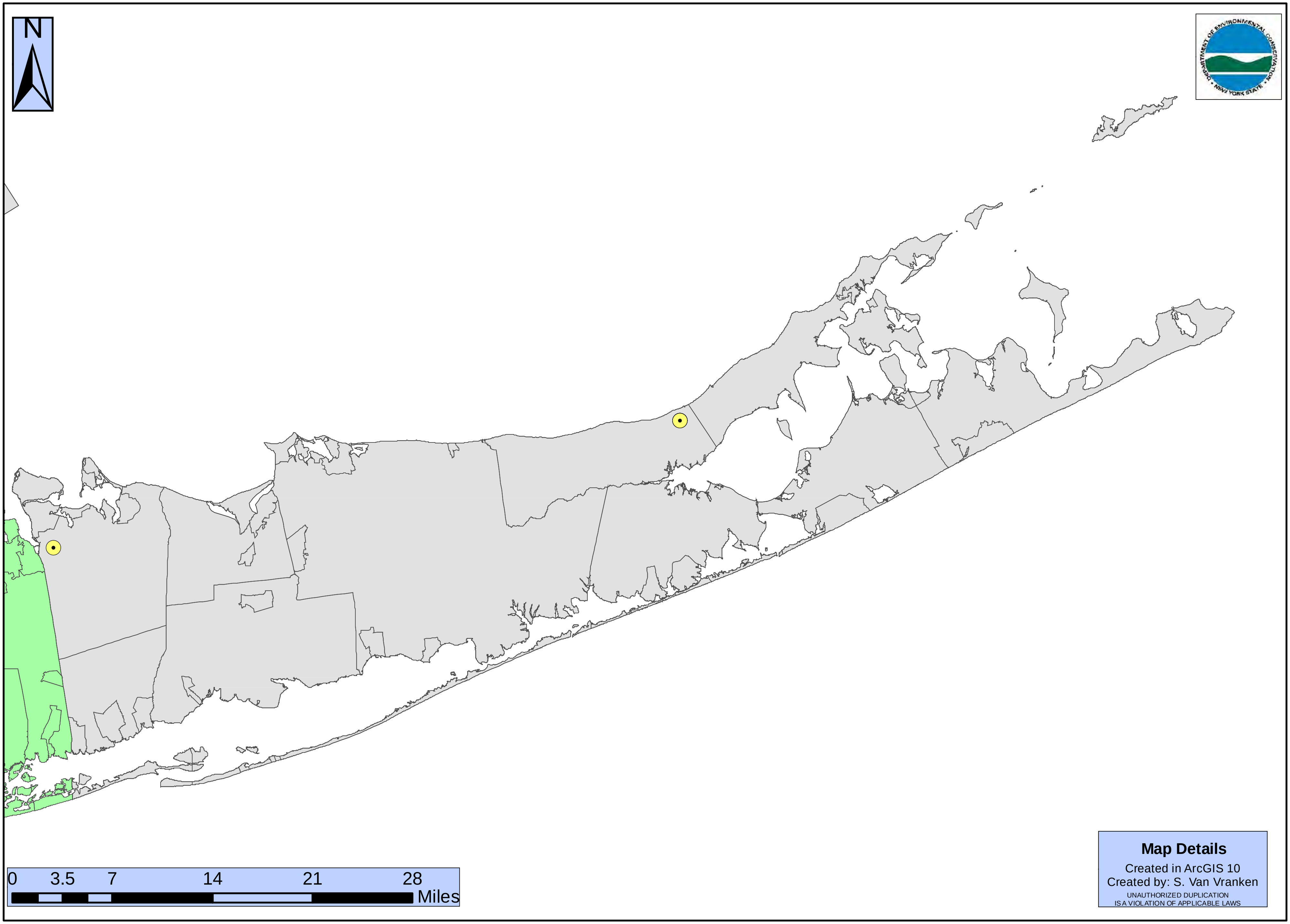
2009 NYSDEC Nassau County Atrazine Usage Locations



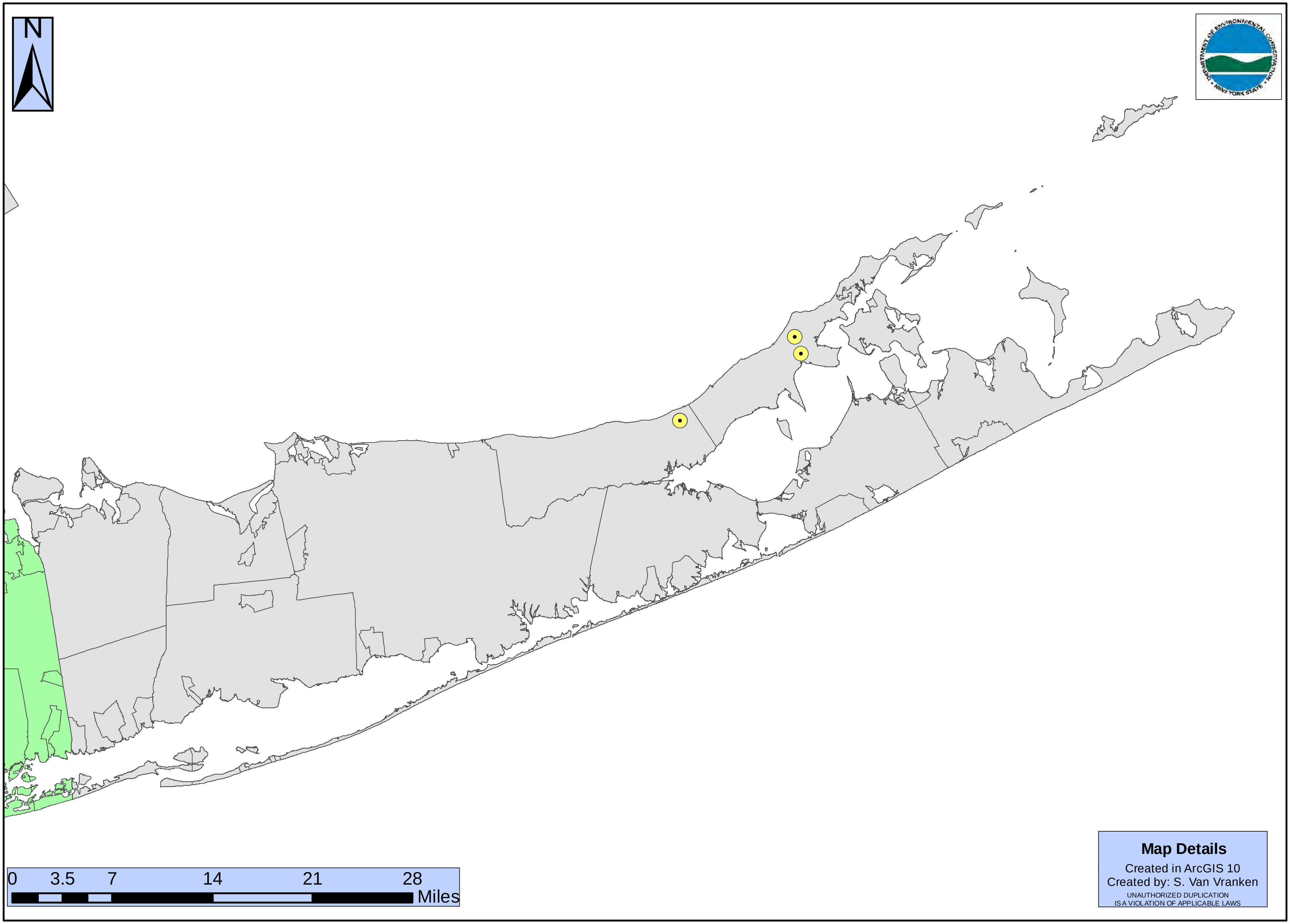
2012 NYSDEC Nassau County Atrazine Usage Locations



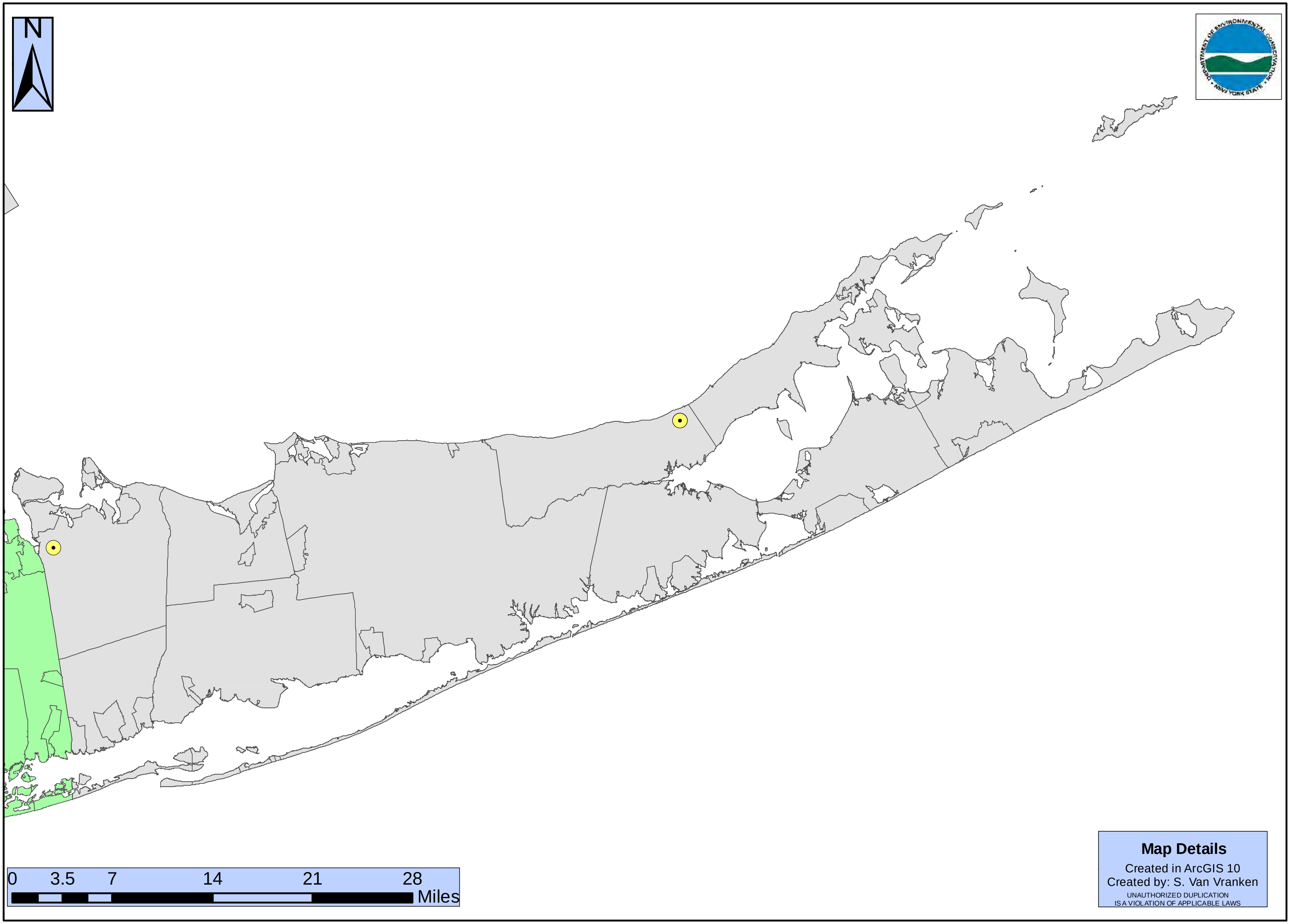
2003 NYSDEC Suffolk County Atrazine Usage Locations



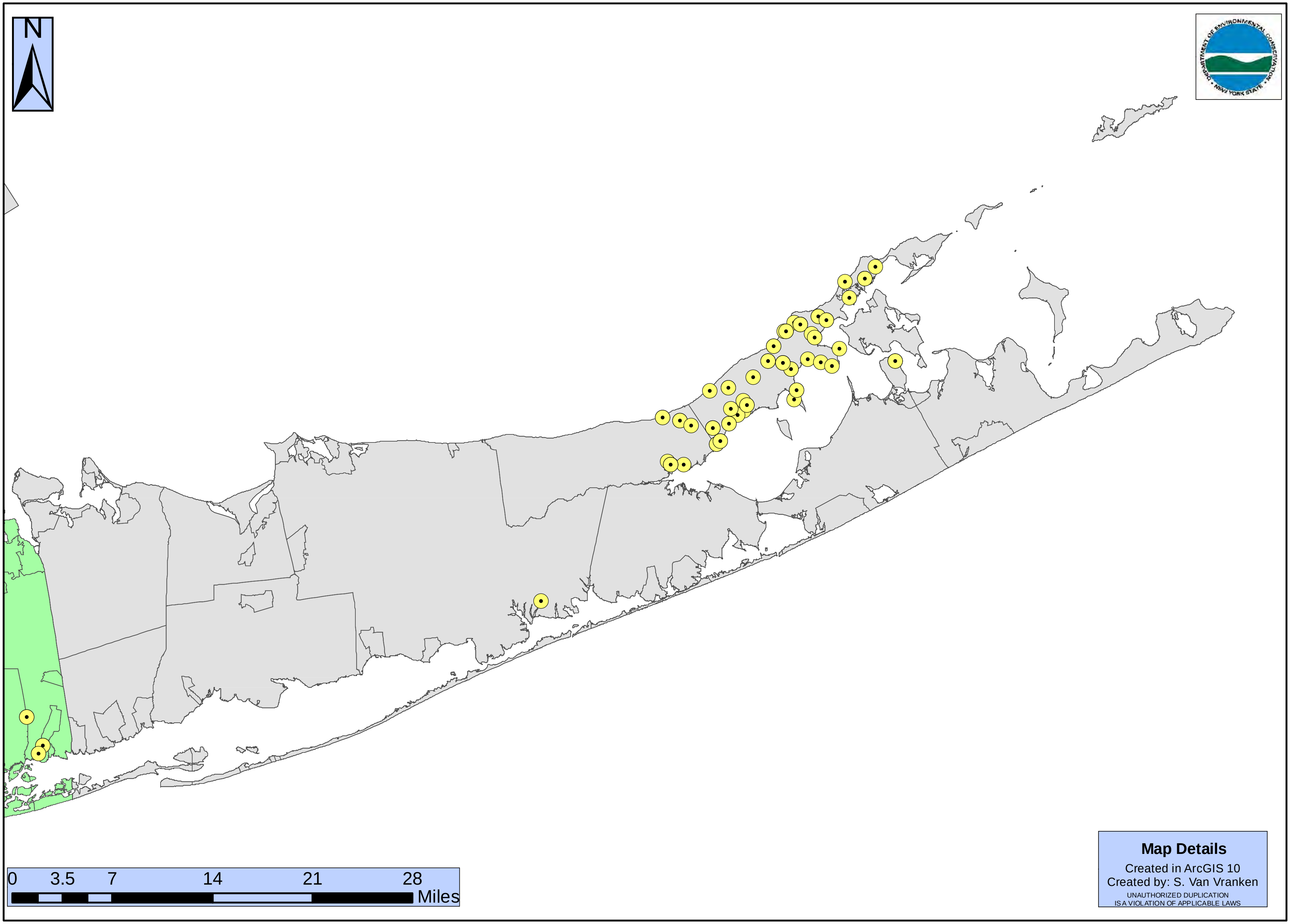
2006 NYSDEC Suffolk County Atrazine Usage Locations



2009 NYSDEC Suffolk County Atrazine Usage Locations



2012 NYSDEC Suffolk County Atrazine Usage Locations



Attachment 2

<u>Pesticide Use Profile for Atrazine on Long Island – A Working Document</u>

Prepared by Cornell Cooperative Extension of Suffolk County

Dated May 3, 2012

Pesticide Use Profile for Atrazine on Long Island:

A Working Document

This information is provided at the request of the New York State Department of Environmental Conservation (NYSDEC) to inform decisions concerning future registration and use of this product on Long Island, NY. As part of a complex and dynamic issue, this paper should be used to further a dialogue with NYSDEC and other scientists and is not intended for use by the general public where more detailed information would be necessary. As a working document, it is expected this paper will be modified as additional information becomes available.

1. General use/need

Atrazine (*6-chloro-N-ethyl-N- (1-methylethyl)-1, 3,5-triazine-2, 4-diamine*) is photosynthesis (Photosystem II) inhibitor in Herbicide Group 5 (HRAC). It impedes photosynthesis in susceptible plants by binding to specific sites within the plant's chloroplasts. Injury symptoms include chorosis of leaf tissue followed by necrosis of the tissue. Atrazine is taken up into the plant via the roots or foliage and moves in the xylem to plant leaves. As a result, injury symptoms will first appear on the older leaves, along the leaf margin. In foliar application, the herbicide is less mobile and does not move out of the leaf tissue.

Atrazine, the active ingredient in AAtrex 4L and AAtrex Nine-0 among others, is a selective pre- and early postemergence herbicide for use in corn that provides season long control or suppression of many annual grasses and broadleaf weeds. AAtrex use rates in corn range from 0.5 to 2.0 lb ai/A with a maximum rate not to exceed 2.5 lb ai/A per year.

Products containing atrazine are also registered for use in sorghum, conifers, roadsides, southern turfgrass and residential sites, certain fallow systems and certain other crops not generally grown on Long Island. Consequently, these applications are not and have not been practiced on Long Island.

2. Crops with no/limited alternative

In the past, and currently, vegetable growers have found that atrazine, even when applied at or below 1.0 lb./a (a.i.), has been very useful for control of difficult annual broadleaf weeds. Because of the paucity of herbicides labeled for other vegetable crops, growers have been able to take advantage of this good control by rotating to crops with few weed management options and thereby gaining a level of residual control for these crops. In particular, Galinsoga (Galinsoga parviflora) is a weed that is well controlled in corn by atrazine and can be reduced as a problem the following year in other vegetable crops.

3. Alternatives – pesticide and non-pesticide practices

Between-row cultivation is often practiced to incorporate side-dressed fertilizer and to break up soil crusting which prevents uniform water penetration. However, in recent years, s-metolachlor has been banned for use by L.I. growers. This preemergence herbicide was the only residual herbicide that provided control of yellow nutsedge (*Cyperus esculentus*). This weed spreads rapidly in fields that are cultivated because the underground tubers are carried along the row by cultivator shoes. Therefore, any more cultivation in cornfields than is already being done will only worsen this problem.

The table below includes herbicides registered for use in corn on Long Island including atrazine. No other product on this table is a pre- and postemergence selective herbicide for management of both broadleaf and grass weeds. Other pre- and postemergence products include Callisto, Sandea, Prowl, and Roundup Weathermax. Only Roundup Weathermax controls both broadleaf and grass weeds, although it is a non-selective herbicide. Most of the other products registered for use in corn on Long Island are postemergence herbicides.

4. Suggested label changes/modifications

Reduction in atrazine rate can be achieved while maintaining effective weed control by tank mixing with other herbicides. Atrazine application at a reduced rate of 0.5 lb ai/A is recommended when tank mixed with Callisto and Laudis. Princep 4L and Princep Caliber 90 can be tank mixed at rates ranging from 0.67 to 1.44 lb ai/A of atrazine.

Atrazine can also be tank mixed with Accent, Prowl 3.3EC and H20, Permit, Impact, Option, Basagran, and RoundUp products. However, labels of this latter group do not specifically state that a reduced atrazine rate is necessary or beneficial.

Currently, atrazine is generally applied only once on a corn crop during the early part of the growing season. However, restricting the number of applications to one spring application per year would insure that over-application would not occur in a given location.

Other possible avenues to overall reduction in atrazine use include a reduction in the number of crops labeled for L.I. use. Although corn is generally the only crop that has atrazine widely applied to it, a restriction against use on other labeled crops would also insure that atrazine use would remain limited in application scope.

5. <u>Possible outcomes of atrazine use restrictions:</u>

Currently atrazine is a vital component of commercial sweet corn production on Long island. Growers generally are applying atrazine at the rate of 1 lb./a (a.i.) or lower. This rate has been able to be reduced to as little as 0.25 lbs./a (a.i.) in recent years with the advent of other herbicides that can be combined with atrazine to achieve broad spectrum weed control. CCE of Suffolk County staff is currently (2012) conducting field studies to determine what consequences might result from restriction or elimination of atrazine for sweet corn production. These studies are evaluating both the crop safety and weed control efficacy of currently labeled herbicides for sweet corn. The concern for many is that the loss of atrazine will result in more expensive and less effective weed management strategies. Also, there is a concern that rotation restrictions of alternative products may limit or alter crop schedules. Growers need to adhere to Best Management Practices for farmland rotations in order to avoid buildup of disease and insect pest populations. Weed population dynamics are affected by several factors. However, it is universally true that reducing weed seed production also helps reduce weed problems in following crops and years. The loss of atrazine would possibly adversely affect not only corn production but other vegetable crops as well because of the benefits that growers derive from the season-long weed control that atrazine provides.

Prepared by Weed Science Program
Cornell Cooperative Extension of Suffolk Co.
May 3, 2012

Atrazine Alternatives for Use in Corn on Long Island

Trade Name	Active Ingredient	Form	EPA No.	Restricted	Pre/ Post	Weeds Controlled*	CORN Rate Range (per A)	CORN Rate Range (lb ai/A)	Label Rate Range (lb ai/A)	CORN Max Use Rate (lb ai/A/yr or season)	Rotational Crop Restrictions						Field Use EIQ	EIQ Total	Est Half-Life**	GWLeaching+ Consumer EIQ
											Bean	Cucumber	Pepper	Potato	Pumpkin	Tomato				
*AAtrex 4L	atrazine, 4 lb/gal	4L	100-497	yes	Pre/ Post	BL, supress	1-4 pt	0.5-2	0.5-10	2.5	following year or more (see label)						10.0-24.9	22.85	60 to 100+ days (soil)	7
*AAtrex Nine-0	atrazine, 0.9 lb/lb	90WDG	100-585	yes	Pre/ Post	BL, supress	0.56-2.2 lb	0.5-2	0.5-2	2.5	following year or more (see label)						11.5-28.9	22.85	60 to 100+ days (soil)	7
Accent	nicosulfuron, 0.75 lb/lb	75WDG	352-560	no	Post	GR	1/3-1 1/3 oz	0.02-0.08	0.02-0.08	0.08	10-18 mos. (see label)						0.6	19.52	26-63 days (soil)	8
Aim EC	carfentrazone, 2 lb/gal	2EC	279-3241	no	Post	BL	0.5-25.6 fl oz	0.008-0.4	0.008-0.031	0.031	Registered crops: see label, all others: 12 mos.						0.1	20.18 (speedzo	0.3-1.1 days (soil aerobic)	5
Basagran	bentazon, 4 lb/gal	4L	7969-45	no	Post	S	1-2 pt	0.5-1	0.5-1	2	see label						12.3-16.5	18.67	14-35 days (soil)	9
Callisto	mesotrione, 4 lb/gal	4L	100-1131	no	Pre/ Post	BL	Pre: 6-7.7 fl. oz, Post: 2.5-3 fl. oz.	Pre: 0.188-0.24, Post:0.078-	0.078-0.5	0.24	18 mos.	18 mos.	no	10 mos.	18 mos.	no	Preemergence: 2.7-3.5;	18.67	14 days (soil)	7
Impact	topramezone, 2.8 lb/gal	2.8L	5481-524	no	Post	BL,GR	0.5-0.75 fl. oz.	0.0109-0.0164	corn only	0.0164	no	no	no	9 mos.	no	no	0.4	27.17 (clio)	30-35 days (anaerobic	5.5
Laudis	tembotrione, 3.5 lb/gal	3.5L	264-860	no	Post	BL,GR	3 fl. oz	0.082	corn only	0.164	10-18 mos.	18 mos.	bioassay	10 mos.	18 mos.	10 mos.			11-133 days (soil)	
Option Corn	foramsulfuron, 0.35 lb/lb	35WDG	264-685	no	Post	BL,GR	1 1/2-1 3/4 oz	0.033-0.038	corn only	0.0765	60 days	60 days	60 days	60 days	60 days	60 days	0.5-0.6	15.33 (aramo)	5-176 days (soil)	7
Permit	halosulfuron, 0.75 lb/lb	75DF	81880-2	no	Post	BL,S	2/3-1 1/3 oz	0.031-0.062	0.031-0.062	0.125	9 mos.	9 mos.	10 mos.	9 mos.	9 mos.	8 mos. (transplants)	0.6	20.2	18-27 days (anaerobic)	6
Sandea	halosulfuron, 0.75 lb/lb	75DF	10163-254	no	Pre/ Post	BL,S	2/3-1 1/3 oz	0.031-0.062	0.023-0.07	0.125	2 mos.	2 mos.	4-10 mos.	9 mos.	9 mos.	2 mos.		20.2	18-27 days (anaerobic)	6
Princep	simazine, 4 lb/gal	4L	100-526	no	Pre	BL,GR	1.6-2.0 qt	1.6-2.0	1.0-4.0	2.5	following year or more (see label)							21.52	28-234 days (soil)	14.48
Princep Caliber 90	sinazine, 0.9 lb/lb	90WDG	100-603	no	Pre	BL,GR	1.77-2.2 lb	1.6-2.0	1.0-4.0	2.5	following year or more (see label)							21.52	28-234 days (soil)	14.48
Prowl 3.3EC	pendimethalin, 3.3 lb/gal	3.3EC	241-337	no	Pre/ Post	BL	1.8-4.8 pt (northern	0.743-1.98	0.495-4.0	1.98	12-20 mos. (see label)						17.5-46.7	30.17	90 days (soil)	5.5
Prowl H2O	pendimethalin, 3.8 lb/gal	3.8ACS	241-418	no	Pre/ Post	BL	2-4 pt (northern	0.95-1.9	0.48-5.99	1.9	12-20 mos. (see label)						23.4-46.7	30.17	90 days (soil)	5.5
Roundup Weathermax	glyphosate, 5.5 lb/gal	5.5EC	524-537	no	Pre/ Post	BL,GR	(non-RUP Ready): 16-32 fl. oz	0.69-1.38	0.13-7.29	7.29							weeds up to 6": 12.3-17.2; weeds 6" or taller: 17.2-	15.33	12-70 days in pond water	3
2,4-D (Weedar 64 used for comparison)	2,4-D, 3.8 lb/gal or 38.9 AE	3.8L	71368-1	yes	Post	BL	1/2-2 pt	0.24-0.95	0.24-1.90	2.85								15.33-20.67	1.5 to 16 days (soil)	2-8

*BL=broadleaves, GR=grasses,S=sedges

tested under a wide variety of conditions, est. only!

Attachment 3

Summary of Possible Practices to Improve Atrazine Usage and Reduce or Eliminate Groundwater Contamination

Summary of Possible Practices to Improve Atrazine Usage and Reduce or Eliminate Groundwater Contamination

Options to Reduce Atrazine Usage or Increase Effectiveness of Atrazine Applications on Sweet Corn		Advantages	Disadvantages
1) Application Modifications	Tank mix with other herbicides.	• Reduces amount of atrazine usage. • Broader control of weeds.	• Possible incompatibility of herbicides. • Possible increased use of herbicides that have a tendency to leach.
	Apply atrazine by banding over the row and either cultivating or using post-emergence herbicides between the rows.	• Limits the atrazine application area and usage reducing the volume of atrazine that could potentially travel to ground or surface water. • Reduced cost associated with less atrazine usage. • Combining banded application and cultivation reduces time and labor investments.	• Requires specialized equipment. • Cultivation practices may compromise soil health and increase loss of soil through runoff.
	Restrict the use of atrazine to one (1) spring application per year.	• Atrazine continues to be available when it is needed most. Growers rely heavily on atrazine for early corn and there are not many other options. • Reduces frequency of application and atrazine usage.	• May not provide season-long weed control.
	Lower atrazine application rate to ≤1 pound active ingredient/acre/year.	• Reduces amount of atrazine usage while still providing weed control at the reduced rate.	• May not provide season-long weed control. • May not provide carry over for following growing season crop rotation. • May promote disease development.
	Adjust application timing to maximize quantity staying on target and loss of atrazine through runoff.	• Reduces amount of atrazine usage. • Possibly reduces off-site movement of herbicide	
	Restrict the use of atrazine to corn crops.	• May eliminate use of atrazine for other uses thereby reducing frequency and amount of atrazine usage.	
	Promote guidance on buffer zones necessary for atrazine usage.	• Reduces potential for atrazine to readily enter the surface water and groundwater systems.	
	Rotate atrazine with other herbicides.	• Reduces amount of atrazine usage. • Reduces potential for resistant strains to develop.	
	Use of Precision application methods.	• Reduces amount of atrazine usage. • Reduced cost.	• May require use and purchase of additional or specialized equipment.
	Improve calibration of application equipment.	• Reduces amount of atrazine usage. • Reduced cost.	
2) Herbicides that are Possible Alternatives to Atrazine or that can be used in Rotation with Atrazine — Active Ingredient Name (Product Trade Name)	Nicosulfuron (Accent)	• Low application rate for sweet corn (0.08 lbs/acre/year). • Is a selective postemergent grass weed control.	• Leaching potential (GUS = 3.79) greater than atrazine (GUS = 3.3). • Does not provide preemergent control.
	Carfentrazone (Aim EC)	• Low application rate for sweet corn (0.031 lbs/acre/year). • Leaching potential (GUS = -0.32) lower than atrazine (GUS = 3.3). • Is a selective postemergent broadleaf weed control.	• Does not provide preemergent control.
	Bentazon (Basagran)	• Leaching potential (GUS = 2.3) lower than atrazine (GUS = 3.3). • Provides postemergent sedge and broadleaf weed control.	• High application rate for sweet corn (2 lbs/acre/year). • Does not provide preemergent control.
	Mesotrione (Callisto)	• Low application rate for sweet corn (0.24 lbs/acre/year). • Is a pre and postemergent herbicide for broadleaf weed control.	• Leaching potential (GUS = 3.43) greater than atrazine (GUS = 3.3). • Is not effective for the control of grass weeds.
	Topramezone (Impact)	• Low application rate for sweet corn (0.0164 lbs/acre/year). • Provides postemergent grass weed and broadleaf weed control.	• Leaching potential (GUS = 4.75) greater than atrazine (GUS = 3.3). • Does not provide preemergent control.
	Tembotrione (Laudis)	• Low application rate for sweet corn (0.164 lbs/acre/year). • Leaching potential (GUS = 2.53) lower than atrazine (GUS = 3.3). • Provides postemergent grass weed and broadleaf weed control.	• Does not provide preemergent control.
	Halosulfuron (Sandea, Permit)	• Low application rate for sweet corn (0.125 lbs/acre/year). • Is a pre and postemergent herbicide for sedge and broadleaf weed control.	• Leaching potential (GUS = 8.56) greater than atrazine (GUS = 3.3). • Is not effective for the control of grass weeds.
	Pendimethalin (Prowl)	• Leaching potential (GUS = -0.39) lower than atrazine (GUS = 3.3). • Is a pre and postemergent herbicide for annual and perennial grass weeds and broadleaf weed control.	• High application rate for sweet corn (1.9-1.98 lbs/acre/year).
	Glyphosate (Roundup Weathermax)	• Leaching potential (GUS = -0.69) lower than atrazine (GUS = 3.3). • Is generally a pre and postemergent herbicide for grass weeds and broadleaf weed control.	• High application rate for sweet corn (7.29 lbs/acre/year). • Herbicide can cause severe crop injury and yield loss if applied to crops that are not tolerant to glyphosate.
	2,4-D (Weedar 64)	• Leaching potential (GUS = 1.62) lower than atrazine (GUS = 3.3). • Is a selective postemergent broadleaf weed control.	• High application rate for sweet corn (2.85 lbs/acre/year). • Is not effective for the control of grass weeds. • Does not provide preemergent control.

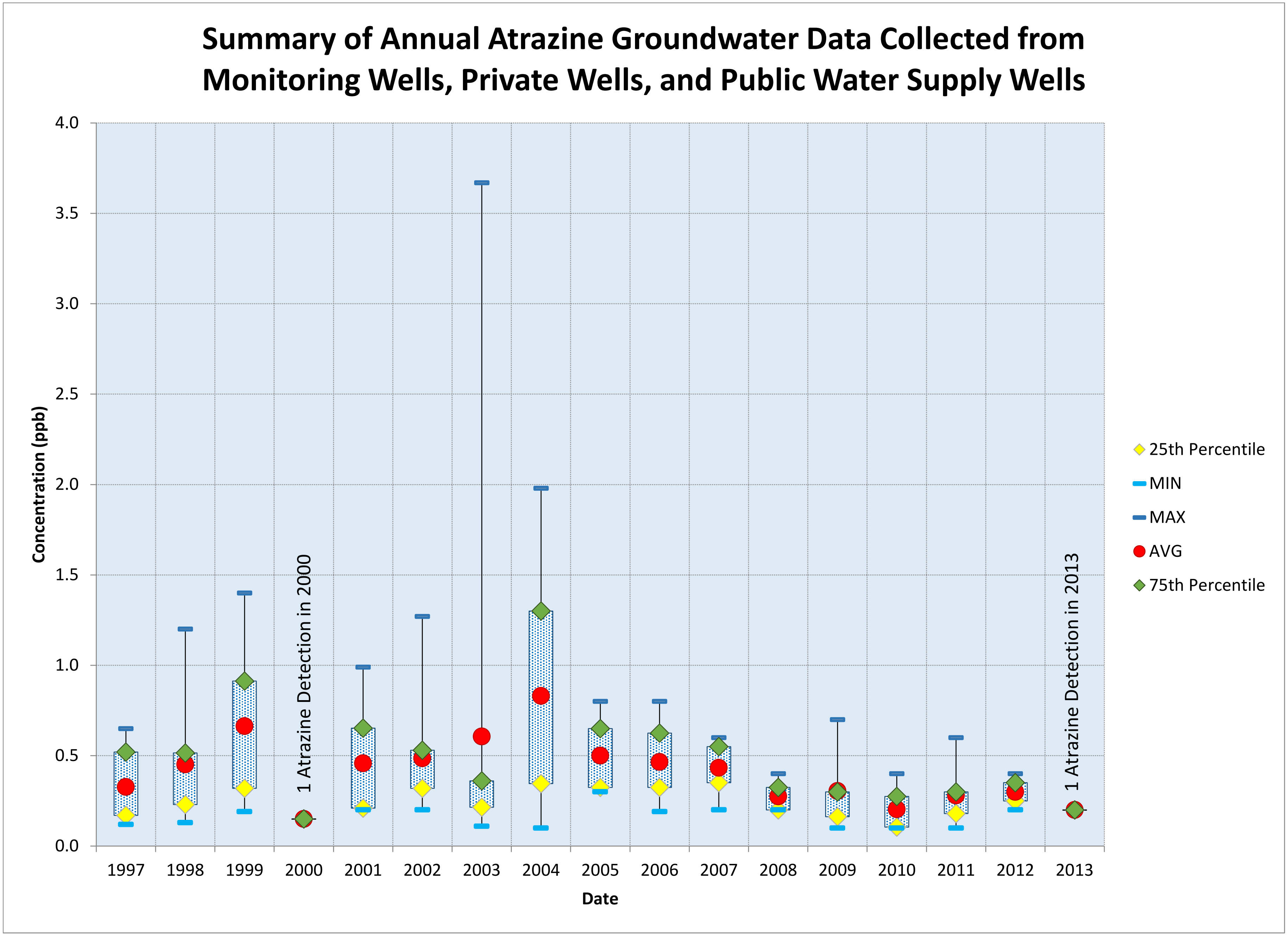
Summary of Possible Practices to Improve Atrazine Usage and Reduce or Eliminate Groundwater Contamination

Options to Reduce Atrazine Usage or Increase Effectiveness of Atrazine Applications on Sweet Corn		Advantages	Disadvantages
3) Possible Non-Pesticide Alternatives	Scout and map weeds to improve selection of the most appropriate weed control practices.	• May reduce amount of atrazine usage thereby reducing costs and potential for groundwater contamination.	
	Plant a cover crop after harvest to compete with weeds.	• Improvements in soil quality and health which buffers against atrazine leaching and off field transport. • Cover crops compete with weeds. • Reduces soil erosion.	• Added cost for establishing the cover crop. • Increased level of crop management required cover crops. • May need to control the cover crop so that it does not compete with the target crop.
	Use cultivation practices for the control or partial control of weeds.	• Reduces the amount of herbicide usage.	• Increases potential for off field transport through soil erosion and increases leaching potential by reducing organic matter. • Possible added cost associated with cultivation.
	Improve soil health and quality to promote immobilization of herbicides, increase water holding capacity, and reduce erosion while increasing crop health and yield. Can be achieved through a combination of cultivation practices and measures to increase soil organic matter.	• May reduce the amount of herbicide usage. • May reduce the overall leaching of pesticides from the soil column by increasing water holding capacity and cation exchange capacity. • May reduce off field transport by preventing soil erosion and encouraging water infiltration.	• Possible added cost associated with increasing the soil organic matter. • Is an alternate cropping system that may take time for growers to implement.
	Shorten corn crop rotations to disrupt weed cycles.	• May reduce the likelihood that weeds become fully established thereby reducing the amount of herbicide usage.	• Requires proper identification and knowledge of weed life cycles.
	Use of early, post-crop planting tine weeding.	• May significantly reduce annual broadleaf weeds and annual grasses.	• May reduce health of soil.
	Control the field through mowing after harvest to reduce weed seed production.	• May reduce the amount of herbicide usage.	• Added cost associated with equipment needed for mowing.
	Plant into a killed cover crop.	• May reduce the amount of herbicide usage. • Reduces soil and wind erosion and improves ability for soil to immobilize herbicides through improvements in soil health. • Provides weed control. • Possible increase in crop yield.	• Added cost associated with establishing the cover crop and then killing the crop prior to seeding. • May increase the use of an alternative herbicide to kill the cover crop. • Specialized crimping equipment and reduced tillage implements for controlling and planting into terminated cover crops.
	Interseed cover crops after last cultivation to reduce weed development.	• May reduce the amount of herbicide usage. • May reduce soil erosion and improve overall soil health. • Provides control of weeds.	• Added cost for establishing the cover crop. • Specialized equipment required for interseeding. • May need to control the cover crop so that it does not compete with the target crop.
	Flame and hot weeding in row crops.	• May reduce the need for herbicides to control weeds.	• Commonly requires specialized equipment. • Typically applied to control small weeds.
	Promote guidance on proper handling of containers and excess product to minimize potential for groundwater contamination.	• Reduces the potential for raw pesticide product to readily enter the subsurface.	• Possible increased operational costs.
	Improve irrigation practices/develop an irrigation water management plan.	• Reduces water usage and associated expenses. • Reduces potential for leaching to occur. • Reduces conditions that may lead to disease development.	• May require retrofitting irrigation system to ensure standardized application rates. • Requires monitoring of soil moisture, water holding capacity, crop condition, and weather conditions as well as application timing.

Attachment 4

Graphical Summary of Atrazine Groundwater Data

Summary of Annual Atrazine Groundwater Data Collected from Monitoring Wells, Private Wells, and Public Water Supply Wells



Summary of Annual Atrazine Groundwater Data Collected from Monitoring Wells, Private Wells, and Public Water Supply Wells
Concentration (ppb)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1 Atrazine Detection in 2000
1 Atrazine Detection in 2013
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Date
25th Percentile
MIN
MAX
AVG
75th Percentile