County of Nassau

DEPARTMENT OF PUBLIC WORKS

Nassau County Storm Water Management Program
Minimum Control Measure Six
Pollution Prevention/Good Housekeeping

Capital Project No. 82010

Task 3: Integrated Pest Management (IPM) Program

November 2007

CORNELL Cooperative Extension

NASSAU COUNTY
PHASE II STORM WATER MANAGEMENT PROGRAM

MINIMUM CONTROL MEASURE NO. 6
POLLUTION PREVENTION / GOOD HOUSEKEEPING

INTEGRATED PEST MANAGEMENT PROGRAM (IPM)

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NASSAU COUNTY
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1.1 Pesticide and Fertilizer Storage, Handling, and Transportation

1.1.1. Program Description

All Nassau County golf courses and many parks facilities use pesticides and fertilizers that are stored and distributed from a central location at Eisenhower Park. Nassau County DPRM recently constructed a new pesticide storage facility at Eisenhower Park that is locked and meets recommended pesticide storage standards. Fertilizers are stored properly on pallets in an organized warehouse. Although some outdated fertilizer products are stored in the warehouse, there is no risk of water damage, leakage, or storm water pollution from the storage of fertilizers, as long as spilled product is swept up immediately and used or properly discarded. Equipment calibration is a critical component of IPM that ensures the proper application rate of pesticide products. Nassau County DPRM contracts with a vendor to calibrate and inspect machinery hoses and nozzles multiple times per year.

Eisenhower Pesticide Handling Area

A storm water pollution risk exists at the Eisenhower Park golf course maintenance facility and at each 9-hole course with regard to the handling and mixing of pesticides and fertilizers, and the management of rinsate from sprayers. At this time there is no mixing pad designed for mixing pesticides and no collection device for spills or rinsate at any of the golf courses. There is also no backflow prevention system for adding water to

Cantiague Pesticide Handling Area

sprayer tanks at each of the 9-hole golf courses, although the mixing area at Eisenhower Park has a backflow prevention device. Pesticide applicators load and mix tanks of pesticides and liquid fertilizers on the ground near a building at Eisenhower Park. At each 9-hole course pesticides and fertilizers are also mixed and handled on grassy areas. The four 9-hole courses began using liquid products this year and had previously only used granular formulations. It is therefore critical for each of the 9-hole courses to install backflow prevention devices to their water systems. The addition of even a small cement pad that will absorb spills, or the purchase of portable mixing and spill containment pads will reduce the risk of ground and soil contamination and the possibility of storm water runoff pollution. Guidelines are available for choosing or constructing adequate mixing and handling facilities for pesticides and fertilizers. See Appendix 3, for Pesticide Storage and Mixing/Loading Guidelines for Pesticide Applicators, published by the Massachusetts Department of Agricultural Resources. Transportation of pesticides and fertilizers must be done properly, safely, and according to State and Federal laws.

Sprayer Maintenance Area

1.1.2. <u>Recommendations for Storage, Handling, and Transportation of Materials:</u>

- Store, handle and transport materials in compliance with Nassau County Department of Health Article II.
- Construct or purchase pesticide load/mix/wash down pads at each golf course facility.
- Install backflow prevention devices at each 9-hole golf course facility.
- When transporting chemicals, keep the Federal labels and the Material Safety Data Sheets with the containers at all times in case of an emergency.
- In case of an accidental liquid chemical spill, carry “speedy-dry” or another absorptive material, and a broom/dustpan or shovel, and heavy duty plastic bags to clean up spills and avoid runoff of hazardous substances into storm drains.

- Mark vehicles with Department of Transportation (DOT) placards identifying them as transportation for any chemical pesticides that qualify as "hazardous substances" by DOT. See Title 49 CFR for details about which products qualify as "hazardous materials".

- Following proper transportation procedures, such as never carrying pesticides inside a vehicle, on the seat, or near passengers.

- Pesticides and fertilizers should always be transported inside spill-resistant containers or boxes in the trunk or the bed of a vehicle. Therefore the DPRM should invest in containers for vehicles that transport pesticides and fertilizers.

1.2 Nassau County Parks

Nassau County manages 83 parks facilities including preserves, museums, historical sites and athletic facilities that total over 6,000 acres of land. Pest management and the use of pesticides are limited by several factors. The County has adopted an unofficial policy of using low-risk pest management strategies, and integrated pest management (IPM), issued by former County Executive Thomas Gulotta. Workers who use pesticides, who were contacted for this project, are basically aware of IPM and are skilled in pest management. They also seem to be motivated and genuinely concerned about using best management practices. Pesticides are used judiciously and only when needed, partly because they are purchased in limited quantities. In addition to environmental and health concerns about pesticides, limited budgets restrict the use of chemical products, which can be expensive. Fertilizers are used on all golf courses and in most facilities with athletic fields, but are used sparingly to prevent excessive plant growth, which requires added mowing. Pesticides for the purpose of maintaining tree health are not in use at this time in Nassau County facilities.

Although turfgrass maintenance has come a long way, the successful management of a golf course or a high-quality athletic field will still require at least some pesticide use. Managing tournament-quality golf courses, such as the Red and White Courses at Eisenhower Park requires both reactive and preventative pesticide use, particularly for disease control. Integrated pest management typically relies on inspection and monitoring for pest evidence, and only when evidence is found are pesticides applied. However, even in an IPM program disease management is best done preventatively when conditions favor disease development because diseases can

appear and create visible damage within hours. Preventative applications of fungicides require smaller quantities of active ingredients than curative applications. In addition, some insect pests are erratic in their distribution and not detected until damage is seen. More thorough monitoring will be required to accurately time insecticide applications, consistent with an IPM program.

The overall success of an IPM program for athletic field or golf course management is dependent on the availability of information about pests in the managed area. Seasonal heat accumulation, rainfall or drought, daylength, microclimates, surrounding vegetation, soil conditions, and many other factors influence pest life cycles. Each site is different and although scientific literature can predict a window of time when pest activity will begin or peak, only site inspections can narrow the window down to a matter of hours or days. For many years IPM scouts have been employed to help growers and even private golf courses anticipate pest problems and target treatments to precise times when pests are most vulnerable. Inspection and monitoring are the backbone of IPM. Nassau County DPRM would greatly benefit from the addition or designation of a single full-time employee devoted to inspecting and monitoring golf course and athletic field pest problems. This employee would map the athletic fields and golf course fairways, and build a database of pest problem areas. The IPM scout would conduct regular monitoring for insect, disease, and weed problems in all facilities that need attention. Using established thresholds that prompt treatments, the scout would help managers coordinate the precise timing of pesticide applications and keep records of pest activity and management tools utilized. In addition, the IPM scout will work closely with Cornell Cooperative Extension's diagnostic laboratory to properly diagnose unusual pest problems.

1.2.1 Athletic Fields

1.2.1.1 - Program Description

Athletic fields in Nassau County abound. At least a dozen parks have general use turfgrass fields and seventeen parks have one or more baseball fields. Management of all, except the Mitchell Athletic Complex, is minimal. Fertilizers are applied at least once a year to all county athletic fields, and aeration is done to all general use fields. At least 15 active and passive

use parks are located along water ways. Most have storm drains in nearby parking lots and paved areas. Some have storm drains in turfgrass or other planted areas as well.

Mitchell Athletic Complex is a 49-acre sports facility that hosts several professional sports teams and amateur and professional sporting events. Additionally, the facility has 5 softball/baseball fields and several turfgrass fields for football and other uses. This facility is maintained at a higher level than other parks facilities, and includes the use of irrigation, pesticides, and fertilizers. Fertilizers include a 22-3-22 granular and slow-release Nutralene. These are both good choices, because the first minimizes phosphorus use, as recommended, and the slow-release nitrogen in Nutralene prevents N runoff. Care must be taken to prevent spills and application on hardscapes. Insects such as white grubs are sometimes problematic at Mitchell, and result in insecticide treatments. Timing is a key factor in successful control of grubs and other insect pests to minimize insecticide use and maximize benefits. Disease control should not be used unless there is a specific disease problem confirmed.

1.2.1.2 - Recommendations for an Athletic Field IPM Program

- Training of grounds managers in basic landscaping techniques as well as best management practices needs to be prioritized in the Nassau County DPRM.
- Hire or designate an experienced and/or knowledgeable person as an IPM scout.
- Conduct a soil pH and nutrient analysis at least once every two years. Correct the soil pH if necessary and apply only the nutrients that are lacking.
- Use a low or zero-phosphorus fertilizer, particularly in areas close to natural bodies of water. Use slow-release nitrogen fertilizers to minimize runoff.
- Fields should be core-aerated at least once, if not twice, per year to improve soil conditions and reduce compaction that enhances runoff.
- After aeration, a ¼" application of organic matter will improve soil quality over time.
- High-quality, high-maintenance athletic fields with irrigation should be overseeded with a blend of Kentucky bluegrass, unless Canada geese are a very significant pest problem.

- Low-maintenance areas with no irrigation should be overseeded with drought-resistant tall fescue, but this must be done yearly to prevent clumping of turfgrass plants.

- Fields that have irrigation or adequate rainfall, but are consistently overused, as evidenced by bare spots, should be aerated frequently and aggressively overseeded with improved varieties of perennial ryegrass.

- Only slow-release nitrogen fertilizers, such as Nutralene, should be used on athletic fields to prevent sudden top growth, which can lead to weakened roots.

- Fields should be mowed to a height of no less than 2.5 inches. Taller grass can tolerate considerably more stress and recent research showed that taller grass does not impact athlete running speeds.

- Use only spot treatments of herbicides and insecticides when thresholds deem necessary.

- Use fungicides only in the highest maintenance fields, and only when absolutely necessary and when a specific disease is confirmed by the IPM scout or CCE.

For more information on high-maintenance athletic field management, see Appendix 4.

1.2.2 Parking Lot, Playground, and Curb Vegetation Management

1.2.2.1 - Program Description

In Nassau County, the most widespread vegetation management occurs in the parking areas of county parks, playgrounds, and other facilities. Glyphosate (formulated as Round-Up™, Monsanto Corp, and other generic products) is mainly used for this purpose and is the most effective herbicide for use in non-selective vegetation management. Glyphosate is a broad-spectrum, non-selective herbicide with systemic activity in plants. Translocation within a plant results in the death of the roots even when only leaves are sprayed. This makes glyphosate the most common and effective herbicide for use on hardscapes, such as pavement. Glyphosate is an acid and poses a risk of eye damage to the applicator. Proper eye protection should be worn. Otherwise, this compound has low toxicity, no reproductive, teratogenic or mutagenic properties, and poses few risks to the environment or wildlife. It does not leach and has low potential for runoff, except in sediments to which it binds (Anon. 1993).

The pesticide applicators in Nassau County DPRM also use least-toxic herbicides for sensitive locations, such as playgrounds and parks where children spend time. Several acetic acid based non-selective products are available commercially and one product, BurnOut™ (acetic acid 25%, St. Gabriel Labs) is routinely used by DPRM. Acetic acid and similar products work by burning down the tops of plants, but do not kill the roots. Products such as this pose no threat to storm water runoff because they are composed of naturally occurring substances that readily break down in soil and water. Applicators working with acid-based herbicides must use eye protection, due to the corrosive nature of strong acids.

1.2.2.2 - Recommendations for Vegetation Management in Hardscapes

- Only apply herbicides to hardscapes when wind velocity is very low (under 5 miles/hour) to avoid drift of product off site and danger to applicators from airborne mist of these products.
- Only apply herbicides to hardscapes when no precipitation is in the forecast for at least 24 hours.
- Applicators should wear proper eye protection when using glyphosate or acetic acid based herbicides.

1.2.2.3 - Special Case: Manhasset Valley Park and Whitney Pond Park.

Manhasset Valley Park and the adjoining Whitney Pond Park are part of a significant waterway leading to Manhasset Bay. These county parks comprise a large portion of the total acreage of the Manhasset Bay watershed. The Manhasset Bay Protection Committee includes representation from Nassau County, North Hempstead, and 11 other coastal communities in the watershed. These municipalities have entered into an agreement for water quality improvement and planning. Although listed as a third level priority (see www.manhassetbayprotectioncommittee.org for

Manhasset Valley Park Waterway

priorities) the Manhasset Valley/Whitney Pond waterway is negatively affected by pathogens, nutrients, sediment, and litter. Nassau County DPRM does not use fertilizers or pesticides in this park, with the exception of occasional herbicide (glyphosate) treatments in the parking lots. However the County should follow up with recommendations to develop ways to improve water quality in Whitney Pond and reduce sediments, pollutants, and nutrients entering the stream. Several areas around the stream have bare soil slopes that lead to the waterway. Allowing or facilitating the establishment of plants, even weedy species, will stabilize the banks, absorb some nutrients, reduce sedimentation, and capture litter that may blow into the waterway. Tall vegetation also discourages Canada geese feeding along the edge of waterways, by eliminating the "escape route" that geese have into the water. Geese prefer to feed on grassy areas with direct access to water. A vegetation barrier discourages the use of both grassy areas and waterways. Geese and other waterfowl droppings are an important source of bacteria and nutrients that negatively impact water quality.

Polluted Water at Manhasset Valley

Additional Recommendations for Parks Facilities:

- Re-seeding bare soils with turfgrass can stabilize soils and prevent erosion. It is recommended that areas to be reseeded be done so with a drought-resistant tall fescue-type grass, rather than perennial ryegrass or Kentucky bluegrass. Perennial ryegrass is less drought-resistant and Canada geese show a distinct preference for tender Kentucky bluegrass plants. Tall fescue is coarse and drought resistant and will survive in places with no irrigation.

- Any pesticide (herbicide, insecticide or fungicide) use should only be done once a professional diagnosis is made to confirm the target pest. Often disease damage in turfgrass is confused with damage from white grubs or environmental conditions.

1.3 Nassau County Golf Courses

1.3.1 Eisenhower Park Golf Course, East Meadow, NY

Nassau County maintains three high-quality 18-hole golf courses at Eisenhower Park. The Red Course has a long history of hosting PGA Championship tournaments and is the most highly maintained of the three courses at Eisenhower Park. The White Course is also very high quality, and the Blue Course is less highly maintained (there are rarely emergency pesticide uses for imminent pest problems), but high quality.

A high quality championship golf course is one that typically receives daily mowing, irrigation and hand watering of the putting greens, and preventative pest management in the form of herbicides, fungicides, and insecticides. A variety of insect and disease organisms can become problematic at the Eisenhower Golf Courses. Insect problems include cutworms, white grubs, and ground-nesting bees and wasps. Diseases such as anthracnose, gray leaf spot, brown patch, and summer patch can be found in many places. Managers rely on the best management practices that they know to control these minor pests. However dollar spot disease and annual bluegrass weevils are the two most difficult problems for managers at Eisenhower.

1.3.1.1 - Dollar Spot Disease

All three courses at Eisenhower are under significant pressure from dollar spot, a disease caused by the fungus *Sclerotinia homeocarpa*. The fungus produces resting bodies, called stomata, which survive long periods of unfavorable conditions in soil and thatch.

Dollar Spot lesions
D. Shetlar OSU

Dollar spot emerges when conditions are good, including temperatures between 60 and

85˚F and continual leaf wetness, which is a key factor in disease development. Warm, humid weather leading to heavy dew enhances the development of this disease. If the turfgrass is under drought stress, but humidity is high, dollar spot can infect and kill most of a green overnight. Dollar coin shaped lesions form quickly and will coalesce, resulting in large dead spots on putting greens. Preventative applications of fungicides are used when conditions favor disease development rather than when disease becomes evident. Preventative control is preferred over curative fungicide applications because the curative application rate is much higher. Nassau County golf courses overseed putting greens with an improved variety of bentgrass, L-93, which shows some dollar spot resistance.

Experts at Penn State University recommend that on golf course greens quick-release nitrogen fertilizers can be applied frequently at very light rates instead of using slow-release fertilizers in areas that typically develop dollar spot. This technique should be explored on multiple greens in a lower maintenance course. Other recommendations include:

- Avoid the excessive use of nitrogen fertilizers.
- Avoid periods of prolonged leaf wetness. Never water turfgrass in the evening. Use mowing or drag a hose over the turfgrass as early in the morning as possible to shake off the dew.
- Continue to overseed with the latest disease-resistant creeping bentgrass cultivars.

1.3.1.2 - Annual Bluegrass Weevil

Many putting greens and some fairways at the three 18-hole golf courses at Eisenhower Park have been afflicted by annual bluegrass weevil (ABW), *Listronotus* (formerly *Hyperodes*) *anthracinus*, for years. This insect spends the winter as an adult, and crawls from overwintering spots into turfgrass in the spring to lay eggs on annual bluegrass, a common grass of public golf course putting

ABW Damage on Putting Green

greens and tees. The larvae develop in the stems of grass plants and often kill the plant before moving to the next plant. ABW damage can be devastating on greens and tees, but is not very damaging on fairways, due to the taller mowing heights. Generally, ABW damage will be localized in certain spots for two or three years, then it will change. Damage occurs in various spots depending on the time of year. At Eisenhower Park, and particularly on the Red Course, managers do whatever is necessary to prevent ABW damage. However, even with the most potent insecticides, ABW causes considerable damage by mid-summer. Although golf course managers are attempting to use good management practices to prevent damage from ABW, they are often forced to resort to the use of the organophosphate, trichlorfon (Dylox 80™, Bayer Corporation), for immediate control on tournament courses where damage is intolerable. Some damage is usually unavoidable. Good preventative management practices that are already in place include:

- Targeting suspected overwintering sites, such as nearby leaf and pine litter, with pyrethroid insecticides;
- Using early season, mid-March insecticide treatments to target adults moving from overwintering to feeding sites; and
- Use of imidacloprid (Merit 0.5G™, Bayer Corporation) to target the larvae of ABW.

Golf course managers need a way to successfully manage ABW while not overusing the more hazardous chemical insecticides. Each staff member who works on pest management at the golf courses should be as up to date as possible with current research and trends in ABW management. This includes attending seminars and maintaining a working relationship with local Cornell Cooperative Extension employees who work with golf course pest management. A customized IPM plan was developed by two Cornell University entomologists based on the conditions at Eisenhower Park. Golf course managers should adopt the recommendations where possible and keep records of the resulting ABW damage. See Appendix 5 for a customized IPM plan for annual bluegrass weevil.

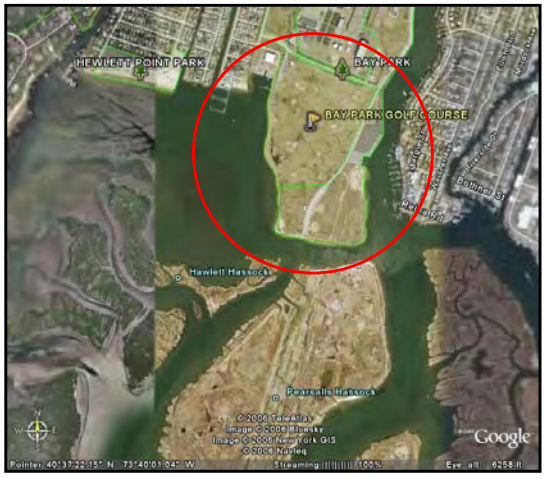
Recommendations

- Follow recommended custom IPM plan for ABW management.
- Hire or designate a knowledgeable and well-trained employee as an IPM scout who is devoted to inspecting and monitoring for pest problems and keeping records of pest activity.
- **Use Scimitar™ (lambda-cyhalothrin, Syngenta Corp.), rather than Tempo 20 WSP™ (cyfluthrin, Bayer Corp.), if possible, for the first mid-March application. Scimitar has about 97% effectiveness, whereas Tempo shows about 87%.
- We encourage Nassau County Golf Courses to try the use of Conserve SC ™ (spinosad™, Dow AgroSciences, EPA No. 62719-291) for ABW as well as cutworms. Conserve SC is a minimum risk pesticide and effective on ABW and cutworms. It can be tank mixed with other insecticides and may help reduce the risk of insecticide resistance development.
- Pyrethroids are highly toxic to aquatic and marine organisms. By Federal label requirements, Scimitar cannot be applied to an area within 100 feet of a coastal marsh or streams that drain into coastal marshes. This limit includes each coastal golf course with storm drains (North Woodmere and Bay Park). Scimitar should not be applied within 100 feet of storm drains.
- Federal law prohibits the application of Tempo 20 WSP™ near bodies of water, and this product should not be applied to areas close to storm drains that lead directly into bodies of water.
- Seek to replace Dylox 80™ (trichlorfon) and Echo™ (chlorothalonil) with lower risk products. Work with university researchers to identify ways to improve pest management so emergency applications of these products are not necessary.
- Pay very close attention to ambient rainfall and adjust irrigation schedules to avoid overwatering.

1.3.2 Bay Park Golf Course, East Rockaway, NY

Bay Park Golf Course is located on a peninsula along Hewlett Bay and is surrounded by tidal wetlands and estuaries. This course is managed at an acceptable but low level. Pesticides are only used on the putting greens; however fertilizers are used once or twice a year on fairways, putting greens, and tees. The most significant pest problems are dollar spot disease and Canada geese. This course was built on fill and several storm drains leading directly to adjacent

surface waters (shoreline) can be found throughout the course. Storm water runoff through storm drains located throughout Bay Park golf course likely contributes significant amounts of nutrients, sediments, and contaminants to the local waterways. These storm drains collect excess rain and flood waters from golf course fairways and roughs and channel them directly to open water. Pesticides are used on putting greens and fertilizers are used on greens, tees and fairways. Chlorothalonil and pyrethroids used in pest management are significantly toxic to marine organisms in waters surrounding Bay Park. Efforts should be made to minimize their use. Scouting should be used for insect pests because it can help target areas for spot applications, which is a common IPM tactic to reduce pesticide use. Resources should be invested into Bay Park to utilize the less toxic fungicides, commonly reserved for Eisenhower Park. Bay Park may be low maintenance but it is surrounded by a high risk ecosystem.



Bay Park Golf Course (Google Earth)

The shoreline of Bay Park golf course overlooks Hewlett Bay and tidal waterways and is a significant habitat for birds and marine organisms. This ecosystem is delicate and should be preserved through a program of restoration that involves planting native wetland grasses, *Spartina alterniflora* and *S. patens*, both important native grasses for Long Island estuaries. A

Bay Park Waterfront

vegetated buffer of grasses will provide a biologically active habitat for birds, fish and invertebrates, and shoreline stabilization that protects the boating channel from sedimentation. The buffer will collect sediments and absorb nutrients from golf course operations and help prevent litter from being blown directly into the waterway. A vegetated buffer will also protect the golf course from flooding and storm damage, particularly in harsh winter weather. Along the west shore of Bay Park, an 8-foot slope has developed. The shoreline is divided into two zones, tidal wetland and upland. Allowing plant growth to occur on the upland side of this zone, as the golf course manager has begun to do, can further protect the shoreline and golf course, and reduce mowing and maintenance activities. Native species should be planted or encouraged along the upland part of this shoreline to further stabilize the soil. Again, tall vegetation can create a barrier between Canada geese feeding areas and the safety of the water that discourages geese from browsing on the turfgrass of the golf course. Overseeding fairways and rough areas with turfgrasses other than Kentucky bluegrass may also deter Canada geese. See www.usga.org/turf/articles/management/bunkers/natural_areas.html for an article on establishing natural areas on a golf course.

If resources do not allow for shoreline restoration, planting these areas could be accomplished through a volunteer program involving Master Gardeners of Nassau County (a CCE program), environmental conservation groups, or student volunteers. *Spartina* grasses are common along Nassau County waterways and can be harvested and replanted according to resources provided by the Natural Resource Conservation Service (NRCS – USDA). See Appendix 6 for details and guidance on the use of *Spartina* for wetlands restoration. Appendix 7 contains a guidance document for tidal wetland preservation for Long Island Sound.

Bay Park Storm Drain

Adjustments in golf course management can provide effective immediate reduction in polluted storm water runoff. Golf course managers should be keenly aware of weather conditions and should never apply pesticides or fertilizers when significant rainfall is forecast. Aeration, thatch removal, overseeding, topdressing, and other cultural practices that improve soil conditions, such as pH management, should be prioritized to maximize percolation through soil, rather than lateral runoff into storm drains. It may also be possible to adjust the shapes of fairways and roughs to incorporate storm drains into vegetated rough areas, which are often left unmanaged and can be made aesthetically valuable. This approach will permit the development of vegetated buffers around storm drains, where grasses, annuals and perennials are allowed to grow. Ideally, these buffers should be planted with non-weedy, native species that do no interfere with turfgrass quality by producing seeds that germinate and must be managed as weeds. Ornamental plantings could be incorporated into these storm drain buffers to make the areas visually attractive. Historically there have been problems with clogs in this storm drain system. Planting the right vegetation could alleviate such problems.

1.3.3 Cantiague Golf Course, Hicksville, NY

Cantiague Golf Course is located in Hicksville, close to a small recharge basin. This course is managed at an acceptable level where fertilizers are used on putting greens, tees, and fairways, but pesticides are only used on the putting greens. The most significant pest problems at Cantiague are annual bluegrass weevil and dollar spot. Occasionally white grubs cause damage. Echo™ has been used for dollar spot and insecticide Merit™ is used for white grubs and ABW. No fungicides are used on fairways and only spot treatments are used for insects. The herbicide, Dimension™, is used as a spot treatment to manage crabgrass in fairways. The golf course manager has noticed many native species of animals, such as owls, hawks, bats, and box turtles.

Cantiague Storm Drain

Cantiague Golf Course has four storm drains located near fairways and in roughs. Around storm drains, vegetated buffers should be developed to filter sediment and nutrients from storm water. This can be accomplished by allowing vegetation to grow tall, by planting native species around storm drains, or by incorporating areas with storm drains into unmanaged natural areas. Applications of pesticides and fertilizers should never be done when significant precipitation is forecast (over 1/2 inch).

As with other Nassau County golf courses, Cantiague Golf Course has no pesticide loading/mixing pad. Instead, this task is done in a grassy area with a garden hose that lacks any backflow prevention device. A backflow prevention device needs to be installed and proper facilities should be constructed for the safe mixing and handling of pesticides and fertilizers.

1.3.4 Christopher Morley Golf Course, Manhasset, NY

Located in a valley in Manhasset, Christopher Morley Golf Course has pest problems associated with excess moisture and drainage problems, such as soil-surface algae, and pythium, a root rotting disease. This course is maintained at an acceptable level with pesticides reserved for putting greens only. A commercial product containing the active ingredient mancozeb is typically used for algae control. An alternative to mancozeb is copper sulfate, however this product is very highly toxic to fish and mollusks and not recommended for use on a golf course with storm drains. Other commercially available products include peroxide containing products that kill microbes, such as ZeroTol Broad Spectrum Algaecide/Fungicide (see www.biosafesystems.com). Attempts should be made to explore alternatives to some of the conventional pesticides used, especially if they are used in limited quantities for small, specific

Christopher Morley Golf Course

problems. Fertilizers are used on Christopher Morley fairways, putting greens and tees throughout the course. There is one small recharge basin close to the golf course, but this is buffered by a wooded area. Storm drains can be found in fairways and roughs in this course. Previous recommendations for pesticide and fertilizer use at other golf courses apply to this course, as well as recommendations for adjustments of vegetation and landscaping around storm drains.

1.3.5 North Woodmere Golf Course, North Woodmere, NY

North Woodmere Golf Course is a well-maintained 9-hole course with few pest problems. Dollar spot is problematic and fungicides, such as Daconil™ and Bayleton™, are used on the putting greens for disease prevention during times when conditions favor development. Humid conditions that result in consistent leaf wetness will promote dollar spot and other diseases. North Woodmere has several windbreaks constructed of chain-link fence and overgrown with vines. To increase circulation across areas of the course, vegetation has been thinned and trimmed back to allow for greater air flow. Trimming should be done on a regular basis to maintain good air flow as a disease-management tactic. Slow-release fertilizers are used twice a year on fairways, tees and putting greens. Grubs are an occasional pest for which spot treatments are primarily used. Herbicides are reserved for putting greens.

North Woodmere Golf Course (Google Earth)

North Woodmere Waterfront and Storm Drain

As with other 9-hole golf courses, North Woodmere needs a pesticide mix/load/ wash pad and a backflow prevention device for the water system. North Woodmere is situated between two tidal waterways that lead into the bay. There is little space between the fairways and shoreline on the eastern side of the park.

Depressions in the soil

The addition of a vegetated buffer of cordgrass and native vegetation strip is highly recommended for the shoreline of this park and in spots where discharge from storm drains may lead to open waters, such as the one pictured above. The use of chlorothalonil (Echo™) and potential for use of pyrethroids are serious threats to marine organisms. Efforts should be made to replace highly toxic pesticides used at shoreline courses with more expensive but environmentally friendly products.

Mosquitoes are often a significant problem at the North Woodmere golf course, mainly as a nuisance pest for golfers. Saltwater mosquitoes, *Ochlerotatus sollicitans*, are common along the south shore of Long Island and are extremely numerous, seasonally. However it was observed that many depressions created by vehicles on soft ground had collected water and were actively breeding mosquitoes, most likely *Culex pipiens,* or house mosquitoes. Efforts should be made to fill in depressions with sand or a porous soil to eliminate the breeding sites for mosquitoes.

General Recommendations for Nassau County Golf Courses
(partly based on BMPs described in Davis and Lydy, 2002)

Short-term Goals

- Golf course management should follow the principles of IPM and use best management practices for golf turf.

- Nassau County is responsible to ensure that every employee who applies a pesticide for work purposes is a New York State Certified Pesticide Applicator. If any key employees are not certified, or have lost their certification, they should attend a 30-hour course immediately and gain certification.

- Nassau County should encourage and facilitate continuing education for all certified pesticide applicators, as well as for those who work in golf course or parks management but who are not pesticide applicators. General maintenance activities also require skill and knowledge.

- Nassau County DPRM should eliminate routine uses of the most highly toxic pesticides (chlorothalonil, pyrethroids, trichlorfon) at golf courses located on waterways (Bay Park and North Woodmere) due to the high risk of contamination of local waterways.

- Managers of the golf courses and parks should explore lower-risk alternatives to the more highly toxic pesticide products and products used in great quantities.

- When using a granular product applied with a spreader be sure to avoid scattering grains on hard surfaces, sidewalks, streets, and into storm drains. Sweep grains or use a blower to redistribute them onto the target location.

- Each golf course facility should have a pH and soil nutrient analysis done on a yearly or bi-yearly basis to optimize nutrient availability and use, while reducing leaching and runoff.

- Purchase and use low-phosphorus or phosphorus-free fertilizers, with the exception of starter fertilizers. New York soils contain high levels of naturally available phosphorus, therefore, it is unnecessary to add phosphorus to established plantings. This nutrient is the main cause of eutrophication of water bodies.

- Never apply fertilizers or pesticides when significant rainfall (1/2 inch or more) is forecast. One of the most important factors in surface runoff contamination is the time period between an application of pesticide or fertilizer and a storm event.

- Avoid pesticide drift by avoiding the application of pesticides with a sprayer during windy conditions.

- Use slow-release organic sources of nitrogen to avoid leaching.

- Develop buffer zones around ponds within each golf course. Allow as much vegetated area around the pond (30-50 feet width recommended, but any buffer will help) to grow tall and thick to absorb pesticides, fertilizers, and trap sediments entering ponds.

- Encourage and facilitate golf course managers and employees to attend golf management-specific training when offered through Cornell University, Rutgers University or other local cooperative extension or industry events.

Long-term Goals:

- Develop native grass buffer strips along waterfronts at Bay Park and North Woodmere golf courses. This will provide great ecological benefits and reduce runoff risks.

- Make structural changes in the storm drain systems first at Bay Park and North Woodmere, to prevent direct discharge into tidal wetlands or other natural bodies of water. Low spots that accumulate water might be tiled and tiles routed to filtration devices or areas, rather than surface waters.

- Seek to join the Audubon International Cooperative Sanctuary Program. This program encourages and supports the evaluation of native and rare species present at a location (golf course), supports the adoption of wildlife conservation and best management practices, and becomes a source of pride and recognition for the course. See Appendix 8 for more information on this program.

- Develop a turfgrass or horticulture internship program between Nassau County Department of Parks and Recreation, Hofstra University, SUNY Farmingdale, Cornell Cooperative Extension and/or the NY State IPM Program at Cornell University. An internship would enable students to obtain real-life experiences and expertise while working as scouts to map and define pest problems in golf course turfgrass or even ornamental plantings. An internship might also be the key to developing a Cooperative Sanctuary program, by utilizing a student for cataloguing species diversity, and fulfilling all the requirements needed for certification.

1.4 Museum Pest Management

1.4.1 Description of Program

Nassau County manages museums by contracted services in the same way as offices and other buildings, which fall under the "Structural Pest Management" category in this report. Very few pest problems have arisen in County museums in recent years. Rodents have occasionally been problematic, however simple trapping and exclusion techniques, combined with containerized bait placements will solve the problem. In one museum there was an outbreak of powderpost beetle, a wood-destroying insect, which infested a wooden tool. This was treated using a specialized boric-acid wood treatment. Pest problems are mainly addressed on a complaint driven basis, and there are few if any complaints from the County owned museums.

1.4.2 Recommendations for Museum IPM

- Despite the apparent lack of pest activity, several components of IPM should be incorporated into museum and collections management as precautionary measures. They include:
- Staff should be trained in very basic principles of museum IPM, involving familiarity with common museum pests, pest damage, and conditions that favor pest problems.
- Staff should be encouraged to inspect museum specimens and collections occasionally for such pests. Staff should be familiar with procedures (i.e. who to call) when a pest is found.
- Contracted pest control services should inspect each museum at least once or twice per year, even if there are no complaints of pest problems.
- Further recommendations for parks museums and buildings are included in the "Structural Pest Management" section of this report.

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2.0 MOSQUITO CONTROL PROGRAM – DEPARTMENT OF HEALTH AND PUBLIC WORKS

Mosquito control in Nassau County began in 1915 in response to occasional localized outbreaks of mosquito-borne malaria. Today the Mosquito Control program is a combined effort of the Nassau County Departments of Health and Public Works. Both departments are committed to the use of integrated pest management (IPM) for management of mosquitoes in Nassau County.

The outbreak of West Nile Virus in 1999 reinvigorated many vector control programs and focused attention on the health and environmental consequences of mosquito control efforts. Accountability became crucial to the continuation and success of mosquito control and Nassau County relied on the Pesticide Advisory Committee, as well as the Nassau County Mosquito Surveillance and Control Report for outreach and accountability to residents.

The mosquito control efforts of Nassau County result from a collaboration of county agencies, along with the New York State Department of Health (DOH) and Department Environmental Conservation (DEC). The foundation of this program is surveillance. Mosquito breeding habitats, larval and adult numbers, and disease status are each regularly monitored throughout Nassau County. Surveillance includes larval sampling to define breeding habitats that need treatment, as well as adult mosquito trapping to assess population numbers and whether larval controls are working. Pools of adult mosquitoes are tested for viruses at a New York State laboratory. Reports of dead birds, sick horses, and general nuisance complaints, including abandoned swimming pools, are handled through a health department hotline.

Mosquito control activities are hierarchical, beginning with surveillance to define the problem. Next habitats are modified to reduce mosquito breeding. This could include the addition of mosquito fish, *Gambusia* or other species, or elimination of standing water. Larvicides are used next, if habitats cannot be altered. Larvicides are restricted to either naturally occurring biological control organisms (*Bacillus thuringiensis* or *B. sphericus*), an insect growth regulator targeted to the breeding area only, or a monomolecular oil film that suffocates mosquito larvae at the water's surface. Only after these techniques are exhausted will Nassau

County resort to the control of adult mosquitoes using two lower-risk pyrethroid insecticides, Scourge and Anvil, through aerial or truck-mounted ultra-low volume sprayers.

In addition, continuing education is considered valuable to this program. All six certified pesticide applicators attend regional trainings and receive in-house training from another highly skilled certified applicator. All of these components add up to an ideal IPM program. No further recommendations can be offered. See Appendix I for a copy of the Mosquito Surveillance and Control Report.

3.0 RODENT MANAGEMENT – COMMUNITY SANITATION PROGRAM – DEPARTMENT OF HEALTH

3.1 Description of Program

The rodent management efforts made by and within Nassau County are described as "neighborhood or resident complaint driven". This means that rodent management efforts are made if and when a complaint is received by the rodent hotline, operated by Nassau County Department of Health. The typical response to a rodent complaint involves evaluating the conditions that may have attracted rodents to a location, including waste management, construction or other disturbed environments, and overgrown vegetation. Recommendations may occasionally be offered to persons responsible for eliminating the conducive conditions. However, Nassau County generally responds by bringing in the County's pest management contractor, Bug Free Exterminating and Tree Spraying.

Technicians of the contracted company are all NY State certified pesticide applicators and skilled in rodent management. Rodenticide blocks (bromodialone, Contrac Blox™, Bell Laboratories) are carefully placed into rodent bait boxes that are secured to the ground with anchors. This is the only rodenticide placement method used by Nassau County. Rodenticides blocks are never placed freely and pellets or meal are never used. There are no risks for stormwater pollution from the proper placement of rodenticides bait blocks in bait boxes. In the case of recharge basins, which often harbor Norway rats, rodenticide baits are placed in boxes on the level surface of the bank near the perimeter of the property. Baits are not placed into rodent burrows.

The use of only one formulated product could over time lead to bait shyness and possibly tolerance of rodents to the active ingredient. However, bromodialone is a preferred anticoagulant because it poses lower risks of secondary poisoning to predators of rodents, such as raptors. It also shows only moderate acute toxicity to freshwater fish, in the case of translocation. Other second generation anticoagulants, such as bromethalin and Brodifacoum exhibit very high toxicity to freshwater fish (Anonymous, EPA, 1998).

3.2 Recommendations for Rodent Management-

- In cases of chronic rodent infestations that require treatment over long periods of time, when no risks of secondary poisoning exist (no raptors are present in the area), at least two rodenticide products should be rotated into the program. This will reduce the potential for bait shyness and bait failure due to resistance.

- It is also recommended that Nassau County spearhead an educational campaign for commercial properties that raises awareness about reducing conditions that attract rodents (such as waste management and construction activities).

- Nassau County should initiate a homeowner educational program to educate residents about how they can reduce conditions that are conducive for rodents. This information would include tips on excluding rodents from homes, altering landscapes to discourage rodents, and garbage handling practices that deter rodents.

- If rodent problems become worse Nassau County should initiate a Rodent Task Force, such as the New York City Rodent Task Force, that brings together county, town, and village officials for a cooperative educational and management campaign.

- Nassau County should pilot a program that seeks to prevent rodent problems by baiting areas before and during the start of construction or habitat disruption. This preventative approach would require planning and coordination, but could vastly improve rodent management efforts by intercepting migrating rodents.

4.0 SEWAGE TREATMENT PLANTS – PEST MANAGEMENT

There are two municipal sewage treatment plants in Nassau County, both located on the South Shore. Barring unforeseen problems, such as broken sewage lines or other structural facility problems, pests are rarely problematic at these wastewater treatment facilities. In recent history mosquito breeding has become a problem at one facility. In such a case, the experts at the Mosquito Control Program are called in to manage mosquitoes and their breeding sites. Low-risk adulticides and larvicides are typically used for mosquito problems, as described above in the "Mosquito Control Program" section.

5.0 DEPARTMENT OF PUBLIC WORKS – HIGHWAY VEGETATION MANAGEMENT

Nassau County Department of Public Works, Highway Division, uses no herbicides for vegetation management along roadways. Fertilizers and plant growth regulators are also not used along roadways. Mowing is the only strategy for highway vegetation management.

6.0 STRUCTURAL PEST MANAGEMENT

6.1 Description of Program

In 1995 Nassau County issued an Executive Order that enabled the County Department of Health to implement a pesticide policy that minimized pesticide use throughout county facilities. This order, although vague, was outlined and implemented by the Health Department despite limited resources and a total lack of enforcement. A Pesticide Advisory Committee was established and composed of county agency representatives, environmental and health advocates, cooperative extension staff, and contractors to the county. Once West Nile Virus concerns on Long Island diminished by 2001, and a new county administration was elected the advisory group stopped meeting. This group helped the county implement IPM.

Nassau County has contracted with Bug Free Exterminating & Tree Spraying, Inc. for nearly all structural properties for many years. This company can be found on the New York State Office of General Services IPM service providers list (see www.ogs.state.ny.us) as well as a resource directory of the advocacy group Beyond Pesticides (www.beyondpesticides.org) as a provider of least-toxic IPM services. This company has consistently followed the principles of IPM and according to a 1997 Nassau County Department of Health report pesticide use had dropped substantially from pre-IPM days. Today, pest management services are rendered both as routine inspections and on-call emergency responses. When no problems are obvious, most facilities receive monthly inspections. If problems arise, the contractor can request to visit more frequently to address the problem. Unfortunately, this decision must be approved and decisions are often delayed or denied for financial reasons. This enables the infestation to spread and grow, making it much more difficult to solve.

Nassau County Department of Health

The five most common pest problems in Nassau County are rodents, cockroaches, ants, stinging insects (wasps and bees), and termites. Visual inspection and monitoring with sticky traps are the first step taken to define the scope of the problem. When detected, rodents are managed using bait in tamper-resistant bait stations, generally placed on the outside perimeter of a building. Rodents living indoors are trapped. Cockroaches and ants are managed using sticky traps and gel or granular baits, which have excellent results and pose almost no environmental or health risks. Strategies for eliminating conditions that favor these pests are recommended by the contractor, though these steps require cooperation on the part of building occupants as well as custodial staff. Stinging insects are managed using targeted pesticide applications to nesting sites. Some precaution must be taken to avoid heavy pesticide applications to ground nests when rainfall is in the forecast.

Termite infestations are handled using the Advance Termite Baiting System, which is an in-ground, cellulose-based bait product that relies on random termite foraging for success. Termite foragers find the bait and recruit others to feed there. Workers bring toxicant back to the colony where it is distributed to larvae and the queen. The active ingredient in this product is diflubenzuron, an insect growth regulator, which has very low mammalian toxicity and due to its immobility in soil, formulation, and use for termites, virtually no potential for storm water pollution (Anonymous, EPA 1997). The contractor has noted a sharp decrease in the number of termite complaints in recent years, and attributes this to the success of this baiting system.

In one extreme case, a large termite infestation had been discovered extending from the structure into paper files in an office. In this case, a more traditional approach was taken. The contractor drilled into foundation walls and floor to apply chlorfenapyr (Phantom, BASF Corp.). This is a new product that is not repellent to termites, and therefore kills worker termites as they cross the chemical barrier, rather than just repelling them. Many precautions are listed on the Federal label, especially regarding groundwater contamination. This product must be used in strict accordance with the label and never near bodies of water, where groundwater is shallow, or when significant rainfall is forecast.

Other structural pest management issues arise from time to time. For example, the Nassau County Jail is frequently plagued with mice. The contractor reports that despite using baits, mice continue to be a problem. The technicians suspect that mice originate in the warehouses of product suppliers and that mice are being brought into the facility with deliveries. This is not uncommon. Several recommended approaches can confirm this and solve the problem:

- Packages should be inspected in an isolated room or at a loading dock before being brought into the building. This is not always feasible, however, given limits of space and time.
- Multiple sticky traps should be placed along the perimeter of the area used for unpacking goods can help pinpoint the source of rodents.
- If the warehouse and delivery vehicles are confirmed as a source of mice, Nassau County should insist that distributors take care of the problem or look to switch to a new distributor.

Another issue that has been highlighted is a gap in communication. The pest control technicians are reporting that Nassau County facilities workers are very cooperative, but that many times technicians are not made aware of pest problems. This can be for several reasons. Technicians may visit when their main contact is unavailable. Technicians do not always speak to other building occupants, yet they should. Building occupants often have no idea that a pest control technician is assigned to their building. And monthly inspections often do not allow the technician sufficient time to know the buildings well. In fact, the contractor reports that there are many county buildings that his company has never inspected.

Overall the pest management services of Nassau County's contractor are a good example of IPM. Inspections and monitoring are the basis of the service, least-toxic products are used primarily, and products with higher risk are reserved for emergencies or difficult situations. Company technicians are well-trained.

6.2 Implementation of IPM

Each type of building can be a case study in pest management. All buildings are different and areas within buildings vary by use. For example a cafeteria located in an office building requires different attention than a cafeteria in a hospital or school. Counties tend to have a wide array of building types, and therefore a diverse set of pest problems. However, the basic principles of IPM can apply to most structures.

6.2.1 Basic Principles of IPM

Integrated pest management is the process of integrating and applying practical management methods, to keep pest species from reaching damaging levels while minimizing potentially harmful effects of pest management measures on humans, non-target species, and the environment, incorporating assessment methods to guide management decisions. The basic steps of integrated pest management are:

- Inspect and identify pests, monitor over time to understand the extent of the problem.
- Identify and eliminate points of entry and conditions that favor pests, such as sources of food, moisture, and places for harborage.
- Use physical control methods, such as cleaning, trapping, and physical removal to gain control of the pest problem.
- If problems remain above a tolerable level, choose a pest control chemical that minimizes risks, such as a bait or insect growth regulator.
- If necessary, use a more traditional pesticide, but do so in a judicious manner (spot treatments, for example).
- Keep records of pest activity and pest control actions and evaluate the process, looking for successes and areas for improvement.

6.2.2 The IPM Log Book as a Main Communication Tool

Since pest management technicians cannot always schedule visits when their main contact person is available and communication between building occupants and maintenance staff may be lacking, an IPM log book can be used as a point of contact among all parties. A log book becomes the responsibility of the facility manager and it lives in a place where the pest management technician can access it at any time. This is a place where pest complaints are recorded, and where the technician can get complaint information immediately. This reduces the need for lengthy inspections and helps the technician target his time toward real pest problems. This also enables building occupants, such as office workers, to participate by making complaints. They become part of the inspection process. Each Nassau County facility should have its own IPM log book. The book consists of pest sighting complaint forms, records of monitoring and actions taken, the material safety data sheets for products used in pest management (which must be kept handy at all times in case of an emergency), pest fact sheets, and copies of laws, policies or anything else that might be useful.

Log books are extremely valuable to IPM programs. The New York City Board of Education is implementing an IPM log book program for its approximately 1200 city school buildings this year. Suffolk County also uses log books throughout county buildings for the pesticide reduction program. For a complete description of log book use and construction, including forms, see Appendix 10.

6.2.3 Who Play a Role in Pest Management?

Changing attitudes toward pest management is extremely difficult. However, for IPM to be successful it usually involves participation or at least awareness at every level. Custodians and facilities managers must be deeply involved in the process of IPM, because building maintenance is often the key factor in a pest problem. Incorporating IPM awareness training into other aspects of training and job responsibilities can be successful. Office workers can be empowered to prevent pests from being attracted to their work space through awareness training and by following some simple rules of sanitation. It can be useful to engage union representatives in the

dialogue because ultimately IPM benefits the health and well-being of all who work in the building.

6.3 Recommendations for Structural Pest Management Programs

- Nassau County should revive the Pesticide Advisory Committee, perhaps as an IPM Advisory Board, to pull together resources and experts that deal with all aspects of pesticide use and pest management technology. The county and its agencies would greatly benefit from this interaction.

- Nassau County should review its IPM Plan and make a commitment to become proactive in the use and promotion of IPM to county residents.

- Nassau County needs to enable the pest management contractor to quickly increase the number of monthly visits to sites in response to immediate and difficult pest problems.

- The contractor should make routine (at least once per year) inspections of every facility included in the scope of the contract.

- A log book program should be instituted at each county facility to cultivate the best communication among building occupants, facilities managers, and the pest management contractor. NYSIPM is willing to help set up this program.

- IPM awareness training should be provided to all employees of Nassau County, as a way to encourage cleanliness, realistic expectations, risk awareness, and especially to foster communication of pest sightings to the pest management contractors.

- IPM awareness training should be emphasized for administrators and all those in managerial positions in Nassau County to provide the needed support.

- Custodial and facilities staff should be given specific and brief training on how they have the ability to impact pest problems in their buildings.

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7.0 RECOMMENDATIONS FOR TRAINING OF MUNICIPAL WORKERS

Training opportunities are available from many sources on Long Island, including green industry workshops and seminars, and courses and workshops offered by Cornell Cooperative Extension. In addition, with the right resources, CCE can arrange training opportunities and develop educational materials specifically designed for Nassau County. Collaboration with Parks or other agencies in Suffolk and Westchester Counties and New York City can also maximize educational opportunities.

7.1 General Employees

- All employees should be made familiar with the term "integrated pest management" and how each person's activities play a role in the attraction of pests and facilitation of pest problems.
- All employees should be made aware of the chain of command for reporting pest problems.
- If Nassau County adopts an IPM log book program, employees should be made aware of the IPM log book in their building or facility and encouraged to utilize it.
- Practices that Nassau County is using in its Good Housekeeping efforts should be summarized and advertised (in the form of a leaflet, for example) for County employees as a form of outreach.

7.2 Public Education Recommendation

- Nassau County should reinvest in public outreach for homeowner education, particularly about mosquito prevention through the reduction of breeding sites on private property. Individuals need to be reminded of messages such as these.

7.3 Land Care or Green Industry

The land care industry, particularly ground maintenance crews for large commercial properties in Nassau County, can and should be engaged in the ideas and the process of water resource protection. Green industry professionals are required to obtain certain set numbers of

continuing education credits in order to maintain professional certifications, such as pesticide applicator licenses and arborist certification.

- Nassau County should sponsor additional outreach and education for the landcare industry, utilizing the resources of Cornell Cooperative Extension of Nassau County and the Master Gardeners programs. For example Suffolk County enacted legislation that mandated that an organic landscaper workshop be offered for anyone interested. Attendance was voluntary but as the program progressed, each year there was greater and greater participation, indicating that the green industry professionals are interested in pursuing alternative practices.

7.4 Certified Pesticide Applicators

There are 13 certified pesticide applicators working for the county golf courses, and three working in County parks. In addition, there are dozens of employees who engage in plant health maintenance in parks, golf courses and on other grounds. Trainings are recommended for all employees involved in plant health or vegetation management, because their impact on soils, plants, wildlife, and storm water is significant, even if they do not apply pesticides. Certified applicators are required to obtain a certain number of credit hours of continuing education, depending on the type and number of categories on their licenses. Nassau County should provide at least some of these credit hours in the form of training workshops. No license is required to apply fertilizers.

Recommended training would include the following subjects.

- Entomology

  Recognizing insect damage and which insect is causing it is important to matching the correct non-toxic control with the correct pest. The necessity for control depends on recognizing the threshold, or level at which the pest actually does damage. In order to keep emphasis on integrated pest management, and particularly on beneficial populations that are highly susceptible to broad-spectrum products, educational support is needed for all entities involved in pest management.

  - How to Recognize Insect Damage vs. Other Problems
  - How to Scout for Insects

- How to Calculate and Use Economic and Damage Thresholds
- How to Recognize One Insect From Another
- Identifying Common Turfgrass Pests
- Identifying Common Ornamental Pests
- How to Recognize and Encourage Beneficial Organisms
- How to Recognize and Reduce Noxious Insects
- How to Use a Successful IPM or Organic Program to Reduce or Limit Insect Pests
- Managing Annual Bluegrass Weevil from Start to Finish

- Plant Pathology

Recognizing disease damage versus other kinds of damage and which disease is causing it is important to matching the correct non-toxic control with the correct pest. The necessity for control depends on recognizing the level and long term ramifications of the disease, and with all non-toxic products and strategies the best chance of success comes with early recognition. Sanitation and proper culture in IPM or organic programs are key to reducing disease.

- How to Recognize Plant Disease vs. Insect or Other Damage
- How to Scout for Disease
- How to Recognize One Disease from Another
- Predisposing factors to Plant Disease
- Identifying Common Turf Diseases
- Identifying Common Ornamental Diseases
- Disease Vectored by Insects
- How to Successfully Use IPM or Organic Programs to Reduce or Limit Disease Pests
- How to Water to Reduce or Eliminate Disease
- Management of Dollar Spot

- Proper Planting and Aftercare

Many pest infestations are related to plant stress. Therefore a nontoxic alternative to pest control is proper planting and aftercare to reduce plant stress which attracts pest chemically and physically as well as predisposing the plant to infection or infestation. Some of the most important aspects of stress reduction are the proper timings for aftercare tasks such as watering and fertilizing or soil amendment.

- Site Selection and Evaluation
- Soils and Soil Amendment
- Proper Planting and Pruning
- Using and Designing with Pest Resistant and Xeric Ornamental Plants
- Installation and Best Management Practices for Turfgrass
- Watering of New and Established Plantings
- Fertilizing of New and Established Plantings
- How to Use a Successful IPM or Organic Program to Get your New Plants Off to a Good Start
- Timing Aftercare for New Plantings

- Pesticides and Fertilizers

  Basic and advanced knowledge about the chemicals used in a municipal operation can greatly reduce risks associated with their use. By training applicators about the potential hazards posed to human and environmental health, it is expected that employees will be more mindful of risks and these products will be used with added caution.

  - Basic Chemistry of Pesticides and Fertilizers
  - Pesticides – Class and Toxicity of Pesticides
  - Formulations and Best Management Practices for Fertilizer Use
  - Environmental Fate of Chemical Pesticides and Fertilizers
  - Nonpoint Source Pollution

Resources for turfgrass manager education can be found at:

- www.usga.org – The United States Golf Association has training resources for BMPs for golf turf management.

- http:// ipmguidelines.org/ - The Cornell University IPM guidelines contain pesticide use and IPM recommendations for turfgrass and ornamental plants.

- www.seagrant.sunysb.edu/nemo/default.htm - Nonpoint Education of Municipal Officials website, part of NY Sea Grant, Cornell Cooperative Extension. NEMO plans to offer workshops that address reducing impervious surfaces, redevelopment, watershed management, site design, best management practices, septic system and maintenance and "water friendly" gardening and landscaping.

Additionally, the following subjects should be addressed for pesticide applicators:

- Hazardous materials course see http://hazmat.dot.gov/training/mods/mod.htm
- Proper transportation of pesticides and emergency spill response

APPENDIX A

REFERENCES

REFERENCES

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APPENDIX B

TABLE OF SOME PESTICIDE AND FERTILIZER PRODUCTS USED IN NASSAU COUNTY

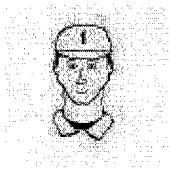
TABLE OF SOME PESTICIDE AND FERTILIZER PRODUCTS USED IN NASSAU COUNTY

EPA No.	Product Name	Active Ingredient	Signal Word	Use
100-1093	Heritage	Azoxystrobin	Caution	Fungicide, golf course turfgrass
60063-7	Echo	chlorothalonil	Warning	Fungicide, golf course turfgrass
1001-69	3336F	thiophanate	Caution	Fungicide, golf course turfgrass
432-1289	Dylox 80	Trichlorfon	Warning	Insecticide, golf course turfgrass
707-284	Dimension Ultra WSP	dithiopyr	Caution	Herbicide, selective
432-1230	Proxy	Ethephon	Danger	Plant growth regulator
3125-462	Tempo 20 WSP	Cyfluthrin	Caution	Insecticide, golf course turfgrass pests
100-741	Banner Maxx	Propiconazole	Warning	Fungicide, golf course turfgrass
None	BurnOut	Acetic acid	None	Non-selective herbicide, vegetation management
66330-41-1001	Endorse	Polyoxin D zinc salt	Caution	Fungicide, golf course turfgrass
241-392	Phantom	Chlorfenapyr	Caution	Termiticide
100-1078	Scimitar	Lambda-cyhalothrin	Caution	Insecticide, golf course insect pests
2217-529	Trimec	2,4-D, dicamba, propionic acid	Caution	Herbicide for golf and athletic field turf
432-942	Chipco Banol	Propamocarb hydrochloride	Caution	Fungicide, sp for *Pythium*, golf courses
432-950	Acclaim	Fenoxaprop	Caution	Selective annual grass control, parks and golf
3125-560	Compass	Trifloxystrobin	Caution	Fungicide, golf course turfgrass
100-937	Primo Maxx	Trinexapac-ethyl	Caution	Plant growth regulator
432-890	Signature	Aluminum tris	Caution	Fungicide, golf course turfgrass
3125-451	Merit 0.5G	Imidacloprid	Caution	Insecticide, golf and athletic turfgrass
12455-79	Contrac Blox	Bromodialone	Caution	Rodent control

APPENDIX C

PESTICIDE MIXING AND LOADING GUIDELINES FOR PESTICIDE APPLICATORS

INTRODUCTION



Poorly stored pesticides and improper mixing/loading practices can present a potential risk to our health and to the integrity of the environment. The quality of surface water, groundwater and soil can be degraded in areas where pesticides are stored under inappropriate conditions, improperly mixed and loaded into application tanks and where equipment is washed and rinsed after application. Accidents involving spills or leakages may have serious health and environmental consequences. Over the past several years, the Pesticide Bureau of the Department of Food and Agriculture (DFA) has received numerous phone calls from farmers, golf course superintendents and other pesticide users looking for guidance on building pesticide storage facilities. Questions concerning proper mixing and loading procedures have also been common. The purpose of this document is, very simply, to provide guidance to individuals looking for information on appropriate techniques and approaches for the mixing, loading and storage of pesticides. This document was prepared with input from written resources, individuals and organizations with a broad range of expertise and experience. It is a compilation of the best information available regarding the mixing, loading and storage of pesticides. The result is a solid body of guidance which represents a general consensus on how pesticide mixing, loading and storage issues should be approached. It is important to remember however that mixing, loading and storage needs will vary greatly from situation to situation and site to site. No document could specify exactly what approach should be taken in each situation. As such, it should be kept in mind that this document is intended as general guidance only. These are recommendations, not standards or regulations and as such can be adjusted to meet individual needs. These recommendations are designed to assist pesticide users in managing their storage areas and conduct their mixing/loading operations in ways that will help minimize exposure to pesticides and reduce the risks to public health and the environment. These are not intended to be regulations and are not enforceable by any state or local agency.

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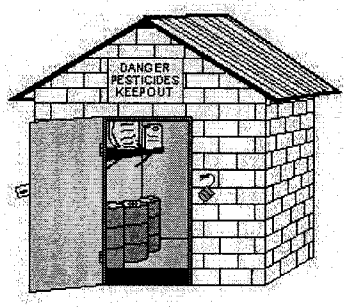
Storage

Safety is the key element in pesticide storage. The safest approach to any pesticide problem is to limit the amounts and types of pesticides stored. The amounts and types of pesticides stored should be maintained at the level that is immediately required and should not be stored beyond immediate needs.

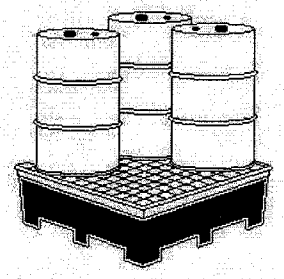


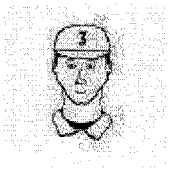
Selecting a Storage Location

An existing or proposed area should be carefully evaluated to determine its suitability for pesticide handling and storage. In particular the potential harm to human health and the environment due to spills, contaminated runoff or fires should be assessed. If possible, the area should be located at least four hundred feet (preferably down hill or down gradient) from any public or private drinking water supplies and two hundred feet (preferably down hill or down gradient) from surface water. Separation from water resources should be greater in areas of sandy soil or fractured bedrock. Whenever feasible, the area should not be located in a 100 year floodplain. Runoff from adjacent areas resulting from a 25 year 24 hour storm should be diverted around the facility. The site location should be accessible in the event of an emergency situation. The pesticide storage area should be located away from direct sunlight, freezing temperatures and extreme heat.

The area should be located at least four hundred feet from any drinking water supply and two hundred feet from surface water

Temperatures in the storage area should be kept between 40F and 100F. Pesticides should not be stored outdoors. Where practical, the mixing/loading area should be located close to the storage facility to minimize the distance that chemicals are carried. Consideration should also be given to the additional area required by a mixing/loading pad when selecting the site for storage.

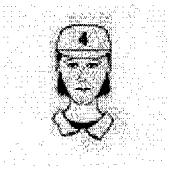




Storage Practices

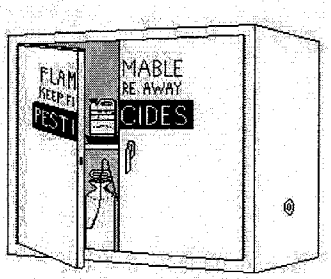
Pesticide storage shall be restricted to a first story room or area which has direct access to the outside (according to the Board of Fire Prevention). Pesticides cannot be stored in basements. Pesticides should be stored in accordance with their label requirements in their original container with the label clearly visible. They should always be kept off the ground to prevent the accumulation of water in or under the containers. Separation of pesticides by hazard and function is essential. Flammable pesticides should be stored separately from non-flammable pesticides, in a fire proof cabinet for example. Dry pesticides should be stored separately from liquid pesticides to avoid wetting from spills. Fungicides, herbicides and insecticides should be stored in separate locations of the storage area to prevent cross contamination and accidental misuse. Pesticides should be stored away from fertilizer, food, feed, potable water supplies, veterinary supplies, seeds and personal protective equipment to avoid cross-contamination. Particular care should be taken if storing phenoxy herbicides due to their volatility. Pesticides shall not be stored in the same place as ammonium nitrate fertilizer (according to the Board of Fire Prevention). Exposure to sunlight can cause chemical breakdown. Pesticides should not be stored in front of windows, unless the windows are covered. Because shelf life is difficult to predict, pesticides should not be stored longer than two years.

Pesticide storage shall be restricted to a first story room or area which has direct access to the outside. Pesticides cannot be stored in basements



Storage of Medium Quantities of Pesticides

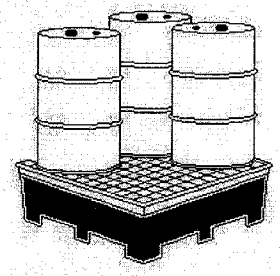
(less than or equal to 500 lbs or 220 gallons)



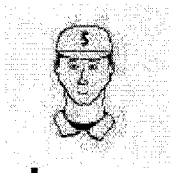
Storage Inside an Existing Building

For storage of medium quantities of pesticides inside an existing building, metal cabinets work well. Metal cabinets should be double walled and constructed with 18-gauge sheet metal. Steel cabinets for storing hazardous materials such as pesticides are available commercially in different dimensions of various capacities. Capacities range from one gallon cans to five gallon cans and fifty five gallon drums. Frequently, cabinets feature built in secondary containment systems such as deep, leak-proof sumps. Wooden cabinets can also be used but should be constructed from 1" thick exterior grade plywood and finished with a chemically resistant product that permits easy cleanup. Shelves can be wooden (if finished with a chemically resistant product) or metal. The door sill to the cabinets should be high enough -at least 5"- to contain up to 5 gallons of spilled liquid. The cabinets should be locked at all times and identified as a place of pesticide storage. The cabinets should be located along an outside wall in an area away from extreme heat or freezing. In the absence of cabinets, storage containers should be placed on impermeable shelves (steel or painted wood) with a lip to catch minor spills or leaks. Storing the containers in plastic leak proof trays to contain any leaks is recommended. Other options include spill containment pallets or floor pallets. Access should be unimpeded. Leaks should be detectable. If containers are in danger of leaking, they should be placed in an oversized plastic container or plastic lined (leak proof) cardboard box with vermiculite or other non flammable absorbent material for spill protection.

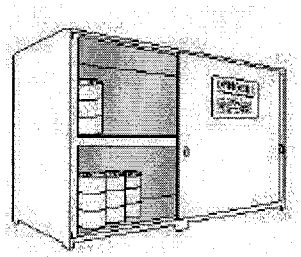
Flammable pesticides should be stored separately from non-flammable pesticides in a fire proof cabinet



Storage of Large Quantities of Pesticides



(more than 500 lbs or 220 gallons)



For storage of large quantities of pesticides (more than 500 lbs or 220 gallons), use of a separate facility is a good idea. Two options for storing large quantities of pesticides should be considered where possible:

1) The acquisition of a Hazardous Materials Storage (HMS) Building

2) The construction of a new Pesticide Storage Facility.

(1) Hazardous Material Storage (HMS) Building

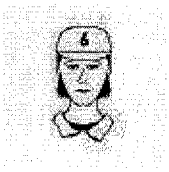
Free standing hazardous materials storage buildings composed of heavy duty steel frames with twelve gauge steel roof and walls are available commercially. The building should ideally have a two hour fire rating. They generally provide double stacking and vertical storage of fifty five gallon capacity drums. Secondary containment is achieved by means of sumps. Doors are self closing and can be locked. The walls have air vents or ventilation fans for improved circulation and relief of gaseous vapor build up. Generally the capacities of the HMS buildings vary from five to forty 55 gallon capacity drums.

Areas used for the storage or mixing of pesticides shall be constructed in accordance with the Board of Fire Prevention Regulations (527 CMR 37.00), the State Building Code (780 CMR) and the BOCA Mechanical Codes (527 CMR 12.00 Appendix A)

(2) Construction of a New Pesticide Storage Facility

(general recommendations)

It is important to consult with an engineer or licensed contractor familiar with the state building code requirements before implementing any plan. Before construction begins, consult with local agencies that deal with planning, zoning, wetlands, health and fire. Areas used for the storage of pesticides shall be constructed in accordance with the Board of Fire Prevention Regulations (527 CMR 37.00), the State Building Code (780 CMR) and the BOCA Mechanical Codes (527 CMR 12.00 Appendix A). A properly designed storage area should be built with regard for worker safety and protection of the environment and public health. It should, at a minimum, facilitate the secure, dry storage of pesticides; safe working conditions for workers with easy access to worker Personal Protective Equipment; secondary containment of incidental spills due to normal mixing/ loading practices and secondary containment of large accidental spills.



HOLLOW MASONRY DEFINITION

<75% solid cross section
or
>25% void

Hollow Masonry Block
Cored Brick
Block Tile

Containment
The building should provide adequate within-building spill containment. In the event of an accident or major spillage, the building should be capable of containing 125% of the volume of the largest container. This can be achieved by surrounding the floor with a curb or by a grated trench which drains to a sump. If possible the floor should slope slightly to the center. A change in slope of, at most, 0.06 inches of drop per foot of run (0.5%) is advisable.

These measures will also prevent water or other liquids from seeping or flowing onto the storage area.

The storage facility shall be constructed in such a way that run-off from fire streams will not contaminate streams, ponds, groundwater, croplands or buildings.

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Walls
The storage building should be separated as much as is reasonably possible from other use areas. The building should be designed to prevent against potential fires due to storage of flammable pesticides within the building and from fire in adjacent buildings. A fire wall slows the spread of fire from one area to another. It is recommended that a storage building with a 1-hour fire wall should be located at least fifty feet from other buildings. For a 2-hour fire wall, the set back distance should be twenty five feet. For a 4-hour fire wall, there is no minimum setback distance. The building should be accessible from all sides for emergency and fire fighting equipment.

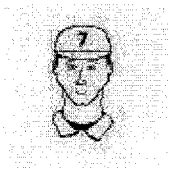
SOLID MASONRY DEFINITION

>75% solid cross-section
or
<25% void

Solid Masonry Brick
Solid Masonry Block
Clay Tile

Fire Rating	Wall Type	Wall Type	Wall Type
1 Hour Wall	3" Hollow Masonry	4" Solid Masonry	3" Solid Concrete
2 Hour Wall	4" Hollow Masonry	6" Solid Masonry	4" Solid Concrete
4 Hour Wall	6" Hollow Masonry	10" Solid Masonry	6" Solid Concrete

Gypsum wallboards of 5/8" thickness on both sides of the wall constitute a one hour rated firewall. Two gypsum wallboards on both sides are considered to be 2 hour fire rated fire walls.



The interior wall surfaces should be impervious to pesticides and easily cleaned. Suitable wall liners are painted steel, aluminum, fiberglass, or high density plastic reinforced plywood panels.

Doors
The doors should be windowless, steel (solid core), 36" wide, set in a steel frame and open to the outside.

Floors & Concrete Specifications
The storage building floors should be water tight, chemically impervious and skid resistant. Concrete floors with an impervious sealant or some other material of comparable strength and impermeability should be used. The following specifications should be used for concrete:

- Type I or Type II high quality cement with 5 - 7.5% air entrainment (this improves water tightness) and compressive strength of 4,000 - 4,500 psi;
- Water - cement ratio of 0.40-0.45 for a stiff (1.5" - 3") slump; a relatively dry mix for maximum strength, pesticide and fertilizer resistance, freeze/thaw resistance and water tightness;

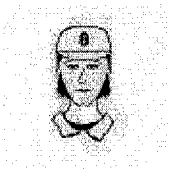
Protective coatings for concrete seal the surface and help prevent the corrosive actions of pesticides and fertilizers on concrete

While concrete is durable, it will deteriorate over time. Liquid fertilizers are the main cause of concrete deterioration. However, pesticides can contaminate concrete and leak through cracks into groundwater. Protective coatings for concrete seal the surface and help prevent the corrosive actions of pesticides and fertilizers on concrete. Among the coatings commercially available are epoxies, urethanes, polyesters, vinyls, chlorosulfonated polyethylene, and polyureas. The appropriate type of coating will depend on the types of pesticides and fertilizers being stored and should be determined in consultation with a distributor.

Lighting
Lighting should be bright enough so that labels may be easily read. The lighting and fan should be turned on by the same switch.

Electrical Design
Electrical equipment and wiring should be designed to prevent sparks. The wires should be shielded. An exterior electrical service disconnect in a locked National Electric Manufacturers Association (NEMA) rated, weather proof box should be provided.

Temperature
Area temperatures should be kept below 100 deg F and above pesticide



freezing points. An electrical heater can be used to keep the temperature above 40 deg F during the winter. Open flames should never be used. Air conditioning may be needed during the summer to prevent the volatilization of pesticides, if this is likely to be a problem. If the storage area is outside, the area must be enclosed in order to protect against the elements, particularly precipitation, freezing temperatures. Outside storage is not recommended in Massachusetts.

For personal safety and protection, good air ventilation should be present at the facility

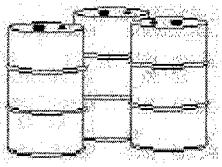
Ventilation design

For personal safety and protection, good air ventilation should be present at the facility. The area should have a continuously operating ventilation system sufficient to prevent the accumulation of vapors and to control temperature. Ventilation should be provided by means of fans. The fans should operate off the same switch as the lighting system. An air inlet should be located within 12" of the floor to facilitate the escape of heavier than air vapors. During occupancy, the ventilation system should provide 6 air changes/hour.

Bulk Containers

Storage containers and appurtenances such as valves, fittings, pipes and hoses, should be installed and maintained so as to prevent the discharge of liquid pesticides. As such they should be structurally sound, resistant to changes in temperature extremes and be constructed of materials that are resistant to corrosion, puncture or cracking. Stainless steel, fiberglass, polyethylene, and lined ferrous metal are acceptable. Valves on storage containers should be locked or otherwise secured except during times of authorized access.

Mixing and Loading Facilities



Contamination of soil, groundwater and surface water can result from small quantities of pesticides spilled regularly in areas where pesticides are mixed and loaded into applicator tanks and where equipment is washed and rinsed after application. Spills or overflows can lead to the accumulation of pesticides in the soil and drinking water supplies.

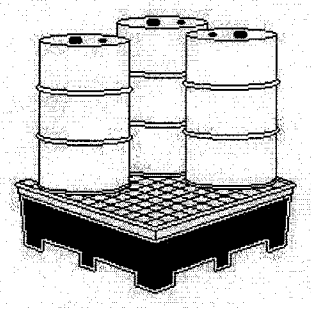
Mixing / Loading Location

Mixing and loading should be avoided in areas where a spill, a leak or overflow could allow pesticides to get into water systems. The mixing and loading of pesticides should not occur within four hundred feet of any private or public drinking water supply or two hundred feet of surface water. No pesticide application equipment or mix tank should be filled directly from any source waters unless a back siphon prevention device is present. Mixing and loading should not occur on gravel driveways or on other surfaces that allow spills to move quickly through the soil.

The mixing and loading of pesticides should not occur within four hundred feet of any private or public drinking water supply or two hundred feet of surface water

Mixing / Loading Practices

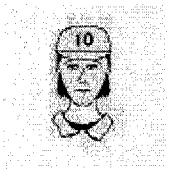
Mixing or loading of pesticides should be avoided in areas where a spill, leak or overflow could allow pesticides to get into water systems. All transfers of pesticides between containers, including mixing, loading and equipment cleaning, should be conducted over a spill containment surface designed to intercept, retain and recover spillage, leakage and wash water.

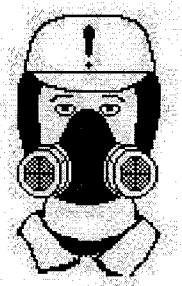


MIXING SAFELY

1. Wear the protective equipment.
2. Mix in a well ventilated area.
3. Pour pesticide down the side of the tank ..... this avoids splashing.
4. Make sure you have a solid footing while pouring.
5. Do your calculations prior to mixing.
6. Mix during daylight hours if possible.
7. Water supply should have a back flow prevention device - to prevent back flow into the water supply.
8. Water should be carefully added to the pesticide mix by pouring down the side of the tank.
9. Do not submerge the end of the water supply hose into the pesticide mix as it could back siphon.
10. Work in pairs.
11. Wash gloves before removing them.

Courtesy of Ward Management Company





Appropriate personal protective equipment (PPE) should be worn before opening a pesticide container

Appropriate personal protective equipment (PPE) should be worn before opening a pesticide container. The label should be checked for Agricultural Use Restrictions. PPE should include front protection such as a bib top apron made of butyl, nitrile, or foil laminate material. A face shield, shielded safety glasses or goggles should be worn. When pouring any pesticide from its container, container and pesticide should be kept below face level. A respirator will ensure protection against dusts or vapors. The container should be closed after each use. A tank should never be left unattended while it is being filled. If the pesticide user should splash or spill pesticides on his person, he should stop the operation, wash thoroughly with a mild liquid detergent and water, put on clean PPE and clean up the spill.

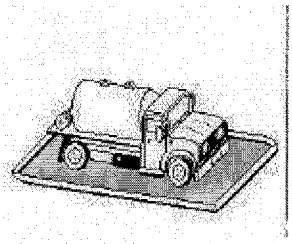
Containment needs depend on the quantities of pesticides that are being mixed and loaded. If mixing small quantities, a tarpaulin can be sufficient to contain any spills. Spills can be then cleaned up with an absorbent material. If mixing large quantities regularly, the construction of a mixing/loading pad is an option to consider. The important point to keep in mind, whichever approach is used, is that incidental spills or accidental spills can be contained and cleaned up. If no spill containment is available, pesticides should be mixed in the field away from sensitive resources and in a different area each year.

Containment needs can be achieved in one of three ways:

1) Mobile Containment Systems
2) Closed Mixing Systems
3) Construction of a Mixing/Loading pad

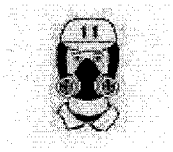
1.0 Mobile Containment Systems

If mixing pesticides in granular formulations, loading over a tarpaulin that can contain any spillage of materials is adequate.



A recommended strategy is to use a mobile containment system. Mobile containment systems, such as a basin or pad of a chemically compatible construction material that contains spills are economical, flexible and efficient approaches to mixing and loading.

Several types of portable, temporary, synthetic drive-over mixing/loading pads are available commercially. Generally the pads are vinyl or nylon reinforced elastomer pads or steel pads and vary in size from 4 X 8 feet to 34 X 74 feet. Most have a flexible wall designed to be self-supporting. The material can be decontaminated. The pads are lightweight, easily deployed, durable and reusable.



The pad is rolled over a rock-free level surface. The sprayer is driven over the berm onto the pad. The spray material is loaded and the sprayer is driven off. Spillages are collected with a sump pump, squeegee, or sponge and mop. The spilled material can be collected and returned to the tank.

A sound option would be to haul water to the field or site and do all pesticide mixing onsite on a mobile pad. Sprayers and equipment could also be rinsed in the field to avoid concentrating residues from repeated rinsing near wells. The mixing site should change each year within the field of application.

Absorbent material such as re-usable gelling agents, vermiculite, clay, pet litter or activated charcoal should be on hand along with a garbage can and shovel to quickly contain and clean up any spills. The spilled pesticide should be contained - it should not be hosed down. Absorbing materials should be used to soak up the pesticide which can then be shoveled into a leak proof drum.

Areas used for storage or mixing of pesticides should be constructed in accordance with Board of Fire Prevention Regulations (527 CMR 37.00) , the State Building Code (780 CMR) and the BOCA Mechanical Codes (527 CMR 12.00 Appendix A)

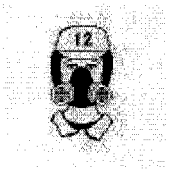
2.0 Closed Mixing Systems

An excellent option is the use of a closed mixing system (CMS). A CMS transfers pesticides from sealed containers to mixing tanks without exposing the worker to the pesticides. The CMS can accurately measure quantities, rinse containers and transfer the mixed pesticide into applicator tanks. Using a CMS greatly reduces the hazards of exposure to concentrated pesticides.

3.0 Construction of a Mixing/ Loading Pad

It is important to consult with an engineer or licensed contractor familiar with the state building code requirements before implementing any plan. Before construction begins, consult with local agencies that deal with planning, zoning, wetlands, health and fire.

If pesticides are often mixed and loaded in the same place, or equipment is cleaned in the one spot, a permanent pesticide mixing/ loading pad is a sound option. Spill clean ups can be made easier, and pesticide waste can be reduced. They can also prevent the harm that spills and runoff can cause to the environment or to people. The area should be located at least four hundred feet (preferably down hill) from any public or private drinking water supplies and two hundred feet (preferably down hill) from surface water. It should not be located within any residential area or other sensitive area (such as feedlots, animal shelters, play areas, schools).



Design

The design of the pad should be a function of the operations performed at the site - the number and volume of different pesticides stored and applied, the rinsing procedures, the size of the spray boom- and also the weather conditions, especially the levels of precipitation and freezing conditions. The pad should be located adjacent to the storage area.

It is recommended that the pad be constructed of an impervious material such as sealed concrete. The pad should remain intact under freezing conditions. The following concrete specifications should be followed to ensure a water tight pad and good surface durability:

- Type I or Type II high quality cement with 5 - 7.5% air entrainment (this improves water tightness) and compressive strength of 4,000 - 4,500 psi;
- Water- cement ratio of 0.40-0.45 for a stiff (1.5" - 3") slump; a relatively dry mix for maximum strength, pesticide and fertilizer resistance, freeze/thaw resistance and water tightness;
- The subgrade (original ground) upon which the pad will be placed must be dense, uniform and relatively free draining to provide a good foundation for the concrete pad. If the subgrade is not adequate a sub-base material should be installed consisting of 4 inches of well compacted clean sand, gravel or sand and gravel mixture;
- The subgrade or sub-base should be moistened immediately prior to concrete placement to minimize shrinkage and cracking potential;
- Large coarse aggregate (1 to 1.5 inches) which permits a lower water content and reduces the potential for cracking should be used;
- Reinforcing steel should be placed two inches from the top of the pad. Reinforcing bars (supported #4 bars at 15 to 18 inch spacing) are superior to wire mesh for proper location of the steel in the slab and to allow workers to step between the bars. Reinforcing steel will keep shrinkage cracks closed if properly located;
- A high level of workmanship should be ensured during concrete placement and curing of the pad.

While concrete is durable, it will deteriorate over time. Pesticides can contaminate concrete and leak through cracks into groundwater. Protective coatings for concrete seal the surface and help prevent the corrosive actions of pesticides and fertilizers on concrete

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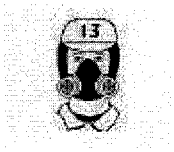


Containment Volume

The total mixing / loading area containment volume should be 1.25 times the volume of the largest tank to be loaded in the area. If the area is not protected from contact with precipitation, the containment volume should be equal to the volume generated by a 2 year 24 hour storm (2.9 - 3.6 inches of rainfall). If the rainwater mixes with a single known pesticide or compatible pesticides (i.e., pesticides with at least one common use site on their labels) the mixture can be applied to the field at or below the label rate.

The pad should be curbed to a sufficient height in order to contain spills, leaks, releases or other discharges that are generated during the mixing and loading of pesticides and to prevent water or other liquids from flowing onto and off of the surface.

To avoid rainwater mixing with pesticides, it is recommended that the area be roofed. Roof overhangs should be at least a thirty degree angle from vertical from the edge of the mixing/loading pad in all directions. As an alternative to roof overhangs, heavy plastic strips or plastic sheeting can be installed to prevent rain from entering the pad.

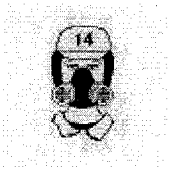
To avoid rainwater mixing with pesticides, it is recommended that the area be roofed. Roof overhangs should be at least a thirty degree angle from vertical, from the edge of the mixing/loading pad in all directions

A well secured heavy tarpaulin can serve as a low cost alternative to a roof. Pads should be constructed with fastening points such as eye hooks to allow quick and secure anchoring of the tarp. It is recommended that a device to elevate the center of the tarp is placed under the tarp to allow rain water to drain off. A greenhouse frame covered with a three year co-polymer film can also be a low cost alternative to a roof. Greenhouse frames are available in widths of up to forty feet. Clean surface and roof water should be diverted away from the pad by a waterway.

Containment needs may be further met by constructing the pad in such a way that it slopes (at least 2%) to a single liquid tight sump.

Sump Designs

The pad should slope to a water tight sump or catch basin. The purpose of a sump is to collect the spilled material and facilitate its reuse. Collected rinsates should be pumped to an above ground holding tank or reservoir and reused for mixing subsequent loads. The sump pump should be capable of transferring the liquid to the holding tank from the sump at a rate equivalent to the fastest sump filling rate. The tanks should not be filled beyond 95% of their capacity to allow for thermal expansion and must be placed on a concrete or other impervious surfaced floor on pallets or on a raised platform to allow the detection of leaks from, or water in or under, the pesticide container.



A single sump can be placed monolithically with the mixing/loading pad or a precast concrete or prefabricated steel sump could be installed before the concrete pad is placed. Precast concrete sumps are built in a range of sizes with capacities up to 100 gallons. A double lined stainless steel sump allows the monitoring by inspection of potential leaks from the sump. Most have a capacity of thirty gallons.

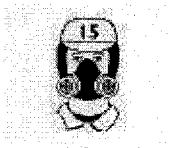
The sump should be kept clean to avoid the creation of sludge due to dirt, mud, trash and rocks. Sludge is considered to be a hazardous waste if contaminated by unknown or incompatible pesticides. If the sludge is contaminated by only one pesticide or a compatible mix, the material can be applied to the land at or below the label rate. To reduce sludge problems in sumps where applicator vehicles are washed, some facilities may require two sumps in series. Sumps should be kept clean as contaminated soil and debris in sumps creates a serious hazardous waste disposal problem. In addition, the sump should be covered with a structural grate to ensure safety. The grate should be covered with a dust cover. The sump should be kept covered and cleaned out especially during spraying season.

The sump should be kept clean to avoid the creation of sludge due to dirt, mud, trash and rocks. Sludge is considered to be hazardous waste if contaminated by unknown or incompatible pesticides

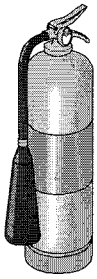
Washing and Rinsing Operations
Washing and rinsing of pesticide residues from application equipment, mixing equipment or other items used in storing, handling or transporting pesticides should occur on the pad.

Protection of Water Supplies
No pesticide application equipment or mix tank should be filled directly from any source waters unless a back siphon prevention device is present.

Non-Liquid Pesticides
If non-liquid pesticides are mixed or loaded the spill containment surface may consist of a tarpaulin made of non-absorbent materials which is of adequate thickness to withstand all forseeable loading conditions.



Recommended Safety Practices



Pesticide Handling Instructions

Materials Safety Data Sheets for each pesticide should be posted in a prominent location. At a minimum the employer should have posted the product label and physical and health hazards associated with the pesticides being used. Agricultural enterprises are required by law to post the labels of the pesticides in use. The measures employees can take to protect themselves from these hazards, including safety precautions and protective work procedures, should be posted.

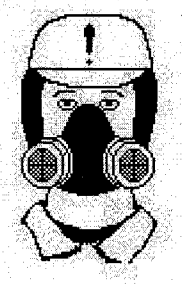
Emergency Response Plan

An emergency response plan should be developed. Such a plan lists actions to take and personnel to contact in the event of a spill or accident. The plan should begin with a current listing of the pesticides used or stored at the facility and should include the following information:

- Names and quantities of pesticides;
- Location of the property including a map with directions;
- Names, addresses and telephone numbers of the owner and key employees;
- Plan of the facility showing pesticides locations, flammable materials, electrical service, water supply, fuel storage tanks, fire hydrants, storm drains, and nearby wetlands, ponds, or streams;
- Location of emergency equipment supplies including breathing equipment and protective equipment;

Copies of the emergency response plan should be located near the entrance to the pesticide facility and with business records. Copies should also be given to the local police department and fire department.

Copies of the emergency response plan should be located near the entrance to the pesticide facility and with business records

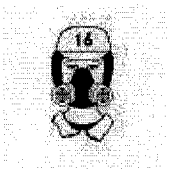


Contacts should include the following: fire department; police; spill clean up firm; nearest hospital; pesticide bureau; board of health; owner of the facility;

The plan should be available in both English and the language or languages understood by workers if this is not English.

Fire Prevention

An automatic smoke detection system or smoke and heat detection system should be installed. The appropriate fire prevention and emergency procedures should be devised in consultation with the local fire department. Suitable methods for extinguishing fires should be installed, such as the



appropriate type and number of fire extinguishers. The number and placement of fire extinguishers should conform with the National Fire Protection Association Standard No. 10. All electrical fixtures and appliances should be non-sparking units approved for use in facilities storing flammable and combustible liquids.

In the event of a fire it is frequently more environmentally sound to allow the fire to burn itself out if it can be contained within the area. This avoids the likelihood of pesticides being released into the ground as a result of water being added.

Personal Safety

Personal protection equipment such as respirators, chemical resistant (CR) gloves, CR footwear, coveralls with long sleeves, protective eyewear, CR headgear, CR aprons and a first-aid kit should be available immediately outside the storage area. The first-aid kit should include the following items: adhesive strips, tape, ammonia inhalant, eye pads, burn cream, gauze bandages and tweezers. Gloves should be made of rubber, neoprene or other chemical resistant material.

It is essential that protective eyewear be worn when mixing/loading. The protective eyewear should consist of safety glasses that provide front, brow and temple protection, goggles or a face shield

It is essential that protective eyewear be worn during mixing/loading. The protective eyewear should consist of safety glasses that provide front, brow and temple protection, goggles or a face shield.

Workers should be instructed in the correct procedure for the removal of contaminated clothing.

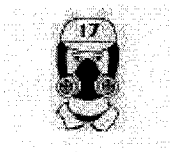
Eye wash stations or portable eye wash bottles should be easily accessed by each person engaged in the operation and should be capable of flushing eyes for a minimum of fifteen minutes. At a minimum, a hose and nozzle should be on hand. Routine wash up facilities, equipped with soap, hand cleanser and single use paper towels should be available near the storage area.

Record Keeping

All discharges to the environment or spills should be recorded. The records should include the date and time of the incident and the cleanup.

Accident Response

An absorbent material such as re-usable gelling agents, vermiculite, clay, pet litter or activated charcoal should be on hand along with a garbage can and shovel to quickly contain and clean up any spills.



Security

The storage cabinets should be kept locked and the door to the storage area should contain a weather proof sign warning of the existence and danger of pesticides inside. The door should be kept locked. The sign should be visible at a distance of twenty five feet and should read as follows:

DANGER
PESTICIDE STORAGE
AREA
ALL UNAUTHORIZED
PERSONS KEEP OUT
KEEP DOORS LOCKED
WHEN NOT IN USE

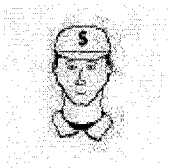
The sign should be posted in both English and the language or languages understood by workers if this is not English.

The storage cabinets should be kept locked and the door to the storage area should contain a weather proof sign warning of the existence and danger of pesticides inside

The following checklist should assist you in quickly assessing your facility

Pesticide Safety Checklist	Yes	No
GENERAL RECOMMENDATIONS		
Clean, neat pesticide storage site		
MSDS posted for each pesticide		
SAFETY		
Smoke detectors / detection system		
Appropriate numbers of fire extinguishers		
Personal Protection Equipment available outside storage area		
First Aid Kit		
Eye wash stations or portable eye wash bottles		
Wash up facilities		
ACCIDENT RESPONSE		
Emergency Response Plan with on-site pesticide inventory		
Posted emergency phone number		
Absorbent materials, shovel and bucket		
RECORD KEEPING		
Accurate storage log maintained		
All discharges to the environment recorded		
Inspection and maintenance records		
PESTICIDE CONTAINERS		
Insecticides, herbicides and fungicides separated		
Pesticides stored in original containers with purchase date and legible labels		
Pesticides stored off floor		
"No smoking" signs posted		
SECURITY		
Storage room posted with sign: Danger - Keep Out		
Storage site well lit and ventilated		
Storage Room locked		
Safety Equipment separated from pesticides		

Funding Options For Farmers



United States Department of Agriculture, Natural Resources Conservation Service
451 West Street
Amherst,
MA 01002-2995
Tel: 413-253-4350

Environmental Quality Incentives Program (EQIP)

EQIP provides technical, education and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their land in an environmentally beneficial and cost effective manner. The program provides assistance to farmers in complying with Federal, State and tribal environmental laws and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan which includes structural, vegetative and land management practices on eligible land. Five to ten year contracts are made to implement the plans with eligible producers. Cost share payments may be made to implement one or more eligible structures such as mixing, loading pads.

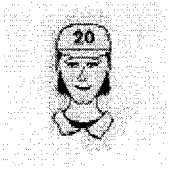
Contact: United States Department of Agriculture, Natural Resources Conservation Service, 451 West Street, Amherst, Massachusetts, 01002-4350. Telephone: 413-253-4350

Massachusetts Department of Food and Agriculture
100 Cambridge Street,
Boston, MA 02202
Tel: 617-727-3000
Fax: 617-727-7235

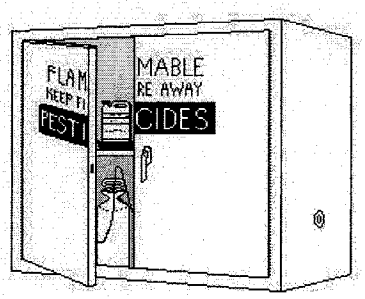
Agricultural Environmental Enhancement Program

Beginning in the winter of 1999, the Massachusetts Department of Food and Agriculture's new **Agricultural Environmental Enhancement Program** will grant $200,000 a year to farmers to purchase materials to protect water quality from the potential impacts of agricultural practices. Eligible materials include pesticide storage facilities and mixing/loading pads, fencing, culverts, seed and gutters.

Contact: Massachusetts Department of Food and Agriculture, 100 Cambridge Street, Boston, Massachusetts 02202. Telephone: (617)727-3000. Fax: (617)727-7235.



Equipment Distributors



1) Grainger Industrial Supplies Inc.
54 New Market Square
Boston, MA 02118
www.grainger.com 888-WWG-4MASS

2) Safety Strategy
Manchester
MA, 01944 978-526-7715

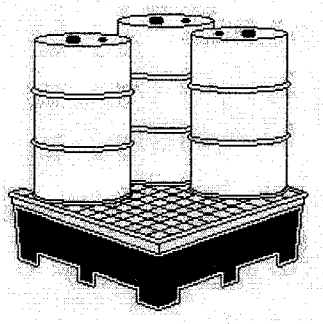
3) Albeco Fasterner & Supply Corp
44 Border St.
West Newton, MA 02465 617-965-8840

4) Environmental Equipment Systems
Division of Turf, Products Corp
157 Moody Rd.
Enfield, CT 06083 800-243-4355

5) Haz Mat Containment Corp. Inc
712 Bancroft Rd., No. 216
Walnut Creek, CA 94598 510-943-5250

6) Safety Storage, Inc.
2301 Bert Dr.
Hollister, CA 95023
www.safetystorage.com 408-637-7405

7) Global Occupational Safety
22 Harbor Park Dr.
Port Washington, NY 11050 800-433-4848



8) Eagle Manufacturing Company
2400 Charles St.
Wellsburg, WV 26070 304-737-3171

9) Hunter Agri-Sales
Box 2
Coatesville, IN 46121 317-539-4400

Acknowledgements

A great deal of the information in this document is drawn from the following document which is the definitive guide to pesticide storage, mixing and loading and is highly recommended.

Kammel, David W., Noyes, Ronald T., Riskowski, Gerald L., Hofman, Vernon L., 1991
Designing Facilities for Pesticides and Fertilizer Containment, First Edition, MWPS-37
MidWest Plan Service, Iowa State University, Ames, Iowa

The Pesticide Bureau is grateful to the following people and organizations for their assistance in reviewing and commenting on various drafts and for their thoughful, constructive comments.

Mr. William Coli of the University of Massachusetts Extension
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The Massachusetts Farm Bureau
The Cape Cod Cranberry Growers Association
The New England Plant Protection Association
Massachusetts Department of Environmental Protection
United States Environmental Protection Agency
The Green Industry Alliance
Steve Ward of Ward Management Co. Inc.

The following publications were also used as reference guides

1) Ross, David S., Bartok, John W. 1995. On-Farm Agrichemical Handling Facilities
NRAES, CES, Ithaca

2) Conference Proceedings, National Symposium on Pesticides and Fertilizer Containment
Design and Management. MWPS-C1. 1992.
MidWest Plan Service, Iowa State University, Ames, Iowa

3) Dean, Thomas W., Ray A. Bucklin. 1995.
Permanently - Sited Storage Facilities in Florida
Florida Cooperative Extension Service

4) Storrs, CT. 1990
Pesticide Storage
Connecticut Extension System

Written By: Gerard Kennedy
Graphics: Mike Cahill
Design and Layout: Miriam Mwangi

APPENDIX D

GENERIC FOOTBALL FIELD MAINTENANCE PROGRAM

GENERIC FOOTBALL FIELD MAINTENANCE PROGRAM

Dr. Dave Minner
Department of Horticulture
Iowa State University

Mowing

- Rule of thumb - Mow frequently enough so that no more than one-third of the grass height is removed at each mowing. If your mower is set at 2 inches then, after mowing the clippings, should only be 1 inch long. Clippings should easily filter into the turf canopy and should not be removed from the field by sweeping or bagging.
- Reel-type mowers produce the best cut and make an attractive stripe on the field.
- For the best traffic tolerance, mow cool season grasses at 2 to 3 inches and warm season grasses at 1 to 2 inches.

Watering

- Water only when the plant tells you. Look for the first signs of visible wilt and then water deep and infrequent. Mature turf can withstand moderate drying, and this will increase root growth and prevent overwatering of the field.
- Over watering can increase turf disease and create anaerobic soil conditions.
- When forcing growth with nitrogen fertilizer and when establishing grass from seed or sod, it may be necessary to water with lighter amounts more frequently.
- A permanent, and preferably automatic, irrigation system that evenly supplies a minimum of 1/4-inch water daily is desired.
- Commercial traveling gun sprinklers have also been successful when an automated system is not possible.
- Small homeowner-type sprinklers are not suitable for football field irrigation.

Fertilizing

- Have the soil tested once a year and make adjustments for pH, phosphorous and potassium.
- In addition, apply potassium during the growing season at the same time and same rate as nitrogen.
- At least once per year, apply a complete fertilizer containing nitrogen, phosphorous and potassium.
- Apply phosphorous in combination with coring to facilitate incorporation into the soil profile.

Nitrogen Fertilization Schedule:

- Cool season grasses (bluegrass, ryegrass and fescue)
- March to April 1.0 lb N/1000 sq. ft. from a soluble N source;
- May 1.5 lb N/1000 sq. ft. from a slow release source;
- Sept. to Nov. 1.0 lb N/1000 sq. ft. per month from a soluble N source.

Pest Control

Contact your State Turfgrass Extension Specialist for local pest control recommendations.

- Pesticides are an effective way to control weeds, diseases and insects when pest populations are high enough to cause turfgrass decline. Your goal should be to properly identify the pest problem in the early stages; determine if the pest population would significantly alter turf function; and develop a plan to reduce the pest population. Routine pesticide application as a preventative measure of pest control is not recommended on high school athletic facilities. Treat the pest curatively once it has been observed; and preventively only when you have had prior outbreaks and have good reason to suspect a recurrence.
- Remember you are not exercising sound policy when pesticides are used as insurance against turf loss and as a substitute for proper employee training in turfgrass management.

Weeds

- Herbicide applications must be carefully scheduled to account for newly emerging turfgrass that may be part of your annual renovation program for high-traffic areas.
- Most herbicides are not labeled for use on newly planted or seedling turf.
- Broadleaf weeds can be effectively controlled with selective post-emergent herbicides.
- When annual grassy weeds are anticipated, control with a pre-emergent annual grass herbicide.
- Knotweed and crabgrass are especially competitive weeds in high-traffic areas. When renovating and reseeding high-traffic areas, seed at 1.5 to 2 times the normal seeding rate to give the young turfgrass a competitive edge. High seeding rates in small areas can often eliminate the need for herbicides.

Diseases

- Specific turf diseases can be managed with fungicides and cultural practices such as mowing, watering and fertilizing. If you are experiencing routine loss of turf from

disease, it is time to change your management practices or select more disease-resistant grasses. Fungicide application should not be a routine practice on high school athletic fields.

Insects

- Subsurface feeding insects are of major concern because they feed on roots, cause turf to be easily dislodged and result in poor footing. Know the life cycle of underground feeders such as grubs and anticipate when they may become a problem. Insecticides can give a quick kill once you know where and when a pest is present. Insecticide application should not be a routine practice on high school athletic fields.

Cultivation

- Hollow and solid-tine coring, water jet coring, slicing and spiking are methods of cultivation that are routinely used on football fields to reduce soil compaction.
- Cultivation equipment physically penetrates the surface to improve air, water and nutrient movement into the soil.
- Hollow-tine coring equipment is absolutely necessary in the management of high-traffic athletic turf. Football fields should be aerated at least twice per year. In high-traffic areas, it is not uncommon to aerate six to eight times per year.

Renovation

High school football fields usually require renovation every 1 to 3 years. The extent and cost of renovation will depend on how long the field has been neglected. Typical components of a renovation are:

- Repair crown by adding soil and regrading.
- Core aerify and add complete fertilizer and other soil amendments.
- Topdress with sand or sand/soil mix.
- Drill or slit seed in two to four different directions with commercial turf-type equipment.
- Drill seeding is preferred, but broadcast seeding in combination with power slicing and coring has also been successful.
- Water light and frequently until turf is established.

Traffic Control

- Managing a football field requires coordination among the administrator, coach, band director, and grounds manager. Administrators should keep in mind that proper traffic control costs nothing in terms of dollars and at the same time offers the most effective

means of reducing dangerously worn areas on game and practice fields. Understanding your role as a user of the field is a first step in communication.

- The coach must take an active interest in scheduling practice activities and preventing excessive turf wear. The coach and the grounds manager can work together to develop improved grass areas specifically for drills that are conducted off the game and practice fields.
- The band director should have a practice field painted on another grass area or in a parking lot. The area should be situated so that the practice can be viewed from above, as if you were in the bleachers. Band practice on the game field should be limited to once per week and only when the soil is dry enough to resist compaction in marching paths.
- No activity (band, football, or field maintenance) should be conducted on the field while there is frost on the grass.
- The grounds manager should realize that he is caring for a multi-use facility rather than just a football field. Extra use requires additional labor, equipment and resources.
- The administrator should clearly define the conditions for using the field. As much as possible, reserve the field for games only. Be prepared to allocate resources on an annual basis for field maintenance and on a less frequent basis for field renovation. Spread larger capital improvements out over multiple years, i.e. automated irrigation system:
- Year 1 install pipe, valves and wire;
- Year 2 install heads and operate system manually; and
- Year 3 install automatic controller.

APPENDIX E

ANNUAL BLUEGRASS WEEVIL IPM PLAN

ANNUAL BLUEGRASS WEEVIL IPM PLAN

The following is a recommended best management practices program for annual bluegrass weevil management at any Nassau County golf course. It was developed by Jody Gangloff-Kaufmann, PhD, and Tamson Yeh, PhD, of Cornell University, Cornell Cooperative Extension.

Monitoring and Inspecting for Pests – Get a Scout!

1. It is highly recommended that Nassau County hire or designate a well-trained individual as an IPM scout for the three courses (one scout for each or preferably one scout for all three 18-hole courses). This individual could be hired through the creation of an internship between Nassau County and a local university with a horticulture department. The scout's job would be to look for early signs of insect and disease problems, keep records, and make pest reports and maps. The time between March and August is critical for scouting, early for insects and later for diseases.

2. Develop a line drawing map of each golf course for recording data.

3. Scout should perform weekly scouting to map ABW and other insect and disease activity. Scout will make notes of dates, locations and species. These maps should be used to compare years and patterns of activity and damage.

March

- Take soil temperatures with soil thermometer. When temperatures are between 50 and 54°F, use a lemon dish detergent disclosing solution to scout for ABW adults traveling from overwintering sites to egg-laying and feeding areas. Alternatives could be using black light traps or looking through grass clippings in the mower for adults. Pinpoint locations with high ABW adult activity for insecticide applications.
- On or around March 15th, or when adults are starting to be found, make the first application of Scimitar**. This is earlier than past recommendations and is based on the observation that ABW will move earlier than March 30 when soil temperatures are warm.

Best practices are:

1. Apply pesticide at night or as close to dusk as possible. Adults are active at night.

2. Apply insecticide for ABW after mowing.

3. Water the spray in LIGHTLY, no more than 1/4 inch of water.

4. Work around the weather and do not apply insecticide if heavy rain is in the forecast.

April

- Continue scouting for adults with a soap flush or grass clipping inspection. Locations of adult activity should be mapped. Treat again, if necessary, rotating to Tempo 20 WSP.

May

- The scout should sample for ABW larvae using a cup-cutter or knife technique and removing turfgrass to just 1 inch deep. Pay close attention to areas with current or past anthracnose damage. ABW may be attracted to these areas.

June

- On or near June 1st, apply a combination spray of Scimitar and Merit to target the larvae. This may be tricky because larvae living in grass stems are not vulnerable to sprays. However, at this point, all life stages will be present, so both adults and larvae are targeted by a combo spray.
- Continue to scout for adults using a soap flush, a black light or inspection of grass clippings.

July

- During the second half of July and early August, scout for adults again. Apply an insecticide if large numbers of adults are seen again to target next year's overwintering adults.

APPENDIX F

NRCS PLANT GUIDE – *Spartina Alterniflora*

SMOOTH CORDGRASS

Spartina alterniflora Lois.

plant symbol = SPAL

Contributed By: USDA, NRCS, Louisiana State Office

Alternative Names
saltmarsh cordgrass, oystergrass, saltwater cordgrass

Uses
SE US Coastal & Shoreline Restoration: Smooth cordgrass is a unique plant species that when established properly and under applicable conditions has proven to provide significant erosion protection to shorelines, canal banks, and other areas of coastal wetland loss.

Grass Images
Texas A&M University

Smooth cordgrass is used primarily for erosion control along shorelines, canal banks, levees, and other areas of soil-water interface. In addition, smooth cordgrass is an effective soil stabilizer used on interior tidal mudflats, dredge-fill sites, and other areas of loose and unconsolidated soils associated with marsh restoration. When established in conjunction with shorelines, smooth cordgrass provides an effective buffer that dissipates energy, reduces shoreline scouring, and traps suspended sediments and other solids. Dense stands of smooth cordgrass are efficient users of available nutrients, producing significant amounts of organic matter. The cumulative effects of organic matter production, sediment trapping, and erosion control not only provide shoreline protection but also accelerate

sediment accumulation and near-shore building. Consequently, smooth cordgrass is a sustainable and renewable restoration resource, and when properly established and in the appropriate habitat, will persist and potentially remain effective indefinitely.

Status
Smooth cordgrass is a native species critical to Barrier Island and wetland restoration along the southeastern coastal states, while it is introduced into areas on the Pacific coast, where has become an aggressive invasive species. Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status, and wetland indicator values.

Description
General: Smooth cordgrass is a herbaceous, native, warm season grass that forms dense vegetative colonies along shorelines and inter-tidal flats in coastal wetlands. Smooth cordgrass is a robust, rapidly spreading plant, tolerant to fluctuating water depths and salinity. Smooth cordgrass spreads primarily by vegetative propagation, producing new stems from an extensive system of underground rhizomes. Plant height will vary according to site conditions, but generally will range from 24" to 72." Colonies tend to grow parallel to and continuous along shorelines; the width and thickness of a vegetative colony is controlled by a number of site-specific conditions such as elevation, shoreline-slope, and frequency, depth, and duration of flooding.

Distribution: Generally, this species occurs in the coastal states along the U.S. It is not native on the West Coast. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Establishment
Adaptation: Smooth cordgrass is an inter-tidal brackish plant species. It is described as a facultative halophyte; that is, it will tolerate salt, but salt is not a requirement for its growth. Smooth cordgrass can be established in freshwater, however, numerous field trials have demonstrated that smooth cordgrass is difficult to establish and will not persist under freshwater field conditions. The ideal salinity range for establishing and growing smooth cordgrass is 8 to 33 parts per thousand or brackish to saline habitats. Smooth cordgrass can be established and will persists in areas of elevated salinity (such as salt-flats and tidal lagoons), however plants in high saline habitats

tend to be stubby and less robust, generally resulting in thinner and more open vegetative stands.

Of primary importance in site selection is that the site be inter-tidal. Smooth cordgrass is critically sensitive to reduced soil sulfides, a condition common to anaerobic and brackish marsh soils. Smooth cordgrass should not be planted outside of the tidal zone. Smooth cordgrass will tolerate fluctuating water levels. Optimum water depths for establishing plants are 1" to 18". Plantings in deeper water have been successful, however plants are slow to anchor and vegetative cover is sparse. Consequently, plants are more prone to washout, and minimal shoreline protection is achieved.

Smooth cordgrass is adapted to a wide range of soils from coarse sands to clays and mucks. Plant establishment and productivity appear to be superior on heavier mineral soils such as mucky clays, silty clays, silty clay loams, and fine sands. Soils with very high levels of organic matter pose structural problems and have proven to be problematic in establishing stands of smooth cordgrass.

Considerations: There are a number of other site-specific elements that should be considered when working with smooth cordgrass. These conditions represent extremes and should be thoroughly investigated prior to committing to a significant project if any of these conditions occur.

- Soil load-bearing properties -- It is not uncommon for soils (especially in dredge deposit sites) to be fluid to the point that they physically will not support the weight of plants. This is an indicator of soils with a very high water-to-mineral ratio.

- High organic soils – Smooth cordgrass will not survive in soils with extremely high levels of organic matter. These soils are described as having very low bulk density and are problematic. When soil texture approaches the consistency of peat moss, there is potential for low plant survival.

- Poor water circulation – Smooth cordgrass is critically sensitive to sulfide accumulations and has a relatively low tolerance to sulfide toxicity.

- Shoreline configuration – Abrupt and steep cut-banks are indications of high wave energy and/or highly erodible soils. Special precautions may be required to keep transplants from dislodging prior to becoming established.

- Herbivore grazing – Smooth cordgrass is a favorite of numerous grazing animals. In areas of heavy nutria population, caging plants may be required to protect newly planted material.

- Smothering – Precautions should be taken when planting in areas of heavy floating debris. Both mechanical damage to the plants from surf-trash and smothering from water hyacinths are common.

If any of these conditions are present, consult with a wetland specialist for additional information and/or possible alternatives.

Planting: Smooth cordgrass is a poor seed producer. Although plants appear to produce a significant number of seeds, most seeds are empty, damaged, or sterile. Consequently, seed fertility is low. For planting purposes, two forms of vegetative plant materials are recommended: containerized and bare-root plugs. Both plant forms have shown to be equally successful in establishing plant stands when planted properly and on applicable sites. There are no commercially available sources of seed, and seeding is not currently a recommended practice.

Smooth cordgrass can be produced in a number of container sizes, however trade-gallons are the most widely used and most popular size. Trade-gallon containers have a higher per unit cost compared to smaller containers or bare-root plugs, but provide the most reliable means of establishment. Trade-gallon plants have proven to be a highly successful transplant, especially along shorelines and other areas of high wave energy.

A trade-gallon will have 5 to 12 aerial stems that are 18" to 24" in height. Smooth cordgrass produces new tillers (stems) and spreads almost entirely from rhizomes. Consequently, a well-developed root mass is critical to the survival and productivity of transplants.

Bare-root plugs are the most economical of the commercially available plant sizes. Per unit production costs are low and transportation costs are very low compared to container plants. Bare-root plugs are generally limited to planting sites that have little or no energy exposure. Typical sites would include mudflats, sediment disposal areas, terraces, or other interior and protected sites. Bare-root plugs because of their limited surface area will not persist in high-energy environments. They tend to dislodge prior to establishing. Bare-root plugs have

significantly less rootmass than container plants, will suffer a higher level of transplant shock, and are slower to spread than container plants. However, if handled properly and used on an applicable site, bare-root plugs can be highly successful transplants.

Bare-root plugs typically consist of 3 stems 12" to 18" in height, and stems should remain attached at the root. Plugs should have a rootmass of at least 2" in diameter at the root crown and 6" of root length.

A complete description (specification) for both trade-gallon container plants and bare-root plugs is available from the Natural Resources Conservation Service in Louisiana.

Planting Date: As a general rule, smooth cordgrass can be planted between April 1 to September 30. Some additional considerations include the following:

- Smooth cordgrass can be planted anytime past the last frost date if there is a need to plant earlier and available transplants are actively growing. In some areas this may be earlier than April 1.

- In interior marshes with poor water circulation, avoid planting between mid-July and the end of August. Elevated water temperatures are generally detrimental to new transplants; therefore July and August plantings should be limited to lakes, bayous, and other areas of frequent tidal exchange.

- Late fall plantings in October and November have been successfully made in the past, but should be limited to sites that are well protected and have minimal winter storm effect.

Planting Location: It is critically important to remember that smooth cordgrass is strictly an inter-tidal plant species and must be planted within the inter-tidal zone. Smooth cordgrass can be used for erosion control along shorelines, canal banks, levees, and other areas of soil-water interface. In addition, smooth cordgrass is an effective soil stabilizer used on interior tidal mudflats, dredge-fill sites, and other areas of loose and unconsolidated soils associated with marsh restoration.

Shoreline Plantings: Shoreline plantings are typically planted as a single row parallel to the shoreline. Transplants should be planted at the mid-point between the high and low tide elevations. Plant spacing within the row will vary according to the size of the transplant materials being used and the rate at which full coverage is desired. Trade-gallons generally are planted on 5' to 8' centers and plugs generally on 2' to 3' centers. Under applicable site conditions, smooth cordgrass will spread laterally filling spaces between plants and will grow up to its highest elevation and down to its lowest elevation. It is not uncommon for smooth cordgrass to produce 8' to 10' of lateral spread in one growing season.

Depending on site conditions and the planting objective, two rows of smooth cordgrass are occasionally planted. A two-row planting will provide quicker and denser short-term coverage than a single-row planting. If two rows are planted, rows should be parallel to each other and about 5' apart using the same plant spacing within row as that of a single row. The first row should be placed slightly above the mean tide elevation and the second row 5' below the first. Plants within the two rows should be staggered on center so that plants alternate between spaces.

Interior Plantings: In addition to planting shorelines, smooth cordgrass can also be used along terraces, levees, across mudflats and dredge-fill sites. The planting configuration should be designed to provide maximum reduction in fetch lengths. Rows can be placed across shallow water exchange points to create a passive hydrologic barrier that will slow tidal exchange and trap suspended sediments. Planting large areas generally will require a significantly large number of plants. Where applicable, plugs can be used and placed in a row-column configuration. The row and plant spacing can vary from a few feet to many, depending on the objective of the planting, the target rate for coverage, and available resources.

Planting Methods: When planting trade-gallons, transplants should be planted in a dug hole. Post-hole diggers, gas drills with modified bits, or any other methods of digging are satisfactory. The planting hole should be the same size or only slightly larger than the root-ball and deep enough so that the top of the root-ball is flush or slightly below ground. The top of the root-ball should not protrude above nor be more than 2" below normal ground. The planting hole should be tightly closed around the plant to prevent the plant from wobbling and plants should remain erect after planting.

Planting sites where high wave energy is a problem may require the addition of a plant anchor. A plant anchor consists of ¼" mild steel re-bar bent into a crosier hook (candy-cane shape) and pushed down into the soil so that hook lays across the root-ball, pinning it to the ground. Anchors are generally about

30" in overall length and will add to the cost of the planting. However, anchors are generally necessary at unusually problematic sites to prevent plants from washing out.

When planting bare-root plugs, holes need only be approximately 3" in diameter and deep enough to cover the roots. Any style of tool that will punch a hole this size such as a dibble bar will work. Cupping the roots of the plug in hand and pushing down into the mud carefully will also work in more fluid soils. There are no plant anchors for plugs, and in practice plugs should not be used at any site where wave energy is a factor.

Fertilization: There is no clear consensus on the effectiveness of fertilizer when used in saturated and/or anaerobic soils. However, the additional cost of fertilizer is a small investment given the overall cost involved in vegetative restoration. High nitrogen slow-release fertilizer tablets will add approximately .08 to .10 cents to the cost of an individual plant.

Slow-release fertilizer tablets are commercially available in a range of weights and analyses. Recommended tablet weight should be between 15 and 25 grams and have a nitrogen content of not less than 15% or more than 30%. When using tablets with trade-gallon plants, push the tablet into the top 3" of the root-ball immediately prior to or immediately after planting the transplant. The resulting hole should be pinched closed. When using tablets with bare-root plugs, drop the tablet in the planting hole prior to inserting the plug.

Cultivars, Improved and Selected Materials (and area of origin)

Please check the Vendor Database, expected to be on-line through the PLANTS Web site in 2001 by clicking on Plant Materials. There are two known cultivars, 'Vermilion' and 'Bayshore'. Vermilion was released in 1989 for use in the Gulf of Mexico northern basin, and Bayshore was released in 1992 for use on the Atlantic Coast. The Natural Resources Conservation Service Plant Materials Program released both.

Plant materials are generally obtained from two sources, a donor wetland site or commercial nurseries. The use of donor wetlands to obtain young plants will eventually affect the health and vigor of the donor stand regardless of the care taken in frequency, spacing, and location of plant removal. In addition, the removal of plant materials without the applicable permits may be in violation of standing state and federal regulations. Removing plant materials from donor stands is not recommended.

Nursery-grown stock is generally the most reliable and ecologically appropriate way to obtain plant materials. There are a number of commercial nurseries that produce and maintain smooth cordgrass transplants. Trade-gallon and vegetative plugs are the two most common sizes, however most nurseries will contract for other container sizes. Smooth cordgrass seed is currently not commercially available.

Vegetative specifications should be used to tailor plant material quality and quantity to a specific project. These specifications should include acceptable sources, cultivars, ecotypes, plant size, stem height, container specifications, and extent of root development. In addition, other requirements such as climatic hardening, salt hardening, procedures for transportation and handling are commonly included.

A list of commercial wetland plant nurseries and assistance in developing plant material specifications is available from the Natural Resources Conservation Service in Louisiana.

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For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site <http://plants.usda.gov>.

APPENDIX G

TIDAL WETLANDS BUFFERS GUIDANCE DOCUMENT

OFFICE OF LONG ISLAND SOUND PROGRAMS

TIDAL WETLANDS BUFFERS GUIDANCE DOCUMENT

INTRODUCTION

This document was developed to provide local land use agencies with background information regarding the value of vegetated buffers as a tool in protecting tidal wetlands from adverse impacts associated with adjacent upland development. It presents a brief overview of tidal wetlands followed by a discussion of what vegetated buffers are, how they function, what characteristics make the ideal buffer and how buffers can be used to protect tidal wetlands. Key concepts in the development of buffer regulations are presented and model regulation language is provided.

This document concentrates on the value and establishment of buffers to protect tidal wetlands. However, it should be noted that buffers can be an effective tool in protecting other sensitive resource areas.

TIDAL WETLANDS

WHAT ARE TIDAL WETLANDS?

Tidal wetlands are:

> those areas which border on or lie beneath tidal waters, such as, but not limited to banks, bogs, salt marshes, swamps, meadows, flats, or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters, and whose surface is at or below an elevation of one foot above local extreme high water; and upon which may grow or be capable of growing some, but not necessarily all, of [a list of specific plant species - see Connecticut General Statutes (CGS) section 22a-29(2) for complete list of species]" [CGS section 22a-29].

In general, tidal wetlands form in "low energy" environments protected from direct wave action. They are usually flooded by tidal waters twice a day and support a diverse ecosystem of vegetation and wildlife.

WHY ARE THEY VALUABLE?

Tidal wetlands are areas of high nutrient and biological productivity that provide detrital products forming the base of the food web in Long Island Sound. Next to tropical rainforests, tidal wetlands are the most biologically productive resource in the world. Tidal wetlands provide habitat, nesting, feeding, and refuge areas for shorebirds; serve as a nursery ground for larval and juvenile forms of many of the organisms of Long Island Sound and of many estuarine-dependent oceanic species; and provide significant habitat for shellfish. Most of the commercial fisheries stock that we eat start their lives in tidal wetlands. These resource areas also improve water quality by trapping sediments, reducing turbidity, restricting the passage of toxics and heavy metals, decreasing biological oxygen demand (BOD), trapping nutrients, and buffering storm and wave energy. Tidal wetland vegetation stabilizes shorelines and buffers erosion. Tidal wetlands provide recreational opportunities for fishing, wildlife observation and hunting; are important to commercial and recreational shell- and finfisheries; and are areas of scientific and educational value. Tidal wetlands are a major source of coastal open space and offer exceptional scenic views.

WHY DO TIDAL WETLANDS NEED PROTECTION?

Due in part to their transitional location between upland areas and coastal waters, tidal wetlands are very specialized habitats that are sensitive to disturbance. Human actions, both direct and indirect, can adversely impact tidal wetlands and their functions. Direct actions include activities such as filling, dredging and trampling; indirect actions include upland uses that result in sedimentation, increased stormwater discharge, proximate septic system failures or the installation of culverts in a manner that decreases salt water flushing. In these cases, the delicate balance between soil surface, water level, water quality and/or salinity is disturbed. This results in a stressed habitat which is usually less productive than a healthy marsh and frequently supports undesirable species, most typically Common Reed (*Phragmites australis*). Historically, many of these activities have occurred in Connecticut resulting in the loss or degradation of the majority of tidal wetlands. As a result it is even more important to protect the wetlands that remain.

WHAT ARE MUNICIPAL RESPONSIBILITIES TOWARD TIDAL WETLANDS?

Although activities within tidal wetlands are regulated by the DEP, municipalities are responsible for ensuring that adjacent upland development does not harm these resource areas. The Connecticut Coastal Management Act contains policies and standards regarding tidal wetlands that must be applied during municipal coastal site plan review process. Generally speaking, land use boards and commissions in coastal municipalities must ensure that development will not result in degradation of tidal wetlands, and that tidal wetlands are preserved, protected and, to the extent practicable, restored.

VEGETATED BUFFERS

WHAT IS A VEGETATED BUFFER?

A vegetated buffer is an undisturbed area or strip of land covered with permanent stable vegetation adjacent to a resource area. They can be either in a natural state or artificially planted. If artificially planted, low-maintenance, preferably native, non-invasive vegetation should be used. Vegetated buffers are frequently used to protect inland wetlands and watercourses. Depending upon their purpose and site-specific conditions, effective vegetated buffers can range in width from a few yards to several hundred feet.

WHY ARE VEGETATED BUFFERS VALUABLE FOR TIDAL WETLANDS PROTECTION?

Properly designed buffers protect resource areas from direct and indirect adverse impacts associated with adjacent upland development. They protect tidal wetlands from adverse changes to water quality and temperature; control erosion and trap sediment; protect and provide wildlife habitat; reduce the effects of flooding on adjacent upland property; reduce the potential for direct human and/or pet disturbance of sensitive wetland areas; maintain aesthetic diversity and enhance recreational value of coastal areas. An effective and established buffer provides a mosaic of inter-dependent functions.

Establishing a vegetated buffer area can decrease lawn maintenance requirements and associated costs and impacts by reducing the area of manicured landscape. This results in lowered costs for lawn care, including mowing and fertilizer and pesticide application, while improving tidal wetland protection.

HOW DO WE KNOW THAT VEGETATED BUFFERS ARE EFFECTIVE?

There have been numerous research projects to assess the value of buffers as wetland protection measures. The scientific literature to date has examined several different types of buffers (e.g., forested, grassy, shrubby) of varying widths and evaluated their effectiveness at protecting water quality in adjacent wetlands and watercourses from specific impacts associates with identified upland uses. As with most scientific research, each study has generally had a narrow focus and has examined specialized functions such as the retention of nitrogen, phosphorous, sediment or pesticides and herbicides. The majority of this research has been done with respect to freshwater wetlands and watercourses with little research specific to tidal wetlands. Despite the research done to date, there are still too many unknowns to determine the optimum buffer width for every instance.

HOW DO VEGETATED BUFFERS WORK?

In general, retaining an undisturbed buffer area adjacent to a tidal wetland will promote stormwater infiltration, pollutant retention, and habitat protection. It will also discourage direct human disturbance and increase visual diversity. Buffers provide these benefits in very specific ways, depending upon the intent of the buffer.

HOW DO VEGETATED BUFFERS PROTECT WATER QUALITY?

When used for water quality protection, the primary role of a vegetated buffer is as a stormwater management measure. Since the land within a buffer area is not developed or significantly disturbed, it typically does not generate pollution. Such an undisturbed area acts as a filter to intercept and absorb nutrients, sediment and other pollutants carried in stormwater runoff that flows across or through the buffer. A vegetated buffer also slows the flow of runoff which both reduces erosion of the buffer area and allows silt and other suspended solids to settle out within the buffer before reaching adjacent wetlands. Additionally, any contaminants attached to the trapped sediment are retained in the buffer area and do not reach the wetland. Slowing the speed of runoff also allows the water to infiltrate the soil and ultimately discharge to the wetland as groundwater rather than as overland flow thereby reducing the volume of surface runoff. This is especially significant as freshwater, even if of drinkable quality, when introduced into a saline habitat, such as most tidal wetlands in Connecticut, can have significant adverse impacts by diluting the natural salt content of the receiving area. Discharge as groundwater reduces potential adverse impacts as it is usually below the root zone of the wetland area and, thus, has less effect on the resource. Buffer areas also trap bacteria, pathogens and pesticides which then decompose or break down in place, aiding in the preservation of water quality.

HOW DO VEGETATED BUFFERS PROTECT AND PROVIDE WILDLIFE HABITAT?

Vegetated buffers provide wildlife with needed areas for feeding, resting, nesting and raising young, as well as corridors through which wildlife can safely transverse otherwise developed areas. Vegetated buffers not only provide wildlife habitat directly within the buffer area but also protect adjacent wildlife habitat in the abutting resource area. Some wildlife species use the buffer area itself, while others use the tidal wetlands protected by vegetated buffers and some species will use both areas.

HOW DO VEGETATED BUFFERS PROVIDE FLOOD CONTROL?

Naturally vegetated buffer areas adjacent to tidal wetlands serve a number of functions for flood control. On level areas abutting tidal wetlands, vegetated buffers can serve as areas where flood waters can spread out. Root systems of shrubby and forested vegetation within the buffer areas generate pores in the soil, allowing flood waters to infiltrate the soil within the buffer. Significantly more water can infiltrate soil that supports shrubby and forested vegetation than land used for lawn, buildings, patios and terraces, driveways or other less permeable surfaces. Buffers

also provide flood control by moving development back from the naturally flood-prone resource area.

HOW DO VEGETATED BUFFERS PROTECT WETLANDS FROM HUMAN DISTURBANCE?

When used to protect tidal wetlands from disturbance by humans and their pets, a vegetated buffer primarily provides a physical barrier between areas of human occupation and tidal wetlands. Human disturbance often takes the form of trampling, disposal of grass clippings and other lawn waste, intermittent filling, and other improper disposal actions. Pets can interrupt the life routines of wildlife of the wetlands and buffer area by both predation and general disturbance. The denser the vegetation in the buffer area, the less it is apt to be penetrated by humans and their pets.

HOW DO VEGETATED BUFFERS MAINTAIN AESTHETIC DIVERSITY AND RECREATIONAL VALUE OF COASTAL AREAS?

A healthy tidal wetland is usually fairly flat and the most obvious vegetation is comprised of grasses. Abutting vegetated buffers can offer a visually interesting contrast in terms of vegetation type and texture. This contrast increases aesthetic diversity of the coastal area and, because they are both interesting to look at and provide habitat for birds and other wildlife, they increase the recreational value of the coastal area by providing improved opportunities for birding, painting/drawing, and other passive recreational pastimes.

WHAT DETERMINES THE OVERALL EFFECTIVENESS OF A VEGETATED BUFFER AREA FOR PROTECTING TIDAL WETLANDS?

- The general topography of the buffer area. Flat or gently sloping buffers are more effective because they are more successful at slowing the rate at which stormwater flows across them. A slower flow rate enhances the infiltration and filtering capability of the buffer. The ability to provide flat or gently sloping buffers is clearly related to individual site characteristics.

- The type of stormwater flow. Sheet flow (slow unrestricted flow across the ground) along the length of the buffer allows the buffer area to more effectively trap sediments, attenuate pathogens and pollutants, and encourage infiltration. Concentrated flow (e.g., flows directed through swales, pipes or other conveyances or flows that are strong enough to create gullies or other eroded channels) reduce or essentially eliminate the effectiveness of a buffer for stormwater management.

- The permeability of the soils and the depth to the water table. Generally, higher soil permeability (the rate that water can flow through soils) and greater depth to the water table will increase the rate of infiltration and attenuation within the

buffer area. It should be recognized that, except for areas where the land slopes sharply up from the wetland boundary, generally the depth to groundwater adjacent to tidal wetlands is quite shallow.

- Whether the current vegetation is native or non-native, its density and its character (e.g., forested, shrubby, grassland, etc.). Dense, minimally groomed, native vegetation is inherently suited to the local climate and generally provides an effective buffer that requires less maintenance than non-native or heavily groomed vegetation.

- Whether the land use above the buffer poses a high, medium or low risk for pollution or other disturbance. The higher the risk posed by the upland use, the greater the need for an effective buffer. Increasing the width of a required buffer and/or increasing the density of native plantings can aid in offsetting the potential impacts from a high-risk upland use.

- What types of activities are permitted within the buffer. The fewer activities allowed, the more valuable a vegetated buffer will be. Land clearing, grading or other disturbances and establishing or maintaining impervious surfaces with vegetated buffer diminish their overall effectiveness for a variety of purposes. However, in some instances, minimal access to the tidal wetlands edge might be appropriate as a reasonable exercise of riparian or littoral rights in order to obtain access to a dock or boating facility. For large projects, passive recreation amenities, such as hiking trails, benches and/or picnic tables may be appropriate to provide a necessary water-dependent use provided they are properly designed to minimize disruption of the buffer as a resource protection measure.

HOW WIDE IS WIDE ENOUGH?

The scientific literature to date has examined several different types of buffers (e.g., forested, grassy, shrubby) and evaluated their effectiveness at protecting water quality in adjacent wetlands and watercourses. As is typical with research projects, most projects have been narrowly focused and generally each study has examined isolated impacts or values associated with specific upland uses. For example, a single research paper might examine the effectiveness of a 60 meter (197 foot) wide buffer in removing total suspended sediments (TSS) in stormwater runoff. Or a study might investigate the use of a 30 meter wide buffer by avian species for general habitat.

The majority of this research has been done with respect to freshwater wetlands and watercourses. However, in the absence of tidal wetland specific investigations, it may be reasonable to assume that the data on freshwater systems is transferable to tidal wetlands.

The data available does not clearly indicate an optimum minimum buffer width for multi-purpose buffers. However, The Scientific Basis for Protecting Riparian & Wetland Buffer Zones (REMA Ecological Services) indicates the following removal rates can generally be provided by a 100 foot buffer:

81 percent of total suspended solids
89 percent of sediment
89.5 percent of nitrogen
82 percent of phosphorous

Of these potential water quality contaminants, TSS is only one for which a removal standard has been set. The US Environmental Protection Agency has set a TSS removal goal of 80 percent.

It should be noted that there is a strong indication in the literature that the effectiveness of buffers is not a linear function. In other words, one cannot take the data listed above and assume that if a 100 foot buffer removes 82 percent of phosphorous, for example, each foot of buffer will remove 0.82 percent of phosphorous or that a 122 foot buffer will remove 100 percent of phosphorous. However, this data does suggest that a 100 foot vegetated buffer has a significant effect in removing the listed substances.

In contrast, the data related to the provision of buffers for wildlife functions, including feeding, nesting, resting and movement corridors vary considerably. The following list of effective buffer widths for wildlife functions is taken from How Ecology Regulates Wetlands (Washington State Department of Ecology).

15-23 m (49-75 feet) of riparian wooded area can provide general avian habitat
15-30 m (49-98 feet) of densely growing mixed vegetation can protect wetlands habitat from low-intensity disturbance
30 m (98 feet) of unspecified area can provide a wildlife travel corridor
30-45 m (98-148 feet) of densely growing mixed vegetation can protect wetlands habitat from high-intensity disturbancest
60 m (197 feet) of unspecified area can provide breeding sites for fragment-sensitive bird species
60-100 m (107-328 feet) of unspecified area can provide general wildlife habitat
67 m (220 feet) of wooded riparian area can provide small mammal habitat
91.5 m (300 feet) of natural vegetation a can provide protect significant wildlife habitat
178 m (584 feet) of unspecified area can provide general wetland habitat protection
200 m (656 feet) of unspecified area can provide diverse songbird habitat
<200 m (656 feet) of riparian forest can provide reasonable habitat for all except the largest mammals

As is apparent from these limited data examples, there is no single universal width that can provide all the desired benefits of a buffer. It can be stated, however, that the effectiveness of a buffer increases with its size. Wide buffers (e.g., 100 feet or greater in width) provide the best protection for water quality by moderating temperature changes and improving control of erosion, sediment and pollution and provide the widest range of wildlife values. It can be concluded that wider buffers also provide more

overall benefits such as reducing human disturbance, maintaining wildlife habitat and providing improved flood protection. However, even a narrow buffer (25 to 50 feet in width) can be effective for specific purposes in certain limited situations. For example, a 50-foot buffer supporting dense native vegetation might provide substantial aesthetic benefits and general avian habitat; however, it would not provide adequate entrapment of total suspended solids to meet the EPA goal of 80 percent unless combined with the implementation of other best management practices.

Thus, it should be apparent that the optimum width of a tidal wetlands buffer depends upon a combination of on-site and adjacent conditions (topography, soils, upland use, etc.) and desired function of the buffer (water quality protection, wildlife habitat provision, physical barrier to human intrusion, etc.).

IN GENERAL TERMS, WHAT DOES THE ULTIMATE TIDAL WETLANDS BUFFER LOOK LIKE?

The answer will depend on what you want the buffer to do. Realistically, given Connecticut's historic patterns of development and irregular topography, it often will be difficult to provide a vegetated tidal wetlands buffer that can do it all. However, in general terms, the ultimate tidal wetlands buffer is relatively flat with only a very gentle slope, with undisturbed, moderately permeable soils and dense native vegetation with a heavy layer of leaf litter and is as wide as possible given the lot size, site conditions and proposed upland use(s).

CREATING VEGETATED TIDAL WETLANDS BUFFERS:

WHERE SHOULD WE USE VEGETATED TIDAL WETLANDS BUFFERS?

Tidal wetlands buffers should be located between tidal wetlands and adjacent upland development. Some water-dependent uses or water-dependent components of projects will likely require development within a buffer area, but water-dependent uses and tidal wetlands buffers are not necessarily mutually exclusive. Structures which provide private water access such as appropriately designed walkways or docks may also need to be sited within a buffer area; however, such access should be carefully designed and implemented to minimize potential adverse impacts to the abutting tidal wetlands.

HOW BIG IS BIG ENOUGH?

As indicated above, the size of an effective buffer is dependent on many factors and can be anywhere from a relatively narrow unmown area of a lot to a wide forested strip. The ideal buffer width will depend on the desired emphasis (water quality, wildlife habitat, temperature moderation, erosion control, etc.), the amount of available land, and the current or proposed use of the property. In general, a 100-foot wide vegetated area will provide many of the desired buffer benefits.

HOW CAN A MUNICIPALITY IMPLEMENT TIDAL WETLANDS BUFFERS?

- Update zoning regulations to better protect sensitive tidal wetlands by establishing or increasing protective buffers between development and all tidal wetlands1. These buffers should be required landward of the upland limit of tidal wetlands. In those cases where steep slopes (25 percent or more) abut tidal wetlands, the buffer width should be measured in from the top of the slope. The most effective buffers support dense growth of shrubs and trees. (see below for model regulation language).

- Most uses should be prohibited in vegetated buffers. A reasonable exception might be to allow limited access to and, in the case of general public access, along the tidal wetland border.

- Once buffers are established by regulation, they should be strictly honored. Variances of the minimum buffer width should only be allowed in those extremely limited cases where there is a strict statutory hardship as defined in the Connecticut General Statutes section 8-6(3) and where compliance with the buffer requirement would render an otherwise buildable lot unusable.

- Revise subdivision regulations to require 100-foot wide vegetated buffers abutting all tidal wetlands in new subdivisions.

- Revise zoning and subdivision regulations to limit clearing of vegetation adjacent to tidal wetlands and within buffer areas. Establish specific standards for the removal of invasive species and perhaps allow minimal clearing to enhance views and provide access where necessary while maintaining the effectiveness of the buffer.

- Revise zoning and subdivision regulations to require larger minimum lot sizes in areas containing or abutting tidal wetlands.

- You may want to consider adopting buffers to address other resource protection needs.

Different approaches to creating vegetated buffers

There are many different ways to structure a requirement for vegetated buffers. The most simple approach is to specify a fixed minimum width. While this is simple to administer, it may not be effective enough unless the minimum width is quite wide (100' or more). A wide fixed buffer may be hard to implement in Connecticut given our established development patterns that frequently resulted in housing and other development clustered along the edges of tidal wetlands. Nevertheless, this approach is attractive due to its simplicity.

A second approach is to require that a minimum percentage of lot depth be established as a vegetated buffer. This provides some flexibility to respond to the constraints posed

1 For technical legal reasons, a municipality cannot establish a tidal wetlands buffer under its inland wetlands authority, however, this is not a problem because municipal planning and zoning authority is amply sufficient.

by existing development. However, the common perception may be that owners of deeper (perhaps more valuable lots) are being penalized by being required to provide more buffer in overall width than owners of smaller, less deep lots.

A third approach is the use of an equation that factors in specific site conditions such as slope, existing vegetation type (e.g., grassy, shrubby, forested), soil permeability and upland use(s). Often these equations can be quite complicated, municipal staff would require specialized training to enable them to determine the minimum buffer width on a case by case basis. Implementation and enforcement can be labor intensive and time consuming.

A fourth technique utilized by some states is to grade wetlands into categories based on their existing value and functions and establish minimum buffer widths that vary based on the category of abutting wetlands. This is not a practical approach to establishing tidal wetlands buffers in Connecticut as our general statutes do not differentiate between varying qualities or values of tidal wetlands. If a wetland area meets the definition of tidal wetlands its specific condition (e.g., pristine or degraded) is not relevant to the statutory responsibility to protected the resource.

There are other approaches to establishing a tidal wetlands buffer that do not prohibit development within the buffer area, but include incentives for locating new impervious surfaces outside of the buffer. Usually these incorporate the creation of compensation areas based on the area of new impervious surface proposed within the minimum buffer area. This type of approach is attractive as it provides more flexibility than the other approaches noted above. However, establishing appropriate regulation language is a difficult task that requires careful and deliberate consideration.

The suggested model regulation language offered below is fashioned after the most simple approach of designating a fixed, effective minimum width tidal wetlands buffers. Based on the data available, a minimum width of 100 feet is recommended for a fixed width vegetated buffer.

MODEL REGULATION LANGUAGE

Based on the above discussion regarding the value of tidal wetlands buffers and the types of approaches to requiring them, OLISP offers the following model regulation language that establishes a uniform 100-foot vegetated buffer adjacent to all tidal wetlands. Prior to adoption, this regulation may be tailored to the specific conditions and concerns in your municipality.

A resource protection buffer of 100 feet shall be established along the upland edge of any tidal wetland as defined by Connecticut General Statutes section 22a-29(2). The width of the buffer shall be measured inland from the upland edge of the tidal wetlands except in the case of wetlands bordered by slopes greater than 25% in which case the buffer shall be measured inland from the top of the slope.

The following uses and activities are prohibited within the buffer:

1. *new building construction that increases the building area or footprint including minor additions to existing buildings;*
2. *detached accessory buildings such as garages and sheds;*
3. *pools, tennis courts, patios, terraces;*
4. *driveways, parking areas;*
5. *other impervious surfaces;*
6. *seawalls, bulkheads, retaining walls, landscaping walls or similar structures;*
7. *grading, excavation or filling, including the construction of new septic systems;*
8. *land clearing, except for minor clearing to allow for appropriate landscaping or the provision of acceptable access as noted below;*
9. *dumping of lawn clippings and other wastes; and*
10. *the application of fertilizers and/or pesticides except when necessary to address a public health issue as determined by the local health official and/or the State Department of Health Services or to control an infestation of invasive vegetative species if authorized by the local conservation commission.*

The following uses and activities, although not expressly prohibited, are discouraged within the buffer area:

1. *the establishment of new lawn areas;*
2. *extensive clearing or pruning. Minimal clearing to provide views may be allowed; however, to maximize the effectiveness of the buffer, pruning should only be done to the extent necessary to clear a view lane and in a manner that maintains the understory and, if forested, the canopy of the buffer area, i.e., no pruning should be conducted within three feet of the ground to protect the understory and, if wooded, no pruning should occur above 9 feet above the ground to protect the canopy.*

The following uses and activities are permitted and/or encouraged within the buffer area:

1. *preservation of existing native vegetation, including shrubs and trees;*
2. *removal of invasive species and replacement with native species;*
3. *elimination and/or minimization of mowing to encourage a variety of native species including shrubs and trees;*
4. *planting of native vegetation; and.*
5. *provision of passive recreational opportunities, including the provision of public access where appropriate. However, such uses should be provided*

at an appropriate scale so as not to significantly diminish the performance of the buffer as a measure to protect tidal wetlands from disturbance and/or degradation. For larger projects, passive recreation components within a tidal wetlands buffer could include provision of walking trails, benches, small-scale picnic areas, and associated amenities.

This regulation does not prohibit the continued use, reconstruction or renovation of any septic disposal system, building, or other improvement in existence on the effective date of the regulation nor does it prohibit the construction of new improvements necessary for the function of water-dependent uses as defined by Connecticut General Statutes section 22a-93(16) except when those improvements can functionally be located outside of the buffer area.

Variance of this regulation is strongly discouraged. Exceptions may be made only in those instances where strict adherence would render a parcel unusable. In those cases, the minimum variance necessary to make the parcel usable should be the maximum variance considered.

PRIMARY REFERENCES

1. *"How Ecology Regulates Wetlands"* Washington State Department of Ecology, February 1992, Publication #97-112*"Vegetated Buffers in the Coastal Zone: A*

2. *"The Scientific Basis for Protecting Riparian and Wetland Buffer Zones: A Summary of the Literature"* REMA Ecological Services, LLC

3. *Summary Review and Bibliography* (Desbonnet et al. 1994) prepared by the Coastal Resources Center of the University of Rhode Island School of Oceanography

4. *"Vegetative Buffers along Coastal Waters: a Case Study of the Chesapeake Bay Critical Area Program"*, Jenny Lynn Plummer, May 1993

5. *"Wetland Buffers: Use and Effectiveness"* Washington State Department of Ecology, February 1992, Publication #92-10

APPENDIX H

AUDUBON COOPERATIVE SANCTUARIES PROGRAM FOR GOLF COURSES

Getting Started in the ACSP for Golf Courses

Great golf and a healthy environment go hand in hand for courses enrolled in the Audubon Cooperative Sanctuary Program for Golf Courses. Photo: The Ekwanok Club, VT

The Audubon Cooperative Sanctuary Program for Golf Courses (ACSP) is an education and certification program that helps golf courses protect the environment, preserve the natural heritage of the game of golf, and gain recognition for their efforts. Through collaborative efforts begun in 1991 with the United States Golf Association, membership in the ACSP has steadily grown to include more than 2,300 golf courses in the United States and two dozen countries worldwide.

The ACSP assists each golf course member to take stock of its environmental resources and any potential liabilities, and then develop a plan that fits its unique setting, goals, staff, budget, and time. The program is easily tailored to a variety of different types of courses, including: private clubs, public and municipal courses, PGA sites, 9-hole facilities, resort courses, and golf residential communities.

Audubon International provides information to help golf courses with:

- Environmental Planning
- Wildlife and Habitat Management
- Chemical Use Reduction and Safety
- Water Conservation
- Water Quality Management
- Outreach and Education

By implementing standard management practices in these six areas, a golf course is eligible for designation as a *Certified Audubon Cooperative Sanctuary,* improving its stature and reputation.

Joining the program

To join, a golf course must fill out a simple registration form and submit it with an annual membership fee of $150 ($200 US for international courses). Golf courses may register online or by sending in the registration form in the ACSP for Golf Courses brochure.

Upon registration, the golf course receives a packet of information and educational materials, as well as an attractive membership certificate and subscription to Audubon International's bimonthly

"The absolute beauty of the ACSP is that everybody wins. First and foremost, the environment and land are protected and enhanced to maximize wildlife and to provide a sanctuary for not only wildlife, but also for people."

— Eric Niemur,
Director of Grounds,
Fox Hills Golf and Banquet
Center, Plymouth, MI

newsletter, *Stewardship News*. Members receive *A Guide to Environmental Stewardship on the Golf Course*, a manual that provides information on how to implement a comprehensive environmental management program. Members also receive a *Certification Handbook* to help them plan, organize, and document their efforts.

The ACSP for Golf Courses offers educational information and assistance to its members, but all decisions regarding the operation of the course remain with the golf course itself. The program suggests that courses strive to meet current golf industry standards for environmental management, and Audubon staff work with course superintendents to achieve that end.

Environmental Planning

Once a course is registered, its next step is to complete a *Site Assessment and Environmental Plan,* provided in the *Certification Handbook.* This information helps golf course personnel to assess current golf course environmental management practices and plan improvements.

The information also enables Audubon International staff the opportunity to gain an introduction to the golf course. Thus we begin a productive relationship of working in partnership to help golf course staff achieve their environmental goals. We strongly recommend that golf course members return the *Site Assessment and Environmental Plan* within four to six weeks of joining to take full advantage the program.

Certification

Audubon International awards certification to recognize golf courses that meet the environmental management standards outlined in their environmental plans. Certification demonstrates a course's leadership, commitment, and high standards of environmental management.

What's involved?

To become certified, a golf course implements its environmental plan and documents its efforts and results, using the *Certification Handbook* as a guide. Certification involves activities in the six key components of the program listed on the previous page.

Designation as a *Certified Audubon Cooperative Sanctuary* is awarded to the golf course upon meeting environmental management standards in each area. Recertification is required every two years to maintain the Certified Sanctuary designation. There is no additional fee for certification.

How long does it take to become certified?

Most courses achieve certification within one to three years, depending on how quickly they plan, organize, implement, and document their environmental practices.

"This is not just some philanthropic activity. It's good business. We conserve fuel, we conserve electricity, and we have made this a part of our risk management system."

— Ken Giedd,
Former Director of Golf
Kingsmill Resort, VA

Proven Value for Golf Courses

Becoming involved in the ACSP for Golf Courses has proven economic and environmental benefits:

- **Image and Reputation–** Proven environmental performance can help a course differentiate itself from others in a crowded market and add value by improving public relations and marketing opportunties that attract new golfers or club members.
- **Customer Satisfaction–** Enhancing the nature of a course can enrich golfers experience of the game. Surveys show that golfers rank "being outside in nature" among their top reasons for playing golf.
- **Financial Performance-** An effective golf course environmental management program can result in reduced insurance premiums, as well as reduced costs for energy, water, pesticides, and fertilizers.
- **Worker Safety and Reduced Liability-** Best practices for chemical management reduce exposure and liability risks from storing, handling, and applying chemicals.
- **Improved Efficiency-** Environmental management cuts down on waste and promotes efficient operations.
- **Environmental Quality**- Last, but certainly not least, participation in the program improves the quality of our land, water, and air, and helps to conserve natural resources for future generations.

To register in the ACSP for Golf Courses, visit our Web site at www.audubonintemational.org, or call (518) 767-9051 , ext. 12 to request a brochure and registration form.

APPENDIX I

NASSAU COUNTY MOSQUITO SURVEILLANCE AND CONTROL REPORT 2005

2005
Nassau County
Mosquito Surveillance and Control Report

Acknowledgements

The following departments and agencies participated in mosquito surveillance and control activities:

- Nassau County Department of Public Works (DPW) provides equipment and personnel for mosquito control, surveillance and water management maintenance.

- Nassau County Department of Health (NCDH), Division of Environmental Health, provides personnel for mosquito and bird surveillance, mosquito trapping, complaint response, monitoring, control, data compilation and communications.

- Nassau County Department of Health, Division of Disease Control, works with health care providers to assure suspect WNV cases are reported and appropriate diagnostic tests are done.

- Nassau County Department of Health, Division of Public Health Laboratories, identifies (speciates) mosquitoes captured in gravid, Faye-Prince, and CDC light traps. Stores "pools" of mosquito specimens, and packages/mails them to the state lab for viral testing.

- New York State Department of Health (NYSDOH) tests mosquitoes for arboviruses by screening for arboviral agents using polymerase chain reaction protocols. Pools from Nassau County are tested for Eastern Equine Encephalitis (EEE), West Nile Encephalitis (WNV), as well as other mosquito-borne diseases.
- NYS Department of Environmental Conservation (DEC), Office of Wildlife Pathologist, examines the birds sent to Wadsworth Center Labs for evidence of WNV.

This report was prepared by the NCDH, Division of Environmental Health, Susan G. King, Director. Inquiries concerning this report and/or requests for additional copies should be made to Bryan Matthews, West Nile Virus Program Coordinator, at 571-3691.

County Executive
Thomas R. Suozzi

Board of Health
Norma J. Henriksen, Acting Chairman
Ellen J. Braunstein, M.D.
Diana Coleman

Commissioner of Health
David M. Ackman, M.D., M,P.H

Deputy Commissioner of Public Works
Joseph L. Davenport, P.E.

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List of Figures, Graphs, Tables, and Maps

Introduction

The Nassau County Department of Health (NCDH) and the Nassau County Department of Public Works (DPW) work together to suppress mosquito populations through mosquito surveillance and control. Both departments are committed to utilizing Integrated Pest Management (IPM), which is a systematic approach to managing pests that focuses on long-term suppression or prevention, with a minimal impact on health, environment, and non-target organisms.

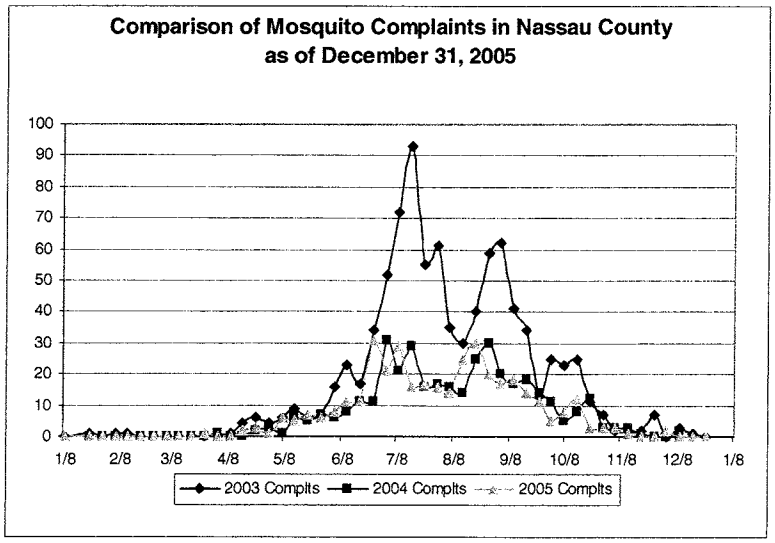
In 1999, an outbreak of West Nile Virus *(WNV), a mosquito–borne disease that was previously unknown in the western hemisphere, occurred in New York City and on Long Island. WNV was first detected in a woman from the West Nile Region of Uganda in 1937. Since then it has been frequently found in Africa, the Middle East and Eastern Europe. There was unprecedented concern by the public after a number of residents contracted WNV and several died in New York City and Nassau County. Fortunately, Nassau County had a mosquito program already in place to competently handle the situation. With the help and expertise provided by the New York State Health Department and the Centers for Disease Control, Nassau County was able to effectively respond to all aspects of the WNV threat.

NCDH and DPW receive many calls from County residents concerning mosquitoes every year. Since receiving more than 100,000 complaints and inquiries in response to the introduction of West Nile Virus to the New York City/Long Island area in 1999, the annual combined number of complaints and inquiries has generally decreased (4,039 in 2003, 3,345 in 2004, and 3002 in 2005). Although some of the overall reduction of complaints can be traced to less media attention to WNV, the efforts of both departments dedicated to public health and conducting a viable mosquito program, as well as the implementation of IPM principles, have reduced mosquito populations contributing to these lower numbers.

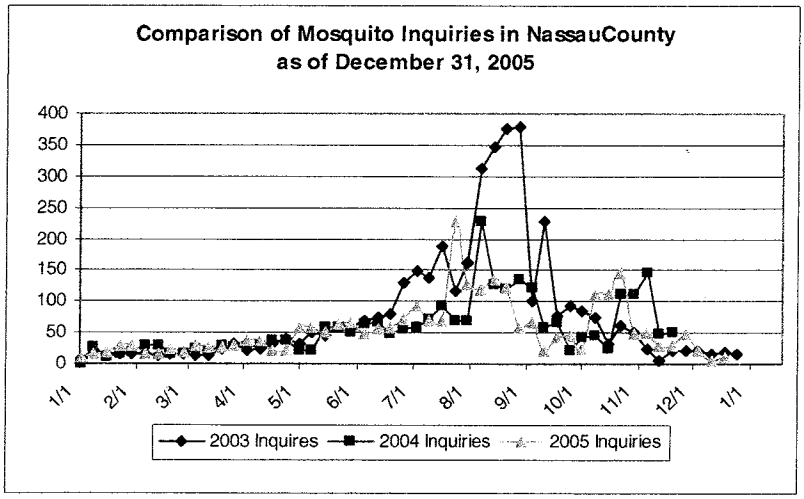
In addition to mosquito related complaints, NCDH also receives and records reports of dead birds in the County (birds are known to be a reservoir for WNV). In 2005 there were 624 reports.

*WNV symptoms usually occur 5 – 15 days after the bite. Most people have no symptoms or may experience only slight fever or headache, resulting in many cases of WNV never being diagnosed. Severe infections, which usually occur in persons over the age of 55, may result in encephalitis with high fever, headache, confusion, muscle aches, and weakness, seizures, or paralysis. There is no specific treatment for WNV. Supportive care is provided until symptoms subside. (For routes of transmission see Figure 16)

The following graphs reflect the influx and distribution of complaints, inquiries and bird reports in 2003, 2004, and 2005.

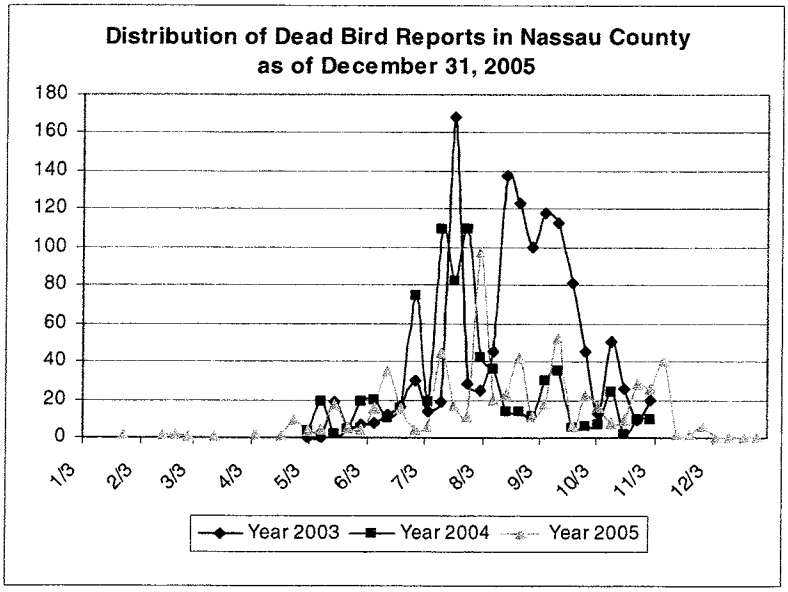


Graph 1



Graph 2

Note – Complaints are defined as situations which required a field visit, inquiries are those that could be handled by phone or letter



Graph 3

Background

Mosquito control began in Nassau County in 1915 as a response to mosquito-borne malaria outbreaks. Kerosene or #2 oil were used to coat bodies of water suspected of breeding mosquitoes, suffocating the mosquito larvae, thereby reducing the overall mosquito population. This practice was continued until 1920, at which time the malaria threat was brought under control.

The application of oil on standing water continued for purposes of nuisance control. In 1929, the first Mosquito Commission was formed in Nassau County. The Commission was comprised of village mayors and officials, businessmen, and other residents from the community. They introduced the concept of ditching to provide effective drainage of the salt marshes, consequently removing many of the conditions conducive to breeding mosquitoes. Ditches were dug by hand and, in some cases, dynamite was used to quickly remove soil, vegetation and sand.

In 1948, the Nassau County Mosquito Commission was placed under the direction of the Department of Public Works (DPW). Under new consolidated direction, improvements were made to the antiquated mosquito control techniques. Mechanization of ditching procedures, the use of spray trucks, and introduction of new mosquito control products helped to control the mosquito population. By 1970, a surveillance program to assess mosquito populations was initiated by placing mosquito traps at 8 sites across the County, and modern mosquito control began.

Figure 1

In the 1950's and 60's mosquito control relied on spraying oils on standing water.

In 1996, NCDH and DPW were directed to work together to establish a new mosquito control program. Both departments transferred personnel into the program, and equipment was purchased for ditch rehabilitation, surveillance activities, control tactics, etc. With the addition of the Health Department to the Mosquito Surveillance and Control Program, the Board of Health implemented a new pest control concept called Integrated Pest Management (IPM), which had just been initiated in County-owned buildings. IPM is a system which seeks to control pests, including mosquitoes, by non-chemical means whenever possible, incorporating all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological, or chemical control methods to reduce pest populations to acceptable levels.

Pesticides would only be used if other methods of control failed and the potential risk of not controlling the mosquitoes outweighed the risk of disease or nuisance they might cause. If that occurred, then the least toxic mosquito control product to humans and non-target organisms would be used.

In 1999, with the outbreak of WNV, Nassau County expanded its Mosquito Control Program using IPM principals. This resulted in the addition, increase, or expansion of: the number and types of mosquito traps deployed, mosquito surveillance activities, mosquito identification, mosquito shipping and handling, weekly mosquito update reports, interaction with media regarding mosquitoes, and mosquito complaint response.

The additional work required an increase in the number of personnel dedicated to the Mosquito Surveillance and Control Program, as well as their appropriate training and certification to perform tasks such as mosquito identification and the application of mosquito control products.

Mosquito Habitat

Mosquitoes have four distinct stages in their life history; the egg, larvae, pupae and adult. The larvae, also known as "wrigglers" and the pupae, sometimes called "tumblers," are found in water. Although the larvae live and get their food in the water they must come to the surface for air or obtain air from the underwater portions of aquatic plants. Mosquitoes have adapted to most kinds of aquatic habitats except running water and the open water of lakes, seas, and oceans. Different species of mosquitoes prefer certain types of aquatic habitat, and can be categorized based on this preference. The four types of habitat are; permanent pools, transient water, floodwater, and artificial container and tree holes. Mosquitoes preferring permanent pools are generally found in fresh bodies of quiet water. Typical habitats are shallow marginal ponds, lakes, and smaller impoundments, the main characteristic being a degree of permanency. Transient water types are generally associated with waters found in street storm drains, roadside ditches, clogged streams and puddles. Floodwater species of mosquitoes prefer areas that are intermittently inundated with water. Tidal marshes on the County's north and south shores provide extensive areas of floodwater habitat.

The final category is composed of mosquitoes that favor artificial containers and tree holes. This type of habitat is extremely common in all residential areas of the County. Swimming pools, bird baths, rain gutters, old tires, pails, cans, children's toys, or any object that can collect and hold water may serve as a breeding site.

Figure 2
Children's toys can hold water and breed mosquitoes

Figure 3
Ornamental and fish ponds may breed mosquitoes

Seasonal Duration and Weather

Mosquitoes may be active from March until freezing weather. Nassau County's mosquito program operates throughout the year; however the busiest time is from May through October. Mosquito larvae have been found as late as the middle of November for the last 3 years. Mosquitoes sometimes over-winter as adults in residential homes, street drains and other warm and moist places, emerging on mild days. Storms from April through October are a major factor leading to mosquito breeding, as well as higher than normal tides which affect the egg hatching of the salt marsh mosquito. The accumulations of water, with the presence of organic matter in any container, depression, object, etc., for as little as four days, or as in most cases 1-2 weeks, can serve as a breeding site for mosquitoes. Therefore, rainfall plays an important part in the reproductive cycle of the mosquito (see Figure 4). Air temperatures are also a factor, as colder temperatures decrease mosquito activity.

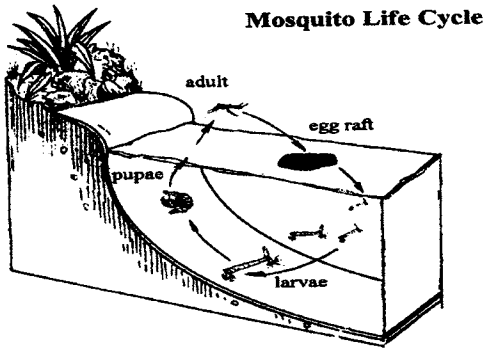


Figure 4

Mosquito Surveillance

Surveillance of the larval and adult stages of the mosquito is an integral part of any effective program. Two methods of monitoring actual and/or potential mosquito populations are

"dipping" for larvae, and "trapping" adult mosquitoes with CDC light traps, Gravid traps, Faye-Prince traps, and New Jersey light traps.

Dipping for Mosquito Larvae

The most effective means of controlling mosquito populations is to identify breeding sites so that they can be modified to prevent standing water conditions conducive to mosquito breeding and/or treated to kill the larvae before they become flying, biting adult mosquitoes.

"Dipping" for larvae is the sampling technique used to estimate the number of larvae present in standing water. If the number of larvae is excessive, the habitat may be modified or an appropriate larvicide applied. All treatments are made in compliance with the product labels and permits obtained from New York State Department of Environmental Conservation (NYSDEC). The information gained from these larval dipping surveys allows us to determine if control measures are necessary and, if so, what measures to take. NCDH's Integrated Pest Management Program (IPM) dictates that we do not apply pest control products indiscriminately; therefore, dipping plays an important role in minimizing the use of pesticides. When necessary, treatment (larviciding) can be applied by hand to specific breeding locations or by helicopter over larger and less accessible areas.

Figure 5

Figure 5A

A "dipper" consists of a long pole with a cup on the end. The inspector dips the cup into the standing water and then views what is captured in the cup. The picture on the next page shows the contents of dipper.

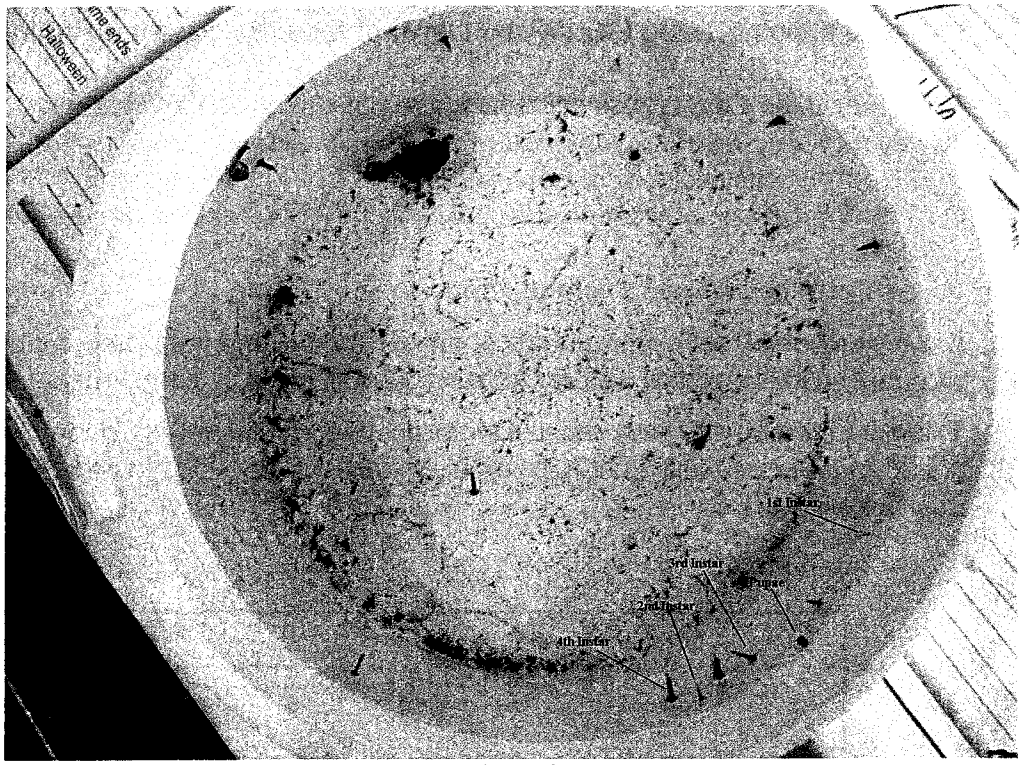


Figure 6
Mosquito larvae (approximately ¼ inch long)

This dipper cup has larvae and debris that has been scooped from the standing water. The larvae are counted and possibly speciated, to provide the inspector with information which enables him/her to determine the type of mosquito that is breeding in the body of water, and decide on proper treatment. There are 4 molts or "instars", lasting approximately 4 days each, which provide information as to how soon the flying mosquitoes might emerge.

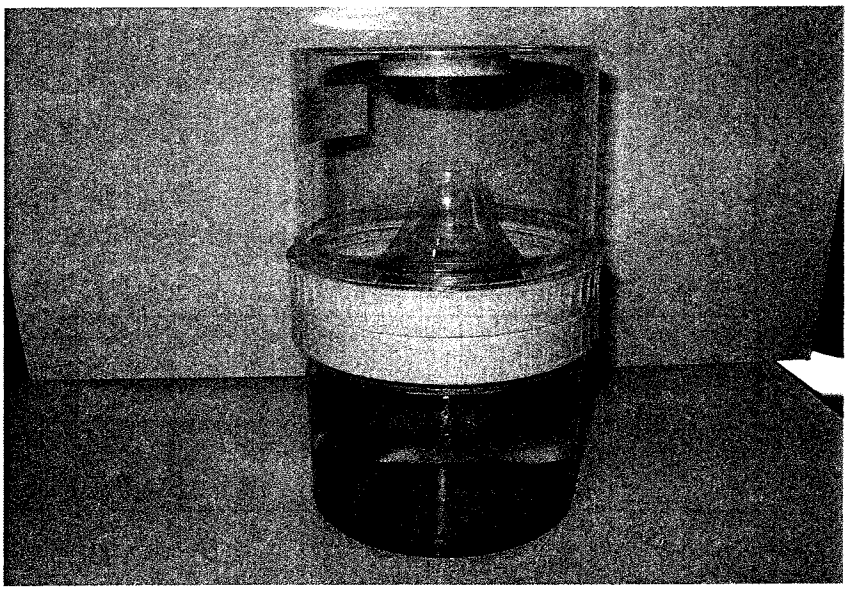


Figure 7
Mosquito Rearing Chamber, used to allow larvae to mature into adult mosquitoes which can then be identified

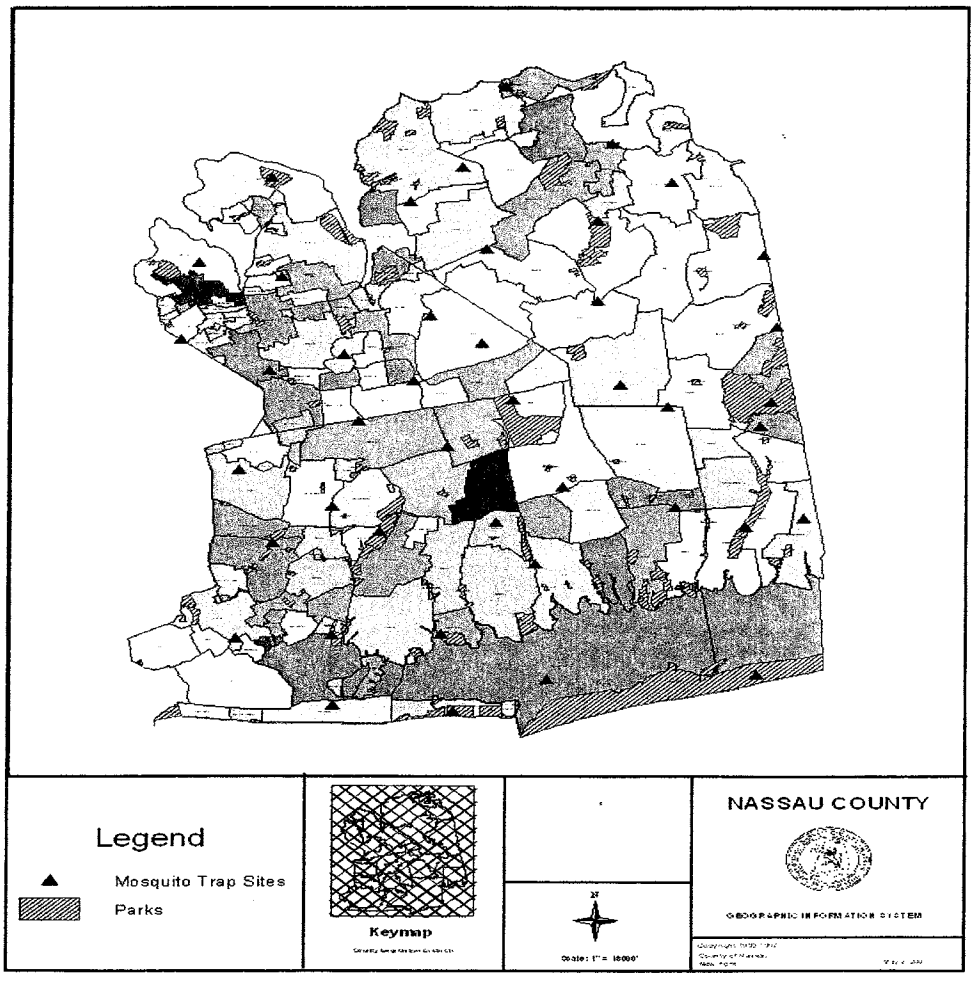
Trapping Mosquitoes

Mosquito trapping, using four different types of traps, is done for the following purposes:

1. Estimate the Countywide adult mosquito population at a given time
2. Identify specific areas with high mosquito populations
3. Identify genus and species of mosquitoes
4. Test for disease, especially West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE).
5. Assess effectiveness of control efforts.

If the number of adult mosquitoes is unacceptable, an appropriate control measure may be recommended, as well as a closer look at breeding areas in the vicinity.

There are currently 42 sites situated strategically throughout the County where CDC and gravid traps are utilized, although auxiliary sites may be added to assess special situations (see map below).



Map 1

Above is a map of Nassau County indicating a network of Gravid and CDC Light Traps

CDC Light Traps

CDC light traps use a combination of light and carbon dioxide (from the sublimation of dry ice) to attract mosquitoes. CDC traps were placed at all 42 trap sites throughout the season. In 2005, 805 CDC traps were run, capturing 13,232 mosquitoes, resulting in an average of 16 mosquitoes per trap night.

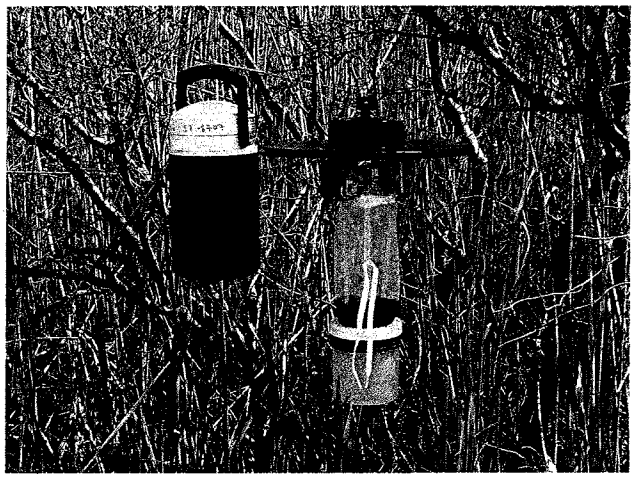


Figure 8
CDC Light Trap with dry ice attractant

Gravid Traps

Gravid traps are another type of trap used to capture mosquitoes (especially *Culex.*) In 2005 gravid traps were also used at all 42 trap sites. A female mosquito is considered to be gravid when she is heavy with eggs. Generally a blood meal is required to provide the nourishment necessary to develop her eggs, which then can be deposited. Gravid mosquitoes are considered to have a higher probability of carrying disease because they are more likely to have taken a blood meal.

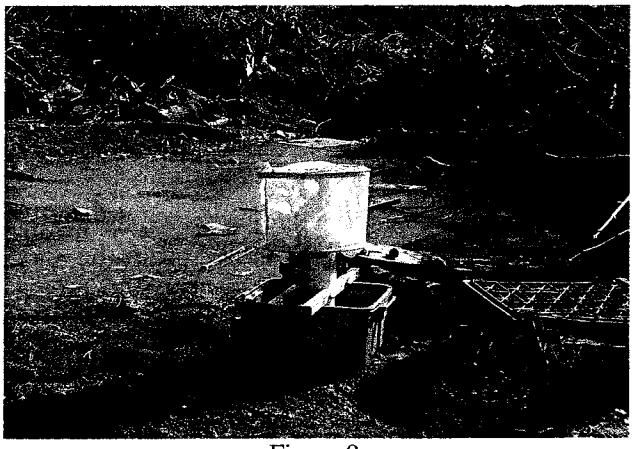


Figure 9
The gravid trap imitates the stagnant water scenario the mosquito instinctively seeks out to lay her eggs.

The gravid trap consists of a tray containing standing water with the high organic content necessary to nourish mosquito larvae once they emerge from their eggs. Just above the water level in the tray is a cylinder with a battery-driven fan inside. The fan sucks the mosquitoes into the collection bag above when they fly in to deposit their eggs on the putrid water. In 2005, 320 gravid traps were run, trapping 7,449 mosquitoes, resulting in an average of 24 mosquitoes per trap night. Generally gravid traps are more effective later in the season, once mosquitoes have obtained blood meals, therefore fewer gravids are set as compared to CDCs during the mosquito season.

Faye – Prince Traps

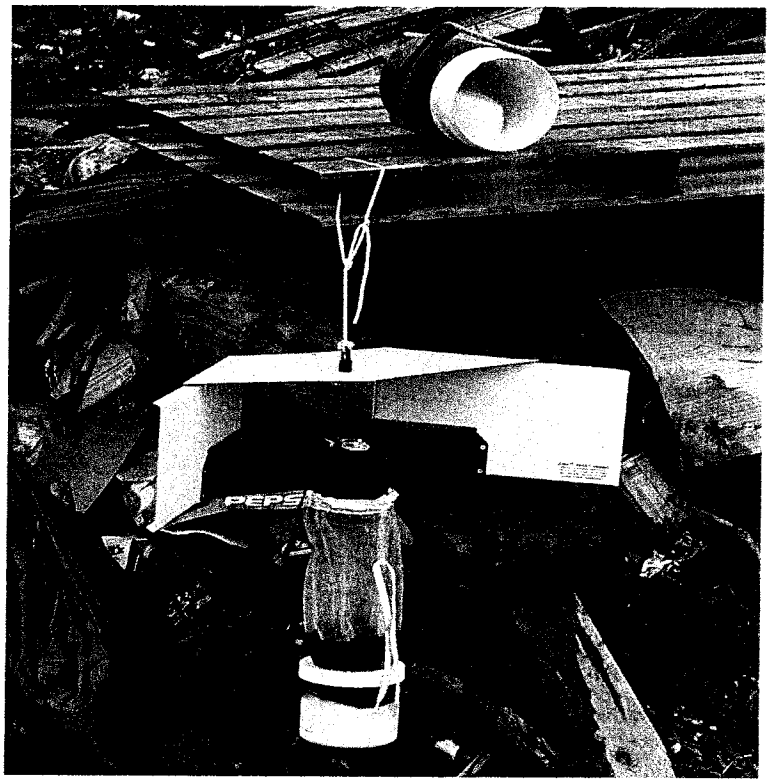


Figure 10
Faye-Prince Trap

Faye-Prince Traps use only carbon dioxide as an attractant; they are most likely to capture mosquitoes that are active daytime biters such as *Oc. triseriatus*. The trap design is based upon the attractiveness of contrasting gloss black and white panels and employs a wind orienting cover.

New Jersey Light Traps

New Jersey light traps attract mosquitoes solely by light, and are suitable for monitoring the large numbers of salt marsh mosquitoes found on the shores of Nassau County. A limitation of this type trap is the need to have an electrical outlet, since they are not battery operated as are the CDC Traps. NJ Traps also tend to damage the mosquito specimens, which makes identification very difficult. Therefore NJ Traps are used solely to estimate mosquito populations without particular attention to the species. New Jersey light traps were located at the following sites:

The High Hill Area of Jones Beach
State Houses @ Jones Beach
Jones Beach Sewage Treatment Plant
Cedar Creek Sewage Treatment Plant, Wantagh
Inwood Country Club
Cold Spring Harbor Fish Hatchery
Lido Beach, adjacent to water tower

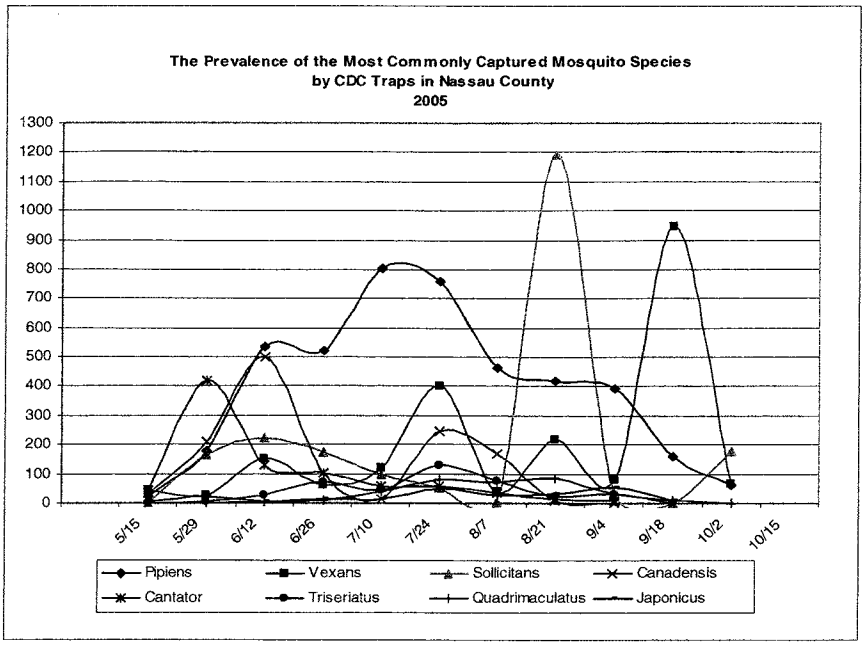
Figure 11
New Jersey Mosquito Trap

The New Jersey light traps were operated from May to October in 2005. They generally showed light adult presence (< 50 mosquitoes per trap per night.) The highest counts were at the Jones Beach trap sites.

Positive Mosquito Pools

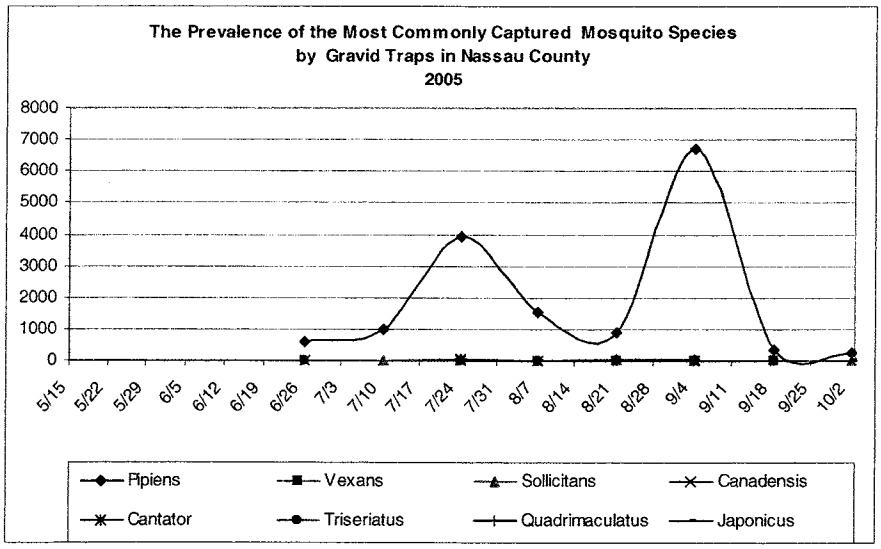
After trapping, the mosquitoes are delivered to the Nassau County Department of Health (NCDH) Laboratory for identification and enumeration. The mosquitoes are then sorted into groups or "pools" by species and type and shipped to the New York State Department of Health (NYSDOH) Laboratory for viral testing.
In 2005, 20,681 mosquitoes were captured, identified, and screened for disease. Those mosquitoes were divided into 473 pools (groups) of mosquitoes. Of the 473 "pools" sent to the NYSDOH Laboratory in 2005, 70 were reported as positive for West Nile Virus.

Figure 12 Figure 12A
Mosquito sorting and identification at the Nassau County Health Department Laboratory



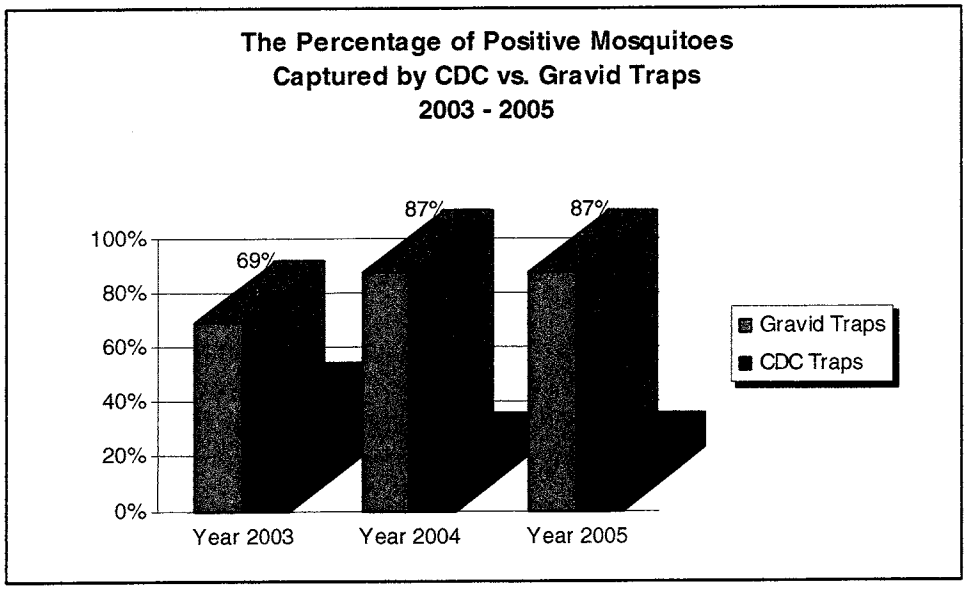
Graph 4

The graph above illustrates the mosquito season in Nassau County; it begins in May and continues into October. *Culex pipiens* (the northern house mosquito), comprised 37% of all the mosquitoes captured in CDC traps and 100% of the CDC/WNV positive pools (9 in the year 2005). The numbers of mosquitoes on this graph represent those that were captured in CDC Light Traps at 42 sites geographically located at approximately 2.5 mile intervals throughout the County. The 2005 season's CDC trap night combined average for all 42 sites was 16 mosquitoes per night. The traps were operated 805 times. (At times additional traps may be added to the network to help evaluate certain situations)



Graph 4A

The graph above depicts the mosquito season in Nassau County; it begins in May and continues into October. *Culex pipiens*, comprised 98% of all the mosquitoes captured in gravid traps and 100% of the Gravid/WNV positive pools (61 in the year 2005). The numbers of mosquitoes on this graph represent those that were captured in gravid traps at 42 sites geographically located at approximately 2.5 mile intervals throughout the County. The 2005 season's gravid combined trap night average for all 42 sites was 24 mosquitoes per night. The traps were operated 320 times. (At times additional traps may be added to the network to help evaluate certain situations)



Graph 5

The graph above represents the percentage of positive mosquitoes captured in CDC and gravid traps from 2003 to 2005 relative to each other. All positive mosquito pools were Culex pipiens. (It should be noted that these percentages do not take into account the number of gravid vs CDC traps operated, as many more CDC traps were run than gravids. For example in 2005, 805 CDC traps were set as compared to only 320 gravids, however the gravids captured many more positive mosquitoes. (See Table 5, pp. 24 and 25)

Additional Surveillance

Boat Surveys

There are more than 100 bodies of land in the south shore bays of Nassau County (hassocks, meadows, marshes, fields, islands, etc.) Most of these are underwater at high tide and so are unsuitable for mosquito breeding. The few islets that do remain wholly or partially above a typical high tide are capable of breeding of *Ochlerotatus sollicitans* and other salt marsh mosquitoes. They are monitored periodically by boat.

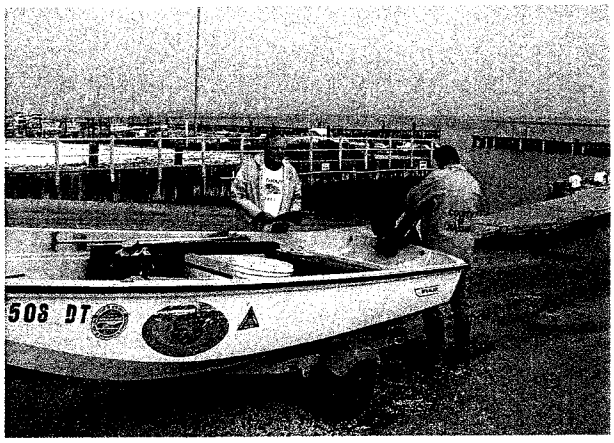


Figure 13
Mosquito Inspectors launching survey boat

Figure 14
Mosquito Inspectors under way to survey hassocks

Salt Marsh Surveys

Salt marsh areas, especially on the south shore of Nassau County, are potential breeding sites for mosquitoes. High tides, storm water, or heavy rains can cause areas not normally covered by daily tidal activity to flood, hatching mosquito eggs within minutes of contact with the water. Therefore, at the beginning of each week during mosquito season, the marsh areas are surveyed and larvicide is applied where necessary.

Upland Surveys

In addition to the salt marsh surveys, many upland surveys of streams, drains, ponds and freshwater marshes are made to determine mosquito breeding potential and, especially, to determine suitability of these sites as breeding areas for *Culiseta melanura* and *Culex pipiens* mosquitoes which are involved in the bird-to-bird/human transmission of EEE and WNV.

Storm Water Recharge Basin Surveys

Storm water recharge basins (SWB's), commonly called sumps, are designed to return surface runoff water to the ground water table. There are approximately 780 sumps in Nassau County: Five Hundred and eighty four sumps are managed by Nassau County, the rest are overseen by local municipalities. Sometimes, they retain sufficient water to become major sources of mosquitoes. In 2005, County sumps were surveyed (using dipping techniques previously described) 1101 times. Mosquito larvae were discovered 210 times (including reinspections). Larvicides were applied in most cases when larvae were observed.

Figure 15

This storm water recharge basin (swb), also known as a sump, holds water all year long. These sumps sometimes become a dumping ground for old tires and debris, which can collect water and serve as ancillary breeding sites for mosquitoes. DPW makes a special effort to remove these items on a regular basis.

Dead Bird Reports and Testing

Birds have been implicated as the reservoir or source of WNV. When a mosquito bites a bird that is infected with WNV, the mosquito may then spread the virus to another bird, other animal or human. The American Crow is quite sensitive to WNV. Although most birds are only sick for a few days and fully recover with immunity to new infection, crows are more likely to die from the disease. Therefore, part of the response plan is to record information about dead birds, especially crows, and in some cases (determined by the NYS Lab quotas) have these birds tested for WNV. In 2005, 624 birds were reported, 57 were sent to the lab for testing, and 13 of those were found positive for WNV.

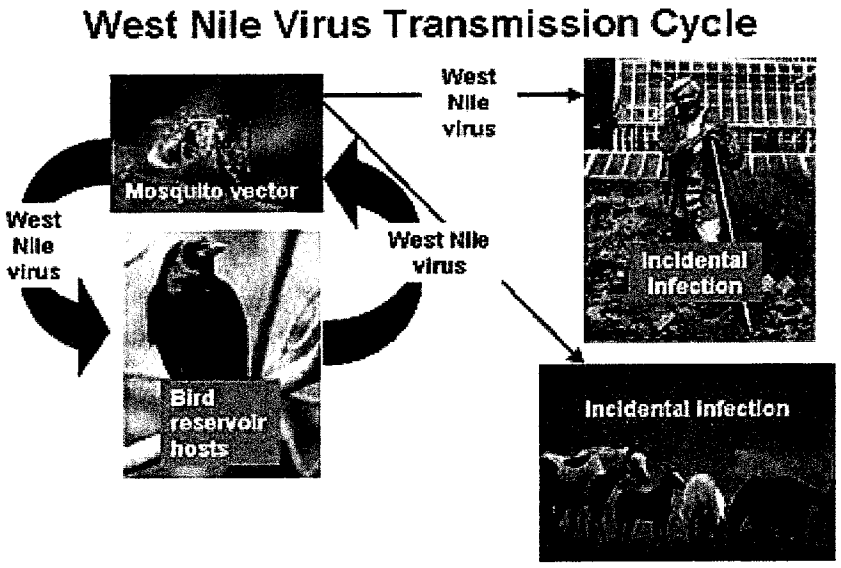
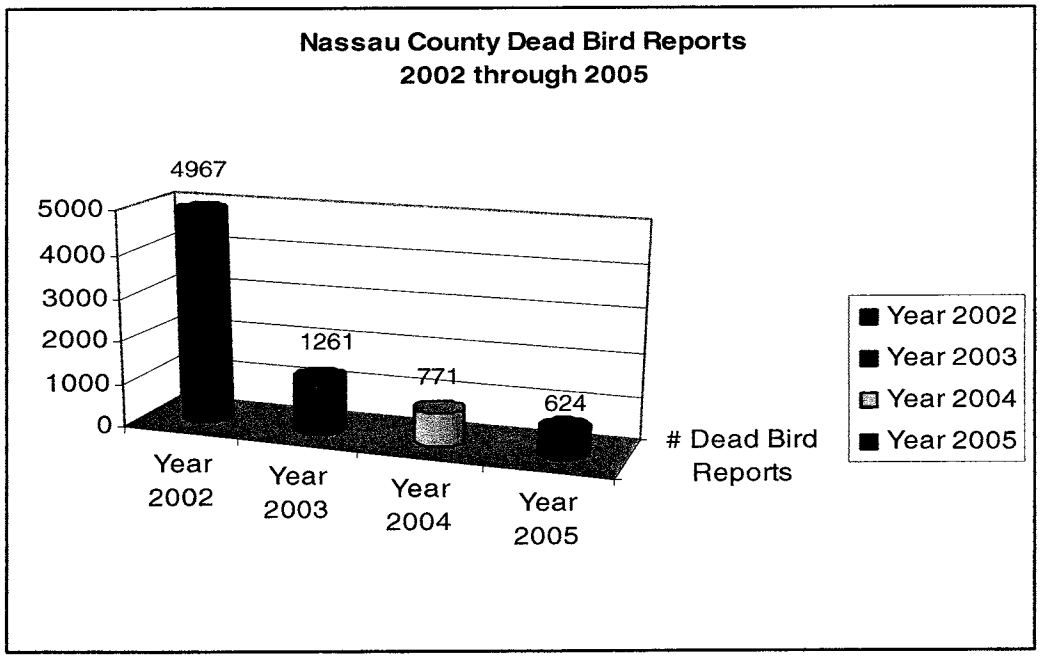


Figure 16



Graph 6

The graph above compares the number of bird reports received over the last four years

Dead Mammal (Horses) Reports and Testing

Horses and other large mammals are also susceptible to infection from mosquito borne viral illness' including West Nile virus (WNV) and Eastern Equine Encephalitis (EEE). As indicated in Figure 16, horses (and Humans) are not considered a reservoir or source of infection. The table below indicates WNV and EEE infections in horses reported in 2005

Table 1
Dead Mammal Reports and Testing

Onset	Disease	Site	Mammal
7/27/2005	EEE	Brookville	Horse
10/7/2005	WNV	Elmont	Horse
10/29/2005	WNV	Elmont	Horse

Complaints/Service Requests and Inquiries

In 2005, 3,002 complaints/inquiries were received regarding the WNV threat. All complaints, whether received by telephone, email, letter, or referral within the county system, were entered in a log and assigned for inspection. Inspection generally involved a visit to the complainant's home, inspection of a specific situation or, more often a neighborhood survey. Surveys included, but were not limited to, streams, ponds, marshes, drainage ditches, standing water, swimming pools, artificial containers, street drains and nearby storm water recharge basins. Property owners were apprised of conditions when present. Otherwise, visit notices and mosquito information pamphlets were left. If appropriate, treatment was made by hand with a suitable larvicide. If a major breeding area was identified, follow-up inspections were scheduled for one to two weeks later. Inspection results and control efforts were entered in the complaint log after review by the supervisor and prior to filing. Inquiries were defined as those situations which were handled by phone or letter. For example, if a resident called and requested information about mosquitoes and WNV, a Health Department Inspector would answer their questions and may send the Nassau County Mosquito Pamphlet, which provides useful information about mosquitoes and WNV.

Control Activities

As stated previously, Nassau County is committed to applying the principles of IPM to all its pest control activities. What this means in practical terms is that the cornerstone of our control strategy is surveillance, so that control strategies are based on reliable information and then monitored for the effectiveness of that strategy. In some situations no treatment is necessary (for example, there may be mosquito-eating fish or insect predators such as dragonfly and damselfly larvae present, or a puddle may dry up before larval development can be completed). In other situations, there are treatment restrictions to be observed in order to avoid harm to non-target organisms, especially in environmentally sensitive areas such as freshwater wetlands. Several treatment options either have restrictions on the label or on the NYSDEC permits, when fish are present. NYSDEC has issued permits for each aspect of the mosquito control program specifying in detail what may be done, when it may be done, and who may do it. All control measures must fully comply with these permits. Furthermore, all

pesticides must be used in accordance with the product labels and all applicable pesticide laws. When treatment is necessary, there are a number of options available such as:

Introduction of Fish

Many saltwater fish eat mosquito larvae. Killifish are present in large numbers in the bays and in the south shore ditches. Several varieties of small top-feeding freshwater fish, including Gambusia, have been introduced to some storm water recharge basins that hold water year-round.

Figure 17

Figure 17A

This storm water recharge basin is filled with many kinds of fish which feed on all stages of the mosquitoes. Fish introduced into private and ornamental ponds also help to prevent mosquito breeding

Modification of Habitat

In addition to the fresh-water mosquitoes, there are several species of mosquitoes that inhabit the extensive saltwater wetlands on both the north and south shores of Nassau County. To reduce salt marsh mosquito populations, approximately 1000 miles of ditches were dug in the past years of which 700 miles were reconditioned since 1977, to improve drainage along the shoreline, on the south shore barrier islands, and among the numerous hassocks and islets. This reduces the size and number of puddles and areas of standing water suitable for mosquito egg hatching and larval development. In 1997, DPW hired additional personnel and acquired new equipment to maintain and recondition the drainage ditches, and to cut access paths that facilitate inspection, maintenance and treatment of mosquito breeding areas. Natural forces such as wind, rain, tides, and major storms continually influence the marsh topography, resulting in new and altered mosquito breeding areas; therefore ditch maintenance is an ongoing and long-term project. Well-maintained drainage ditches provide a habitat for killifish that feed on mosquito larvae, facilitate tidal water movement, and also create a suitable environment for waterfowl.

Figure 18

This floodwater ditch, filled with sand and debris is in need of maintenance, to prevent mosquito breeding

Figure 19
This ditch is well maintained, allowing tidal flows to move in and out, enabling killifish to swim in and eat the mosquito larvae

Once mosquitoes reach the adult stage they need a place to hide and rest. Commonly, these areas are high grass, weeds, and undergrowth, close to a pond, depression, ditch or sump. County workers identify these sites and cut down or otherwise modify them so that the mosquitoes are then exposed to the elements and predators, naturally reducing their numbers.

Figure 20
WNV Program worker cutting back brush used as refuge by adult mosquitoes

Elimination of Standing Water

Mosquito larvae are often found in clogged roof gutters, old tires, boat covers, swimming pools, swimming pool covers and other artificial containers. Swimming pools themselves, when properly maintained or periodically chlorinated, are not a problem. During complaint inspections property owners were advised of conditions conducive to larval development of mosquitoes. The Mosquito Control pamphlet given out during complaint inspections emphasizes the need for eliminating these localized breeding situations.

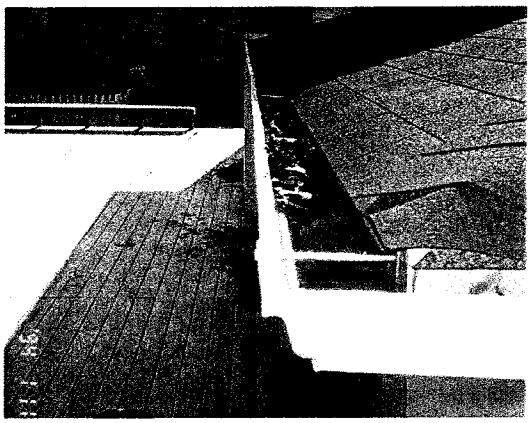


Figure 21
Rain gutter clogged with leaves and standing water

Figure 22
Swimming pool cover with stagnant water and leaves

Figure 23
Tire with stagnant water inside

Figure 24
Pile of used tires with the potential to breed mosquitoes

Hand Treatment with Larvicides

Four larvicides that may be used:

1. BTI (*Bacillus thuringiensis var. israeliensis*) is a naturally occurring soil bacterium that is eaten by the larvae, infecting them, and killing them. It is available in granular form or in a donut shaped briquette. It is very target specific, but will not work against the pupae stage, as pupae do not eat.
2. Vectolex CG (*Bacillus sphaericus*) is also a naturally occurring bacterium that infects mosquito larvae. It persists well in the organic rich environments favored by the *Culex* species of mosquitoes. It also is ineffective against pupae.

3. Altosid (Methoprene) is an insect growth regulator that prevents mosquito larvae from changing into adults. It is sometimes called a juvenile hormone. It is used in a briquette form for hand treating SWB's and other sites requiring long acting control (30 days).
4. Agnique is a non-toxic larvicide which spreads an invisible mononuclear film over the water, reducing the surface tension, making it difficult for larvae and pupae to attach. The film also blocks the breathing tubes of the larvae and pupae and they drown.

Aerial Spraying of Larvicides

DPW has a contract with a private company for aerial larvicide spraying by helicopter. The helicopter is able to spray large non-populated, inaccessible areas with a suitable larvicide, usually a liquid formulation of Altosid. Areas sprayed include the marshy areas of Jones Beach, Lido Beach, and a number of islets and hassocks on the south shore of Nassau County. Decisions as to when and where to treat are based upon the salt marsh surveys, tidal conditions, and boat surveys. The helicopter has been a very effective control measure and will continue to be used in the future. The helicopter was used 10 times in 2005.

Mosquito Adulticides

Adult mosquitoes are sensitive to a number of contact pesticides. The adulticide of choice for mosquitoes is a product named Scourge (Resmethrin 4.14% and Piperonyl butoxide 2.42%) which may be sprayed by an Ultra Low Volume generator mounted on the back of a pickup truck. Driven at a constant 5 mph rate, this method can treat large areas on either side of a roadway. Spraying must be done at times of low wind, usually early morning or late afternoon, to minimize drift. Adulticiding is only done when unacceptably high numbers of adults are present, disease is detected, or other means of control are ineffective.

Aerial spraying of the adulticide Anvil (Sumethrin) was done for the first time in 1999 in response to the initial West Nile threat. It was used because it was considered the least toxic of the aerial adulticides.

Eastern Equine Encephalitis (EEE)/ Adulticide Activities

On August 1, 2005, the New York State Department of Health reported the first Nassau County case of Eastern Equine Encephalitis (EEE) in a horse stabled in Old Brookville.

Eastern Equine Encephalitis is another mosquito-borne viral disease. The virus is transmitted to humans through the bite of an infected mosquito. There has never been a human case of Eastern Equine Encephalitis in Nassau County and only two human cases have been diagnosed in New York State in the past twenty years. A vaccine is available to protect horses, but there is no human vaccine available.

In humans, infection with Eastern Equine Encephalitis virus can result in several illnesses. If symptoms develop, they usually appear within 5 to 15 days after the bite of an infected mosquito. Symptoms range from mild-flu like illness to encephalitis (inflammation of the brain), coma and death. It is one of the most pathogenic mosquito borne diseases in the U.S. with a reported case fatality rate of thirty-five percent (35%).

In consultation with the New York State Health Department, in order to reduce the risk of EEE exposure, Nassau County applied aerial adulticides to decrease mosquito populations surrounding Old Brookville, and the Departments of Health and Public Works greatly increased their surveillance activities in that area.

Pesticide Training and Certification

NYSDEC requires that anyone applying pesticides be certified and receive continuing education in safe pesticide storage, handling, and treatment practices. Therefore, personnel in the mosquito program must take a 30 hour course, pass the state test for certification in Category VIII (Public Health), and then attend continuing education training sessions. Nassau County is fortunate that DPW Mosquito Control has a certified Pesticide Applicator Trainer to instruct other County personnel.

Table 2
Pesticides That May Be Used by the Nassau County Mosquito Control Program

Product	Target	Application Method	Active Ingredient
Agnique	Mosquito Larvae	Hand Held Sprayer	Alchohol Ethoxylate
Altosid Liquid	Mosquito Larvae	Helicopter	Methoprene
Altosid Briquettes	Mosquito Larvae	Hand	Methoprene
Vecto Bac CG	Mosquito Larvae	Helicopter, Hand	BTI
VectoBac 12 AS	Mosquito Larvae	Helicopter	BTI
Bactimos Briquettes	Mosquito Larvae	Hand	BTI
VectoLex CG	Mosquito Larvae	Backpack Blower, Hand	BS
Scourge	Adult Mosquitoes	Truck Mounted Sprayer	Resmethrin, Piperonyl Butoxide
Anvil	Adult Mosquitoes	Helicopter	Sumithrin, Piperonyl Butoxide

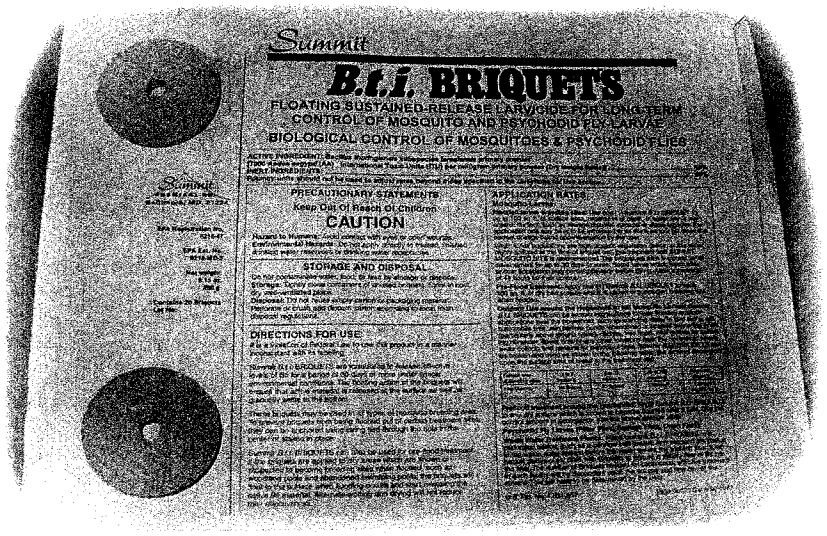


Figure 25
Bti, a naturally occurring soil bacteria, used to control larvae

Table 3
Comparative Mosquito Program Statistics

	Year 2003	Year 2004	Year 2005
Number of General Mosquito Complaints	873	530	352
Number of Inquiries (tel con only)	4,039	2,815	2,650
Number of Bird Reports (birds other than crows)*	877	653	547
Number of Crow Reports *	384	118	77
Number of Birds Sent to NYS for Testing (by NCDH)	37	58	57
Number of Positive Birds (from all sources)	22	12	13
Number of Negative Birds (from all sources)	29	46	44
Number of Positive Mammals	0	0	2
# of CDC Mosquito Light Traps Set (Trapnights)	703	702	805
Total CDC Female Mosquito Catch	31,113	17,146	13,232
CDC Trapnight Avg for Female Mosquitoes	44	24	16
# Gravid Traps Set (Trapnights)	95	320	320
Total Gravid Trap Female Mosquito Catch	3,612	13,665	7,449
Gravid Trap Trapnight Average for Female Mosquitoes	38	43	24
# Faye - Prince Traps Set	12	41	0
Total Faye - Prince Trap Female Mosquito Catch	66	424	0
Faye - Prince Trap Trapnight Average for Female Mosquitoes	6	10	0
Total # of All Mosquitoes Trapped (CDC, Gravid,& Faye)	34,791	31,235	20,681
Number of Mosquito Pools Sent to NYS for Testing	596	696	473
Number of Blooded Mosquitoes Sent to Cornell for Testing	0	0	19
Number of Positive Mosquito Pools	29	15	70
Number of PCR Negative Pools (NYSDOH Lab)	567	681	403
Number of Larvae Breeding Sites Dipped	4,098	4,302	5,285
Number of Larvae Dipping Sites Positive for Larvae	1,549	1,219	1,726
Number of Areas Larvicided by Hand	1.576	1,153	1,513
Number of Helicopter Treatments with Larvicide	17	16	10
Number of Helicopter Treatments with Adulicide	0	0	2
Number of Areas Larvicided by Truck or Backpack	0	0	0
Number of Human Cases	17	0	12

Nassau County Cumulative Summary of Mosquitoes Captured in CDC Light Traps
2005

Table 4

Site Name	Site #	Trapnite avg	# TrapNights	Mosquitoes Trapped / Genus and Species													
				Oc can	Oc ctt	Oc jap	Oc sol	Oc trl	Oc tvt	Ae vex	An pun	An qua	Cq per	Cx pre	Cx sal	Ps pfr	Other	Totals
Woodmere Club	F3317	8.0	13		32		4			5			2	55			6	104
swb 199, Valley Stream	E2649	11.1	16		3	11			2	26	1	5		80	1	1	32	178
Belm Race, Elmont	E2338	0.5	17		1	1				15			2	209			33	9
swb 66 W. Hempst	J2537	0.4	18			14		10	3	31		1		94			23	7
Hemp LkPk, Lakev	K2738	1.2	12	2	1	1		8		4		81		64			17	14
swb 471, Roosevelt	R2626	14.7	18	7		20		36	4	20	2	2	1	134			20	265
swb 85 East Meadow	V2417	6.0	22		1	20			1	43		5		41			21	132
swb 234, Hicksv	W1839	8.6	19			12		2	1	28		1	1	107			11	163
swb 412, Hicksv	Y2036	9.1	20		5	12		4	1	32		2		116			9	181
swb 86 Farmingdale	CC2126	21.0	16		7	5		5	13	20	3	1		244			38	336
Bethpage State Park	CC1948	13.1	20	52	9	23		1	3	20	1	1	12	110		5	25	262
swb 469, Glen Cove	M0829	4.5	22		2	10		14	2	15		4		49			4	100
swb 337, Glen Cove	Q0716	0.5	19		5	4		7	1	3	1	4	1	43			5	9
swb 568, Bayvll	S0326	26.2	16		96	5		12	4	173	1	1	1	62		1	60	419
Planting Fields Arboretu	T0639	14.6	20		256	9		32		3	2	4	1	27	1		36	291
swb 534,Oy Bay C	Y0738	0.7	20	3	3	5		2	7	27	3	4	17	44	1	1	10	13
swb 123, Gardn City	K2136	0.1	18			2			1	13		3	1	67			6	1
swb 82, Mineola	L1946	5.5	22		1	5		4	2	10			1	93			4	122
swb 143, East Hills	N1536	8.4	22		1			4	5	89		10		56			7	185
Old W Grdns Old Westb	Q1637	7.4	22	3		5		70		30	1	7	9	27			11	163
swb 315, Westbury	R1948	16.7	21	4	1	1		4		15	1	1		297			22	351
swb 540, E. Gardn City	P2216	1.4	22					2		7		1		167	1		13	30
Meadow Is, Pt Lookout	T3428	36.2	18		64	1	273			124				144			46	652
TOH C&W, Lido Beach	R3628	11.1	21		19		44			44		3		90			33	233
LBSTP, Long Beach	K3629	2.3	22				1							41	3		6	51
Bay Park Golf Course	J3248	6.6	20		5	1	6			5			1	106			7	131
Bldwn Hrbr Pk, Baldwin	P3227	9.5	21	4	20		16	1	2	55			1	83			18	200
Babylon Tpk, Merrick	T2817	10.7	20	12	7	3	4	2	2	27		9		115		9	24	214
E Ponds, Tobay Beach	CC3319	1.0	12	10	126	1	1614	0		50		2		571	20	1	126	12
swb 173, Wantagh	Y2547	34.5	19		74	10	162	3	2	15		2		62			32	655
Mass Preserve, Massap	BB2647	46.5	15	494	15	7	1	5		7	1	25	1	49			55	697
swb300 Massap Park	EE2519	6.9	17	110	9	9	1	6	6	61		3	1	85			16	118
swb 536, Jericho	V1427	15.0	22		51	9	3	2	1	52		12	1	101	2		17	329
swb 372, Plainv	DD1519	21.1	19		12	2	1	10	19	199	56	5		53		1	43	401
swb 306, Woodbry	CC1139	11.8	17		2	1		11	4	91	1	2	62	17			9	200
Mut Preserve, E Norwich	V0929	18.3	19	91	5	5		2	14	77	4	4	45	68		8	25	348
CW Post, Greenvle	Q1138	32.0	22		1	2		11	26	587	2	1		29			46	705
swb 466, Searingtn	K1717	13.2	18							8		83		131			16	238
Sands Pt Preserve, San	F0738	11.8	21	1	10	20		36	2	26		24	12	77			39	247
Stny Rd, Plandome Man	G1336	15.3	20	65	1	22		79	2	30	1	5	2	71		4	24	306
Alkers Woods, Kings Pt	C1247	35.3	19	412	13			13	2	28	6	1	2	128			66	671
swb 91 Lake Success	F1837	5.4	22	9	2	1		1		25		7	7	50			16	118
Lostritto Farm, Old Brool	P0927	5.0	2							7				3				10
Lostritto Farm, Old Brool	P0928	13.5	2					1		9				17				27
Lostritto Farm, Old Brool	P0929	2.5	2							3				2				5
Totals		16.4	805	1279	860	259	2130	400	132	2159	87	326	184	4279	29	31	1077	13232

Table 5

Summary of Female Mosquitoes

Trapped by Species in 2005

Species	Number	Percent
Culex pipiens/ restuans	11,276	54.52%
Aedes vexans	2,223	10.75%
Ochlerotatus sollicitans	2,222	10.74%
Ochlerotatus canadensis	1,280	6.19%
Ochlerotatus cantator	883	4.27%
Ochlerotatus triseriatus	413	2.00%
Anopheles quadrimaculatus	344	1.66%
Ochlerotatus japonicus	265	1.28%
Coquillettidia perturbans	186	0.90%
Ochlerotatus trivittatus	128	0.62%
Anopheles punctipennis	33	0.16%
Psorophora ferox	32	0.15%
Culex salinarius	29	0.14%
Uranotaenia sapphirina	28	0.14%
Aedes albopictus	21	0.10%
Aedes cinerius	1	0.00%
Culiseta melanura	1	0.00%
Aedes grossbecki	1	0.00%
Psorophora howardii	1	0.00%
Ochlerotatus excrucians	1	0.00%
Culiseta unknown	1	0.00%
	19,369	
Unidentifiable	1,312	6.344%
Total Female Mosquitoes	20,681	100.00%
Total Trap nights	***1,125***	
Mosquitoes per Trap night	***18.4***	
Total Different Species	***21***	

Note- the mosquitoes represented on this chart were captured by CDC and Gravid Traps

Note –the mosquitoes represented on this chart were captured by CDC and Gravid traps

Table 6
Summary of WNV Positive Mosquitoes Captured in Nassau County in 2005

Number	Date collected	Site	Type Trap	Mosq species	# Mosq in pool
1	07/21/05	Belmont Race Track, Elmont	CDC Light	Culex pipiens-res	12 females
2	7/29/2005	swb 85, East Meadow	Gravid	Culex pipiens-res	25 females
3	8/3/2005	swb 315, Westbury	CDC Light	Culex pipiens-res	50 females
4	8/3/2005	swb 315, Westbury	Gravid	Culex pipiens-res	42 females
5	8/4/2005	Belmont Race Track, Elmont	Gravid	Culex pipiens-res	41 females
6	8/4/2005	swb 66, Hempstead	Gravid	Culex pipiens-res	41 females
7	8/4/2005	Hemp Lake, Lakeview	Gravid	Culex pipiens-res	50 females
8	8/5/2005	swb 173, Wantagh	Gravid	Culex pipiens-res	22 females
9	8/12/2005	swb 85, East Meadow	Gravid	Culex pipiens-res	27 females
10	8/12/2005	swb 234, Hicksville	Gravid	Culex pipiens-res	39 females
11	8/12/2005	Bethpage State Park	Gravid	Culex pipiens-res	30 females
12	8/12/2005	swb 412, Hicksville	Gravid	Culex pipiens-res	50 females
13	8/12/2005	swb 466, Searingtown	Gravid	Culex pipiens-res	50 females
14	8/16/05	swb 536, Jericho	Gravid	Culex pipiens-res	27 females
15	8/17/05	swb 123, Garden City	Gravid	Culex pipiens-res	50 females
16	8/17/05	swb 82, Mineola	Gravid	Culex pipiens-res	35 females
17	8/17/05	swb 315, Westbury	Gravid	Culex pipiens-res	36 females
18	8/17/05	swb 540, E. Garden City	Gravid	Culex pipiens-res	13 females
19	8/18/05	Belmont Race Track, Elmont	CDC Light	Culex pipiens-res	50 females
20	8/18/05	swb 66, West Hempstead	CDC Light	Culex pipiens-res	10 females
21	8/18/05	swb 199, Valley Stream	Gravid	Culex pipiens-res	50 females
22	8/18/05	Belmont Race Track, Elmont	Gravid	Culex pipiens-res	21 females
23	8/18/05	swb 66, West Hempstead	Gravid	Culex restuans	44 females
24	8/19/05	Babylon Tpk, Merrick	Gravid	Culex pipiens-res	14 females
25	8/19/05	swb 300, Massap Park	Gravid	Culex pipiens-res	26 females
26	8/24/05	swb 466, Searingtown	Gravid	Culex pipiens-res	36 females
27	8/24/05	swb 91, Lake Success	Gravid	Culex pipiens-res	10 females
28	8/25/05	Long Beach Sewage Plant	CDC Light	Culex pipiens-res	23 females
29	8/25/05	Long Beach Sewage Plant	Gravid	Culex pipiens-res	39 females
30	8/25/05	TOH C&W, Lido Beach	Gravid	Culex pipiens-res	50 females
31	8/26/05	swb 86, Farmingdale	CDC Light	Culex pipiens-res	50 females
32	8/26/05	swb 471, Roosevelt	Gravid	Culex pipiens-res	13 females
33	8/26/05	swb 412, Hicksville	Gravid	Culex pipiens-res	19 females
34	8/26/05	swb 86, Farmingdale	Gravid	Culex pipiens-res	35 females
35	8/30/05	swb 536, Jericho	Gravid	Culex pipiens-res	14 females
36	8/30/05	swb 372, Plainview	Gravid	Culex pipiens-res	29 females
37	8/31/05	swb 82, Mineola	Gravid	Culex pipiens-res	34 females
38	8/31/05	swb 540, E. Garden City	Gravid	Culex pipiens-res	35 females
39	8/31/05	swb 315, Westbury	Gravid	Culex pipiens-res	50 females
40	9/1/05	swb 199, Valley Stream	Gravid	Culex pipiens-res	29 females
41	9/1/05	swb 66, W. Hempstead	Gravid	Culex pipiens-res	13 females
42	9/1/05	Hemp Lake, Lakeview	Gravid	Culex pipiens-res	18 females
43	9/2/05	swb 300, Massap Park	Gravid	Culex pipiens-res	18 females
44	9/2/05	swb 173, Wantagh	Gravid	Culex pipiens-res	43 females
45	9/2/05	Babylon Tpk, Merrick	Gravid	Culex pipiens-res	20 females
46	9/7/05	swb 568, Bayville	Gravid	Culex pipiens-res	23 females

Table 6 (con't)

47	9/8/05	swb 91, Lake Success	Gravid	Culex pipiens-res	33 females
48	9/8/05	swb 466, Searingtown	Gravid	Culex pipiens-res	42 females
49	9/8/05	StonyTown Rd, Plandome, Manor	Gravid	Culex pipiens-res	12 females
50	9/9/05	TOH C&W, Lido Beach	Gravid	Culex pipiens-res	16 females
51	9/13/05	swb 412, Hicksville	CDC Light	Culex pipiens-res	15 females
52	9/13/05	swb 471, Roosevelt	Gravid	Culex pipiens-res	38 females
53	9/13/05	swb 85, East Meadow	Gravid	Culex pipiens-res	25 females
54	9/13/05	swb 234, Hicksville	Gravid	Culex pipiens-res	50 females
55	9/13/05	swb 86, Farmingdale	Gravid	Culex pipiens-res	50 females
56	9/13/05	Bethpage State Park	Gravid	Culex pipiens-res	38 females
57	9/14/05	swb 536, Jericho	Gravid	Culex pipiens-res	16 females
58	9/14/05	swb 372, Plainview	Gravid	Culex pipiens-res	26 females
59	9/14/05	swb 536, Jericho	CDC Light	Culex pipiens-res	33 females
60	9/15/05	swb 466, Searingtown	Gravid	Culex pipiens-res	28 females
61	9/15/05	swb 466, Searingtown	CDC Light	Culex pipiens-res	20 females
62	9/16/05	swb 123, Garden City	Gravid	Culex pipiens-res	32 females
63	9/16/05	Old Westbury Gardens, Old West	Gravid	Culex pipiens-res	11 females
64	9/16/05	swb 315, Westbury	Gravid	Culex pipiens-res	50 females
65	9/20/05	Babylon Tpk, Merrick	Gravid	Culex pipiens-res	19 females
66	9/22/05	Sands Point Preserve, Sands Pt	Gravid	Culex pipiens-res	15 females
67	9/23/05	swb 66, West Hempstead	Gravid	Culex pipiens-res	38 females
68	10/5/05	swb 469, Glen Cove	Gravid	Culex pipiens-res	25 females
69	10/6/05	swb 466, Searingtown	Gravid	Culex pipiens-res	27 females
70	10/7/05	Long Beach Sewage Plant	Gravid	Culex pipiens-res	11 females

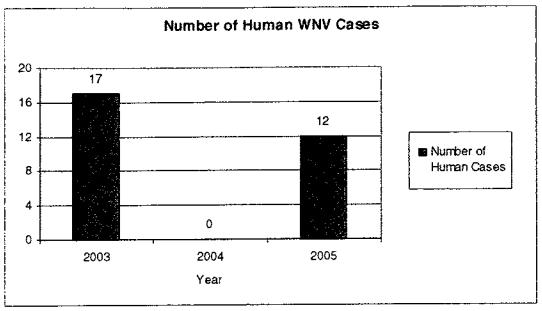
The chart above lists the positive mosquito pools and where they were captured in 2005

Table 7

Birds Found Positive with West Nile Virus in 2005

Number	NY State ID	Bird Species	Site Collected	Collection Date	# Tests Positive
1	NAS050035	American Kestrel	Malverne	August 4, 2005	1
2	NAS050042	American Crow	Levittown	August 4, 2005	1
3	NAS050024	American Crow	Wantagh	August 8, 2005	1
4	NAS050037	American Crow	Wantagh	August 12, 2005	1
5	NAS050032	American Crow	Massapequa (Animal Hospital)*	August 15, 2005	1
6	NAS050031	American Crow	Seaford	August 16, 2005	1
7	NAS050029	American Crow	Garden City	August 24, 2005	1
8	NAS050045	American Kestrel	Port Washington	August 29, 2005	1
9	NAS050049	American Crow	Seaford	August 30, 2005	1
10	NAS050050	Blue Jay	East Meadow	September 1, 2005	1
11	NAS050051	Blue Jay	Plainview	September 5, 2005	1
12	NAS050052	American Crow	Lido Beach	October 3, 2005	1
13	05-42-31	Blue Jay	Glen Cove	September 30, 2005	1
Total					13

Graphs 7 – 14
Fluctuations and Trends Comparing Various Parameters Comprising the Nassau County WNV Surveillance and Control Program 2003-2005



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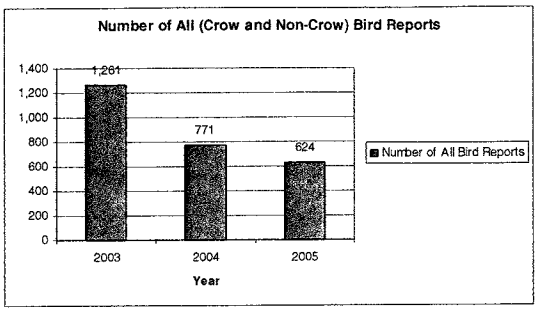

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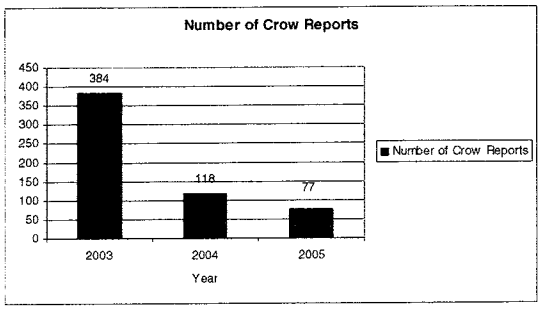

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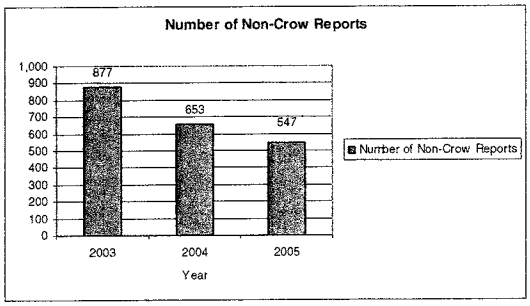

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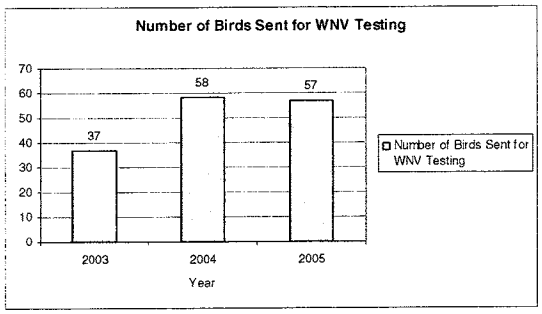

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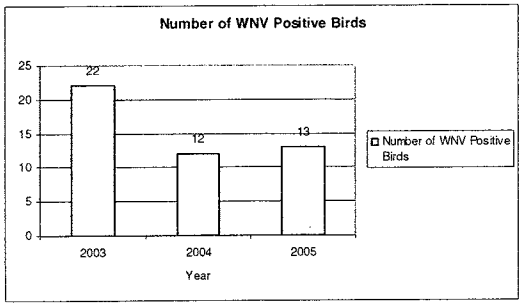

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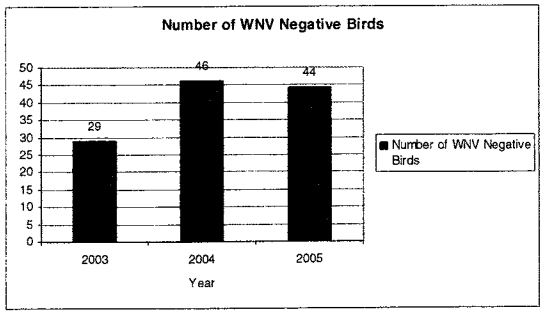

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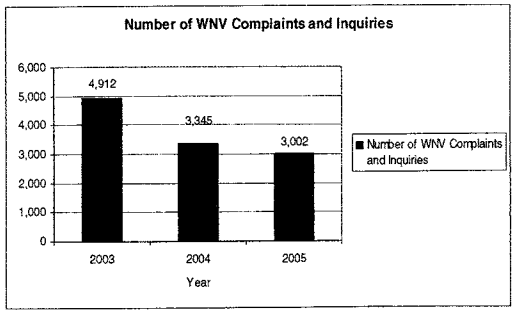

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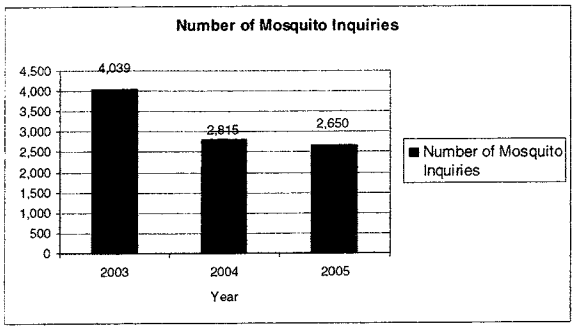
Graphs 15– 22
Fluctuations and Trends Comparing Various Parameters Comprising the Nassau County WNV Surveillance and Control Program



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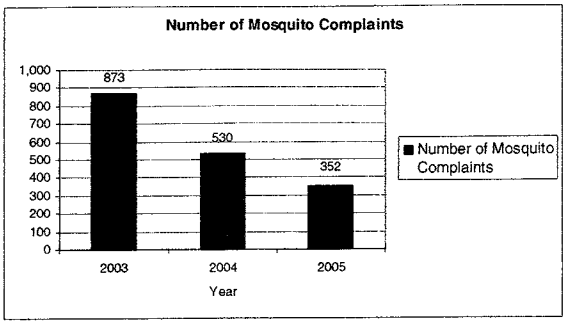

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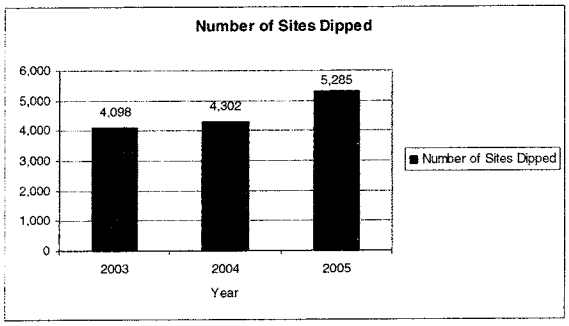

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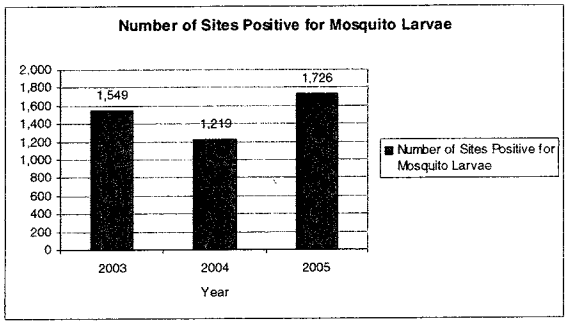

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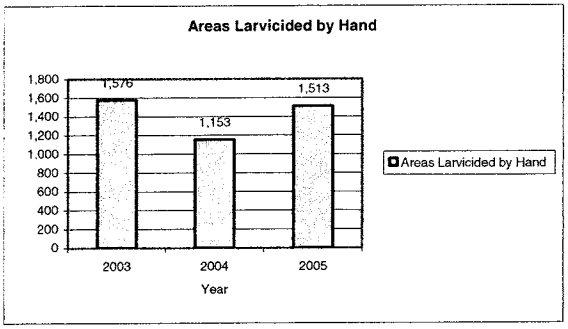

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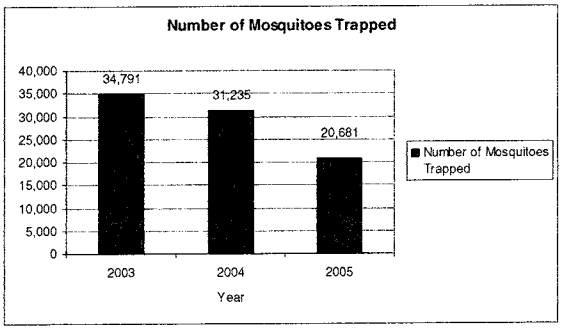

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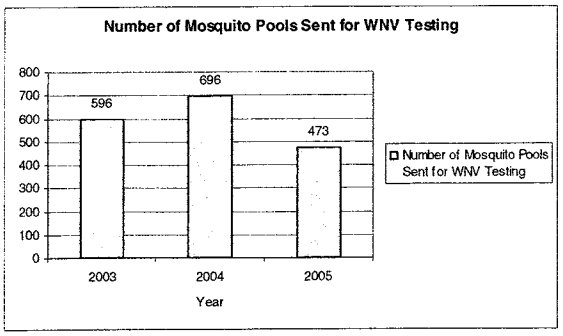

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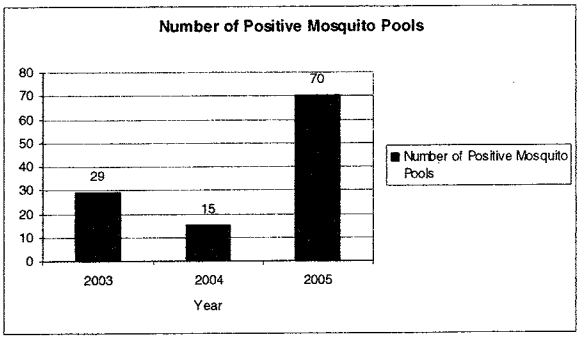

22

Nassau County Mosquito Surveillance and Control Plan for 2006

Nassau County DPW and NCDH believe that our past efforts have been effective and plan to continue the implementation of our West Nile Response Plan in 2006. Together, with the cooperation of local, state, and federal agencies, we hope to minimize the risk of WNV to humans and animals, and at the same time protect our environment. Our plan is outlined below.

I. Planning

The New York State Department of Health, Arthropod-Borne Disease Program plans to continue weekly teleconferences to define objectives, goals, and methods to be used to respond to the West Nile virus threat.
Nassau County will continue to participate in the teleconferences along with representatives from the counties of New York, NYSDOH, NYSDEC, Wadsworth Laboratory, Connecticut, New Jersey, and New York City

II. Public Awareness

Nassau County has developed a proactive awareness campaign, to reach residents, environmental groups, day care centers, hospitals, senior citizens, etc. This includes an information line, web site, pamphlets, reports, press releases, TV spots, etc., to inform the public about how they can prevent mosquito breeding in their own back yards, and protect themselves and their families.

III. Mosquito Surveillance

Maintain surveillance efforts (dependent on personnel allocated to the program) which includes:

a. Dipping for larvae throughout the year
b. Identify and operate effective trap sites (approximately 42/week, May-October)

IV. Tracking – Human and Wildlife

a. Dead bird and mammal reports
b. Human case reports
c. Complaints/inquiries

V. Laboratory Analysis

Arrange with NCDH and NYS Labs to receive, identify, handle, and ship mosquito, bird, and blood samples.

VI. Control Strategies

a. Identification of sensitive areas (to avoid chemical treatment)
b. Removal of mosquito breeding habitats (private and public)
c. Use of larvicides (bacteria and insect growth regulators)
d. Use of adulticides (chemical spraying only as a last resort)

i) Creating an IPM Log Book

Instructions for Creating a Pest Control Logbook for Structural Integrated Pest Management Programs

Jody Gangloff-Kaufmann, NY State IPM Program, Cornell University

The pest control logbook will be the core of the pest control program within each building of the organization. Each building should have a logbook designated for that building. All records and information pertaining to the pest management program should be stored there and the book should be located in a central area where anyone associated with the organization, especially the contracted pest management service, will have access to it. However, it should be the responsibility of one person to make sure the book is used correctly and kept in a secure place. The logbook facilitates communication between building occupants, building maintenance staff, the IPM coordinator, administration and the contracted pest management service or technician.

A three-ring binder with divisions is an ideal book to use. The sections should be organized as follows:

1. District or organization pest management policy and/or plan, contact information for IPM coordinator (who is an employee of the organization), and the telephone number for an emergency poison control center.
2. If applicable, keep a copy of any local laws in section two. This would include county or city pesticide phase out laws or state neighbor or school notification laws, or any other relevant legal information regarding pesticide use.
3. Recordkeeping – Keep the following in Section Three:
    a. A template site map of the building and surrounding grounds that can be copied easily. This is used to indicate building or grounds problems, pest problems, and locations of monitoring stations (usually sticky traps)
    b. A checklist of structural pest problems or damage
    c. A pest sighting log sheet for building occupants who encounter pests (this should also have space for results of follow-up to problems)
    d. Specific trap monitoring information (such as roach trapping results)
    e. Any other monitoring information sheets, such as for landscape
4. Pest fact sheets and information to educate building occupants. University cooperative extension fact sheets and brochures, as well as many other resources are available. See Reference list.
5. Products and Safety section- Keep a copy of the Material Safety Data Sheet (MSDS) for each and every product used for pest control in Section 5. It is required by law that an MSDS for each product be accessible in case of an emergency. Having the MSDS can make a big difference in emergency response to poisoning or fire. Keep information pertaining to personal and applicator safety in Section 5.

Pest Control Trouble Log

Trouble Calls					Pest Management Response			
Date	Building	Problem Description	IPM contact	Phone	Date	PCO Name	Action Taken	Materials used*, amount used

* Pesticides, caulk, traps, etc.

Roach Trap Monitoring

Building #_____

Room or Area_____

Name of person monitoring_____

Trap#	Room# or Name	Date trap was Set	Read	Trap missing?	Location Description	Roaches Captured Adults	Nymphs	Total

Building Maintenance Log

Record any building problems that may contribute to pest problems (leaks, torn screen, sanitation problems, etc.)

Date and Time	Problem with building	Location of problem	Person reporting problem	Actions taken	Date completed

Pest Sighting and Follow-Up Log

Record the pest seen, number of pests, and person reporting. When actions are taken record what was done and date.

Date and Time	Pest Seen and Number of pests	Person who saw pest	Recommended actions	Actions taken	Date completed

APPENDIX J

INSTRUCTIONS FOR CREATING A PEST CONTROL LOGBOOK

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Jody Gangloff-Kaufmann

New York State IPM Program - Cornell University

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    c. A pest sighting log sheet for building occupants who encounter pests (this should also have space for results of follow-up to problems).

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